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In commencing a new volume it may not be amiss to refer to the labors of another year, and to throw out a few hints as to what may be expected as matter of interest and discussion. The difficulties consequent upon the commercial embarrassments of the past year, have retarded, for a time at least, the progress of internal improvement. While the delay is but temporary for all useful and necessary public works, it will have the effect of bringing about a more cautious examination of projected improvements than has hitherto prevailed. A stricter estimate of the resources of proposed public works will hereafter be required, and we conceive that Mr. Ellet has done the profession a service in giving to the public his "Laws of Trade," being the first attempt to reduce to rules and fixed laws, a class of computations hitherto made with the utmost latitude of conjecture.

The difficulty of procuring funds, while operating to the permanent obstruction of injudicious projects, will require much economy in the management of those based upon more solid foundations than mere paper revenues. The assistance of the State authorities becomes more than ever necessary, but before granting this, a very important question has to be settled. Shall the State adopt one or two works and thereby be deprived of the power of giving aid to any other works? The question has been freely discussed in the public prints, and is now very nearly separated from party considerations. There can be no doubt that the best results have been attained where a *complete* and extensive system of public works, has been definitely arranged before commencing. Belgium affords a fine example of this. Now, it is impossible with us, for State governments to accomplish such a task with their own resources. How, then, shall the enterprise of individuals or companies be assisted by the State, without defeating the formation of a connected system of improvements? Obviously by the formation of a State board of public improvement, who, discarding exploded notions in regard to canals shall be able to mould out of the various individual projects asking aid of our legislature, such a system as shall satisfy all the wants of the community, and who shall apportion the aid of the State in such manner as to best forward improvement throught the State.

An evil long existing with us will reappear with increased magnitude upon any revival of professional business. We refer to the want of organization and co-operation among engineers throughout our country. The benefits resulting from a proper *esprit de corps* are entirely lost, and one of the most considerable of these is a greater respect and dignity for and in the profession as a *profession.* There is hardly a class of men in our country containing more respectable and better educated members, and yet as a class they may be said to have no character or standing other than in their individual capacity. The engineers of Europe take rank among the men of science of the day, while the profession with us, scattered over an immense extent of country, possessing a vast fund of experience and information, and enjoying all the advantages of scientific education, have no mode of intercommunication, and no method of giving to the world the results of their labors. We have often endeavored to induce our professional friends to favor us with communications upon the subjects of their various experience—but with a small number of exceptions, we have found that distance, employment, or want of stimulus have prevented them from complying with our wishes. We however, will not let the present opportunity pass, without expressing our warmest thanks to such of our friends as have furnished us with many very excellent papers.

We conceive that much, if not all, of this indifference to commit to paper, the valuable information known to exist, would disappear under the influence of a proper organization of the Profession in the most liberal manner, and with a strict regard to its scientific reputation.

That we are not mistaken in the value and amount of matter that might be accumulated, we infer from the labors of the Chev. de Gerstner. It is understood that this distinguished gentleman has in his possession such a mass of detail, in regard to our public works, as would in itself, constitute a complete body of engineering. This has been entirely collected by the Chev. de Gerstner, or his assistant, who have in person visited every known railroad in the world. It appears that the impression made upon these gentlemen, by an inspection of our railroads, is most favorable, and far more satisfactory than had been anticipated. We have great faith in the confidence in our railroads, which this testimony will inspire both here and abroad—as well as in the respectable standing which it will give the Profession with those previously unacquainted with its labors.

One of the difficulties complained of in this, and in every other attempt to collect railroad statistics, is the loose manner of keeping accounts, which are correct enough as regards the aggregate of expense and income, but which do not distinguish and separate those items which should be carefully understood, in order to have an economical management of the affairs of a company. This indeed is a fault which belongs rather to companies and their agents, than to Engineers, but a remedy might soon be found by a well directed professional body.

The past year has witnessed a new era in our history, the exportation of locomotive engines, to various parts of Europe, and above all, to England. We well remember the ridicule and sarcasm bestowed upon the first accounts of the performances of locomotive engines, which had accomplished more than was possible, according to calculations based upon some of the most antiquated experiments upon the subject. Now, however, the matter stands differently, and we cannot but confess, that we feel no small satisfaction in having at least aided in the dissemination of the truth of a matter having so important a bearing upon our domestic industry.

In the last place, we beg leave to add a few words in regard to ourselves. During the last year, we have suffered in common with the cause of improvement, and in self-defence have been obliged to adhere more strictly to our rule of payment in advance. We conceive that the loss, from our list of non-paying subscribers, will prove a *profit* to those who do pay, as well as to ourselves.

No one conducting a public Journal can satisfy every one; we have endeavored to do our best, and though sensible of some imperfections, we do not pretend to please all kinds of tastes, and have only to say, that if Engineers wish to see less of other men's work and more of their own, a very easy remedy is to be found. *Send us something of your own.*

As to those who desire us to exclude all matters pertaining to locomotive engines, etc., or any other particular branch of inquiry, we beg to assure them, that we shall do no such thing. We conceive that great injury has been done to the Profession by too close restriction, and we certainly cannot consistently curtail our list of subjects, though we will at all times be thankful for any suggestions of our friends.

We have made additional endeavors to increase the value and variety of our matter, and hope to give satisfaction throughout this volume.

We promised in the last number, to take up the subject of the railroad through the southern tier of counties, and now redeem that promise by offering our opinions on the claims of the southern counties, and by frankly stating the reasons which we consider sufficient to justify us in differing widely from the views and wishes of a large majority of the friends of this project.

Were the question an open one, we should be disposed to follow the example of Connecticut and leave all to private enterprize *unaided* by loans or grants from government; but by the construction of the Erie canal, the central counties were rendered populous and rich, and the emigration, which, without that channel, would have filled the northern and southern portions of the State, was turned off to the far west. One of the effects of this canal has been to bring the northern part of Ohio, a large portion of Michigan, and even Chicago nearer to the city of New York than millions of acres of good land in this State, which are still as wild as when the country was first explored, and which would now have been nearly as well settled as the central counties, if the canal had not been constructed.

We do not mean it as the slightest objection to the Erie canal, when we say, that we believe the population of this State would, at this moment, have been much greater had that work never been undertaken. The experience of the last 15 years shows, that the country which contributes to the revenue of the Erie canal, and which is consequently benefitted by it, consists of a belt of land on each side, averaging about 30 miles in width, and the official returns also show, that this State has furnished nine-tenths of the business of the Erie canal up to this period.

Now, the Erie canal is a work as general in its character as any undertaking of the kind can well be, yet, beyond a distance of 25 or 30 miles, its *beneficial* influence ceases, and it is notorious, that it has been the means of retarding the advancement of the southern and northern counties by offering every inducement to the husbandman to leave his native State, because it costs less to send his produce to market from Ohio and Michigan than from nearly one half of the State of New York. The western States offer great natural inducements to settlers, and it would be as unfair to *them* to attempt to check the tide of emigration as it is unjust to our own citizens to use indirect but most powerful means to retard the settling of *our* northern and southern counties. The views of our legislators appear to be too enlarged to be confined to their own State; and we would respectfully, but earnestly ask, Has the government of New York the *right* to tax her citizens in order that the property of the inhabitants of *other* States or Provinces may be carried to and from the seaboard more cheaply than at present rates? Not only is the N. York farmer to be taxed, but the amount so levied is to be expended in reducing the value of his property by adding, at his cost, great artificial to the already superior natural advantages of the west, and thus enabling the inhabitants of that region to undersell him in his own market. The entire course of New York legislation for many years appears to have had in view nothing higher, than to direct the energies and resources of government towards aiding the interests of forwarders and brokers at the expense of the farmer, the regular merchant and the mechanic, who require no exclusive privileges to enable *them* to carry on their business. Thus, the idea that the enlargement would bring to the Erie canal a few thousand more tons of freight, and lead to the sale of a few additional bales of goods, has been considered of more importance than to double the population and wealth of the State in ten years, by developing the resources of the northern and southern counties; and large sums of spare capital which would have been invested in internal improvements in *this* State, have been forced to the western and south western States to be expended on *their* improvements by placing the *at present,* comparatively trifling security of new States on an equality with that offered by the wealth and industry of Massachusetts and New York.

As yet all the means of the State have been spent on the Erie canal or its auxiliaries, and though we fully admit that the latter are of no use to the inhabitants of the central counties or to the Erie canal, because the tolls received on the lateral canals and consequently their contributions to the Erie canal are nominal—we shall still find that these large sums of money expended with that extravagance which appears inseperable from government works, do much to enrich these counties already placed in advance of the rest of the State, by the advantages conferred on them by the Erie canal.

What number of channels will it then require, to place the rest of the State on the same footing as the canal counties? "If we take a map of the State of New York, and suppose to be shaded or covered with paper, the country for 30 miles on each side of the Hudson river, of the Erie and Champlain canals and of the southern shore of lake Ontario as far as Ogdensburgh, we shall find that there are only two parts of the State where works of a *general* character can be projected—the northern part of the State and the southern tier of counties. These works would, like the Erie and Champlain canals, have resources of *their own.*"—*Courier and Enquirer, 7th May last.*) Other important works may be pointed out in various parts of the State, but they differ entirely in character. The Albany and Buffalo, and the Albany and Whitehall chains of railways, are required in *addition* to the present excellent, though insufficient accommodations, of the Erie and Champlain canals; the Albany and New York, and Long Island railroads are to increase the present facilities offered by the navigation of the Hudson and of the Sound; but the channels opened in the northern and southern counties will form their *first,* their *only* direct communication with the city, and must serve for the river, canal, and railroads of more fortunate districts.

If it be the intention of the legislature to pursue the system of internal improvement, either by constructing works themselves or by aiding private enterprise, these portions of the State present not only the strongest, but the *only* just claims, *until* they are placed on an equal footing with other parts of the State, and *then* , if the revenue accumulate so fast that it cannot any longer be disposed of so as to confer *some* benefit, other than that arising from the mere expenditure of money in a certain district, the plethora may be rapidly and permanently reduced by the application of 'lateral canals', to which they have proved themselves admirably adapted, and which is in fact their legitimate function.

We have thus far endeavored to show, that the claims of the southern counties are equal to those of the central counties, consequently we fully acknowledge the *justice* of the adoption of this road by the State, but we feel confident that their *permanent* interests will be better served by constructing it with the *aid* of the State even at considerable expense on their part.

In the first place, a private company can, beyond all doubt, construct and put into operation a single track, for about 20,000 dollars per mile, or, say in round numbers, ten millions of dollars for the entire work. The Philadelphia and Columbia railway, owned by the State of Pennsylvania, cost 40,000 dollars per mile, and to make the southern railway in a style corresponding with the new works on the enlargement, would require at least 60,000 dollars per mile, or nearly 30 millions of dollars. Railroads executed by private enterprise have cost this sum per mile, and the State must pay much more. The first cost cannot be put down at less than double, and the interest must be paid by the southern counties, in the shape of tolls.

Secondly, the time required will be double on account of the additional cost, besides a year or two which will be unavoidably lost in changing or endeavoring to change the present locations for the benefit of those who are unwilling or unable to contribute anything from their own means towards aiding the work. This view of course pre-supposes, that the State will advance as rapidly to the company as to her own officers, by which course, the means of the State and of individuals will be simultaneously expended with a corresponding diminution in time. The security offered the State by the one-fourth part of what the southern counties would cheerfully contribute, would be a better guarantee against any misapplication of her funds than the united security given to the different State governments by all the "Internal improvement commissioners" in the Union.

That the cost of, and the time required to complete the southern railroad will be much greater as a State than as a private work, will be admitted by every disinterested man, and as already remarked, the interest on the additional sum due to government extravagance will aid in increasing the cost of transportation, and thus defeat the very object of the undertaking.

Some have perhaps been influenced in recommending this as a State work, by the expectation of seeing money spent with the same profusion in the southern, as in the central counties, and thus they advocate the southern railroad, as they would a lateral canal—that is, for the advantages derived from the expenditure of a large sum of money within a certain district. To such persons, any other arguments than dollars and cents, would be unintelligible, but the inhabitants of the southern counties generally desire the construction of the road for the purpose of developing the resources of that portion of the State, and they ask the government to undertake it, because the southern counties have been decidedly injured by the canal policy of the State of New York, and because they consider the project too great for private enterprise.

But how is the road to benefit the southern counties, unless by furnishing a *cheap* and rapid communication with the city, throughout the year? And what does the experience of this country offer, to show that railroads, as government works, afford as cheap a mode of transportation, as when in the hands of companies? The States of Pennsylvania and Michigan, have had railroads in operation for some time, the former owning the roads and locomotives, the latter owning every thing, and carrying on the forwarding business in all its details. The former plan was to avoid the imputation of monopoly, and it is the only *fact* advanced in proof of the ability of a State to manage a railroad with advantage. We will comprre the cost of transportation on these State works, with that on some private roads. Strange as it may appear, the actual cost of transportation on the Philadelphia and Columbia railway was not known in Albany last winter, though a report of the superintendant was in the hands of the leading advocate and of the principal opponent of the southern railroad, Messrs. Dickinson and Wager. This document, like nearly all government reports on the subject of internal improvements, abounds in passages calculated to mislead. Thus Mr. Dickinson supposed that the cost of transportation was 12 mills per ton per mile, but his antagonist, Mr. Wager, saw a little further on, that the average rates of toll were $3\frac{2}{3}$ cents per ton per mile, or, as it is stated in the report, 15 cents per 100 lbs.—this mode of giving the charges preventing the generality of readers from perceiving the actual cost per ton per mile. In a note on the same page (Pa. Canal Commissioners Report, for 1837, p. 52) the superintendent gives a list of *prices of transportation* on different private roads—the lowest being the Baltimore and Washington railway, which is not allowed by law to charge more than 4 cents pr ton pr mile, or one-eleventh more than the *tolls* on the Philadelphia and Columbia railroad. The object aimed at was to lead to the belief that the cost of transportation on the latter road was less than on any private road. Now had this report been drawn up with the intention of giving correct information, it would have stated, that the sum paid by the community for the transportation of one ton of goods one mile was $9\frac{14}{100}$ cents. Another example of these miserable attempts at delusion is the following: (p. 52 ib.)

"It is not generally known that the tolls on the Columbia and Philadelphia railroad are lower than any other in the Union, but such is the fact."

Those who have not given much attention to the extraordinary sense in which the commonest terms of the English language are used by no inconsiderable portion of the "officials" of the United States, will perhaps be surprised to hear that, at the time the above remark was written, Pennsylvania was the *only* State in the Union where railway *tolls* were known, and we believe continues so to this day. More yet, she was *then* the only State owning a railway in operation; all which was undoubtedly well known to the superintendant when he stated so positively, that the "tolls" on the Philadelphia and Columbia railroad were lower than on any other in the Union. (For an honest statement of the cost of transportation on that railway, see the clear and concise description of its construction and management by Mr. Wilson, one of the engineers.—Railroad Journal 2nd vol. 1839, p. 175.)

The supposed success of this railway was the only *fact* Mr. Dickinson could adduce in proof of the capacity of a State to manage a railroad with benefit to the public. Had Mr. W. known the *actual* cost of transportation on the Philadelphia and Columbia railway, Mr. D's grand argument, instead of being based on the success of that road as a State work, would have been directed towards showing that its comparative failure to perform the duty of private roads to the public, did not apply to the southern railroad for a variety of those "reasons" which are never wanting in such cases.

The State of Michigan opened 30 miles of the "Central Railroad" in January, 1838, and carries on the forwarding business in all its branches, as well as the transportation of passengers, giving bills of lading for flour, butter, turkeys, live or dead hogs, etc., all under the direction of Commissioners appointed annually. There are of course no "tolls," the Philadelphia superintendent to the contrary notwithstanding—and the cost of transportation in 1838 was 37½ cents per bbl. of flour carried 30 miles, or 12½ cents per ton per mile, while the Mohawk and Hudson railroad, only 16 miles long, with three kinds and five changes of power, charged, and we believe still charges, 6¼ cents per bbl. of floua, or very nearly 4 cents per ton per mile, one third of the price charged by the State of Michigan. This same Mohawk and Hudson railroad charges for light goods 6 cents per ton per mile, which it carries throughout the year at the rate of 10 miles per hour for the very price charged on the Erie canal for transportation during seven or eight months, at the rate of two miles per hour. The rate for light goods from New York to Buffalo for 1839, was $1 20 per 100 lbs. and, deducting 10 cents for the river, there remains $1 10 for 363 miles, or 22 dollars per ton, or 6 cents per ton per mile. The hostility to railroads in a certain quarter, is not without reason, when "exclusive privileges" can alone keep the grass from intruding on the tow path.

The accommodations on State roads, are as contemptible as the price of freight is extravagant. In Philadelphia, the passengers embark and are landed, in the middle of Broad street, while in Detroit, they have not even a pavement to step on, but go direct from the car to the mud. The people of this State and of Massachusetts who have only travelled on the Albany, Troy, Utica, Boston and Lowell, Worcester, Salem, etc., railways, would be surprised at the truly sovereign indifference with which the sovereign States of Pennsylvania and Michigan regard the reasonable accommodation of the "—— multitude." On the Pennsylvania plan, cars and buildings must be furnished by individuals, and it is impossible that the public should, under that system, be accommodated as they now are on the Utica, Lowell and other private roads, for these arrangements require the investment of large sums of money, which can never be expected from those who have a mere temporary interest to serve.

The late Mr. N. Johnson was considered the ablest and most influential advocate of the southern railroad as a government work; hence his report may be expected to embody the views of its best friends. He alludes to the "success" of the Pennsylvania plan, but adds "should this plan prove to be deficient, we may safely rely on scientific and mechanical skill, and that spirit of invention and perseverance which characterizes the people of this State, to remedy its defects, and mature a more perfect system in the progress of experience." This is all very fine; but it will require some years of experience in "this State," to put her on a par with Pennsylvania, and when nearly all our good locomotives are from Philadelphia and from one establishment, it is as well to avoid mentioning the scientific and mechanical skill which is yet to be shown. There can be little doubt that this skill will be shown, when the proper time comes, and that in a few years, establithments equal to those of Philadelphia will be found in New York, to which desirable result, nothing would contribute more than the construction of the southern railroad, by a company, which would, as a matter of interest, offer permanent inducements to the best mechanical skill in the country, which cannot possibly be procured by the ephemeral temptations of the political party, which may happen to be in the ascendant.

In another part of the above report, (No. 38 Sen. Doc. 1839, p. 9,) it is suggested that "such power and control over the commercial and productive interests of the country in the hands of a vast corporation" might prove injurious to "the purity of our institutions and the independent exercise of individual rights." The entire revenue of the federal government is under the control of comparatively few individuals in the large cities, yet they conduct the immense business of the exporting and importing trade of the Union and regulate the delicate and difficult matter of exchanges with foreign countries, with a degree of accuracy contrasting strangely with the abortive attempts of both the federal and State governments to equalize the currency, not only between distant parts of the Union, but between different parts of the same State. The Boston and Lowell railroad, which is supported by the trade and travel between these two places, carries more passengers and more tons of freight, per annum, than the great thoroughfare of the western trade of Philadelphia—the Columbia railway, yet the people of Boston have no more fear for the "purity of their institutions" than have the people of Birmingham for "their individual rights," because the greatest work of internal improvement in the world—the London and Birmingham railway, is owned and conducted by a private company, who have within four years, spent—not borrowed—30 millions of dollars, of their own money on a railroad, the like of which "has as yet been accomplished, in any country, by private or incorporated means,"—*only*.—(p. 9.)

The following admission, (p. 9,) yields all we ask for or even wish.—"Where individual or corporate means are adequate to the accomplishment of a work, *even* with a reasonable proportion of aid from the State, it is doubtless sound policy to leave the work to such control, *exclusively*."

To this we cordially assent, and have no hesitation in declaring our belief that individuals in this State, will contribute towards the cost of the southern railway, in a greater proportion than do the citizens of Massachusetts, to the western railway. We again refer to the example of that Commonwealth. (Mass. H. of Rep., joint special committee, W. Lincoln, chairman, 27th Feb. 1839.)

"The committee were directed to consider the expediency of the purchase by the Commonwealth, of the western railroad. They were of opinion that it was not desirable, while the work remained unfinished, for the State to become the owner. Under the management of the agents of the corporation, it will be carried forward with more of expedition and economy, than by the public officers. If the right of acquiring the whole property at any time is reserved, it may be exercised when the heavy labors of construction are ended, and in return for the help proposed to be bestowed, it may yield large revenues for the use of the government. * * * * * * * * *

When two-thirds of the amount of scrip, created by the act of February 21, 1838, shall have been expended in the construction of the road, then a further sum of $400,000, in scrip, may be delivered to the corporation. When the private stockholders shall have paid, on their part, $75,000. a further loan of $400,000 may be made; and when $75,000 more shall have been collected from the same stockholders, such additional sum may be advanced, as shall be assertained by the Governor and council, to be necssary for the entire finishing of the road. * * * * * * * * * * *

The right is secured to the Commonwealth, at any time, to purchase the franchise and property of the corporation, by reimbursing the stockholders, the sum actually paid by them, with interest at the rate of 10 per cent, annually.

Four of the nine directors are to be chosen annually, by the legislature."

How different is this policy, from that pursued by the State of New York towards the southern counties, which have, with great difficulty, obtained a *loan* of one tenth of the sum to be *given* to the central counties as fast as it can be obtained on the credit of the State, while to the southern counties it is peddled out in sums of $100,000, after they have themselves contributed a like sum towards the construction of the work! Now if the same rule be applied to the enlargement and to the lateral canals, the southern counties would have less cause of complaint, but *their* immediate wants are passed by with indifference, while the most enormous expenditures are incurred in the central counties in anticipation of the present canal being at some future day unable to transport all the freight which *may* offer—the remote interests of the forwarders and the immediate interests of the contractors and speculators, on the line of the canal far outweighing all considerations of the honor, duty and interests of the State as concerned in the developement of the resources of other than the central counties. However glorious may be considered the day which saw the Erie and Champlain canals determined on, it will be eclipsed by that which shines on the rejection of all aid from the State to works, which are avoided by private enterprise, and in the construction of which, individuals will not risk *their own* means—the *only* never failing test of their sincerity, as well as the infallible measure of their confidence in the ultimate success of the undertaking.

It was well observed, some years since, by Judge Wright, that it required "less mind" to manage a canal than a railroad, hence the government is more competent to conduct the former than the latter. Every traveller when carried in a large train of passenger cars, with great velocity, feels his dependance on the skill and judgment of the engine-man; hence their pay is necessarily liberal, and it is worthy of remark, that even in England, there is some difficulty in procuring good men, though the wages are very nearly as high as in this country. Now were the southern railraod in the hands of the State, it is evident that these situations would be filled by political partizans, the lives of the passengers placed in jeopardy by their incompetence, the business delayed and the rates of toll as high as possible, to meet the heavy additional expenses, arising from the ignorance and indifference of the temporary occupants of stations which are held by a tenure, the very reverse of that, which would recommend the incumbents to a private company—the making the duties of their stations a secondary consideration.

It is useless to say, that this general proscription is unnecessary and must not be assumed "a priori;" we have 15 years experience in this State to the contrary, and are very much deceived if the year 1840 prove any exception to the rule. This principle, disgusting and degrading as it is, forms one of the prominent features of the times, is daily assumed to be absolutely necessary to any political party which expects to retain the ascendency beyond its first period of appointment, and is justified in political matters by men, who would scorn a similar course in *their own* affairs. The difference between private and political morality is as strongly marked as that between truth and prevarication, between honor and hypocrisy. However much this state of things may be regretted, *it still exists*, and it is the province of men engaged in the active pursuits of life to view things as they are, not as they wish them to be or as they ought to be.

The patronage of the southern railroad as a State work would be immense—nearly as much as if she owned all the steamboats of the Hudson, all the packet ships of the City, or all the flour mills of the State. The number of votes which the railway could command would be as well known and as certain as the votes which the Erie canal has always given to the party in power, and which, we believe, it will continue to do; but, as a much higher grade of men is required on a railway than on a canal, the injury inflicted on the southern counties, by filling the most important stations with abject politicians, will be proportionally greater, as well as the general demoralization which so atrikingly and disgustingly marks the canal policy of this State *since* the completion of the Erie canal.

Few suppose the State capable of undertaking and completing the southern railroad unless the enlargement be abandoned, which measure no politician would dare to advocate—hence the project of making the former a government work is nearly hopeless. The southern counties have however the power to *prevent* though not to *pass* any appropriations, and it will be by the exercise of this power, and by no other means, that they can obtain such aid from the State, as united with their own means, energy, enterprise and *economy*, will enable them to complete a railway from the Hudson to Lake Erie in 4 or 5 years, while if undertaken by the State, and carried on simultaneously with the enlargement, their completion may be expected about the same time—a period too remote to have any interest for the present generation. The true policy of the southern counties is, to secure a loan which, with their own contributions, will be *sufficient* to complete a single track, which we have stated might be done for 9 or 10 millions of dollars. And, deducting private subscription, the *loan* required would be about 6 millions or the probable amount which is to be *given* to a small portion of the inhabitants of the two counties traversed by the Genessee Valley canal. The southern counties in common with the rest of the State must be eventually taxed for the lateral canals, and it is much better to pay their proportion by direct taxation than to pay the entire deficit in the form of tolls when the southern railroad shall form part of the "system" of State works. A very strong inducement to the canal counties to aid this work, would be to continue the present exclusive right of the Erie canal to carry freight, which it would then become as much the interest of the southern as of the canal counties to support. Fear and interest are the only motives which can have any decided influence in making the claims of the southern counties respected; a fair commentary on the moral effects of the system of State works in general,

There is one argument however in favor of the policy of making this a State work which we confess our inability to answer, though the *justice* of the measure may well be questioned. It was observed at Ithaca in July last, that the southern railroad would aid the State in enlarging the Erie canal. We have already alluded to the probability of this road as a State work, being under the necessity of supporting the "lateral canals," supposing the Erie canal to meet its own expenses. But, if it be required to hold up the former and to aid in enlarging the latter, we are unable to see the benefits it is to confer on the *southern* counties, however convenient it may be to the rest of the State.

The Superintendent of the Philadelphia and Columbia railway in his Report to the Canal Commissioners of Pennsylvania (Nov. 1838, p. 43.) says, "Unless some authority is recognized to prevent such as will not comply with the regulations, from continuing in a situation to violate them, it is believed that the State had better put an end to all connection with companies and take the whole business into the hands of its agents under the control of a responsible head. Under such an arrangement, operations on the road would be systematized, the public business done with far more economy, and travel and transportation be performed with greatly increased satisfaction to the public."

Here is an admission that the Pennsylvanian plan has not succeeded, and an earnest recommendation to the State to "put an end to all connection with companies" and enter fully into the forwarding business. This same officer, in another place, says that the experience of that road has fully proved that a railway can be well managed by a State! All the objections which we have urged against the management of railroads by Government are admitted to their fullest extent, and it is proposed to adopt the system of private companies, a measure which would be utterly repugnant to the people of this State, who have already commenced the work of curtailing, instead of extending the power of the Government, by abolishing the auction and bank monopolies, and who will not for a moment listen to any increase of the patronage or expenditures of the Government. To derive from a railroad all the benefits, which that species of communication is capable of conferring, requires a degree of regularity, subordination and discipline, little inferior to that of an army, and it is impossible to expect this from men whose very bread depends on the result of every general election. It would be more to the interest of the Southern Counties to build their railroad at their *own* cost and to manage it *well*, than to have the work *given* to them and managed in the style of the State railroads of Pennsylvania and Michigan. And why should the people of this State suppose that their Government is more capable of managing a railway than the Government of Pennsylvania where it is officially announced, that their present plan is deficient in system, economy and convenience? The mechanical skill of Pennsylvania is at least equal to that of New York and both are very far behind Massachusetts, yet the latter State declines entering on the construction of public works; and may we not fairly conclude that she does so *because* her superior intelligence and mechanical skill enable her to see clearly the impracticability of the scheme?

The speed also on the Philadelphia and Columbia railway does not exceed from 14 to 15 miles per hour, about two thirds of the average velocity on the Boston railroads of similar construction, and about equal to the ordinary rate of travelling on the Utica railway with the cheap or wooden superstructure. This is one of the inevitable results of endeavoring to conduct by mere electioneering agents, a business which requires all the attention, steadiness, skill and character of the ablest men whom individual sagacity can discover and by liberal inducements, *permanently* retain—their opinions on the subjects of religion, politics, metaphysics or the fine arts having no connection with the management of works conducted by individuals or companies.

All the railways of Massachusetts are constructed in the best manner with the heavy iron rail, while, in New York, we have only *one* edge rail—on the Long Island railroad. In the former State all is left to private enterprise, but here, the visionary projects of Government, called "State works," offer the security of the *whole* population for all the surplus capital to be had on either side of the Atlantic, and thus completely drain the sources on which private enterprise depends. Instead of allowing capital to *seek* a *judicious* investment, the State Governments come forward and offer the faith of the State for any sums which can be procured. The capitalist is thus saved the trouble of investigating the merits of the works for the construction of which he loans his money, and he feels just as sure of his interest on the money squandered on the Chenango canal, as on the money invested in the Erie canal. It is on this account, that our railways are so far behind those of Massachusetts, where the "faith of the State" has only been used to *aid*, not *extinguish* private enterprise.

Experience has shown that the railway cars, and engines must be under the control of a single head, if the full advantages of this mode of communication are to be reaped, and on this account they are denounced as "monopolies." They have the privilege, in common with the most trivial county roads, of going through any man's property, and for this they are bound by law to carry passengers and freight at fixed rates, hence they have been justly styled the "poor man's friend." With the so called "free system" in use on Canals and Government railroads, the *tolls* only are fixed by law, the additional charge for that part of the business done by individuals being regulated by themselves. This anomalous partnership for the transportation of passengers and freight appears to unite the unavoidable disadvantages of State works, with the monopoly unjustly ascribed to private works, for we have seen that the superintendent of the Columbia railway inveighs strongly against it, and some remarks to the same point, founded on the experience of the Erie canal, may be found in the report of the late Comptroller, (Assem. Doc. No. 4, 1839. p. 25.)

Railway companies, being necessarily corporations, have come in for a share of the animosity felt towards banks, with which institutions they have nothing in common except the charter—the objects of the former being to enable an association of individuals to invest their money in forming cheap and rapid communications throughout the year between important points, not merely for the sake of dividends, but for the general advancement of the country traversed, by developing its resources and then rendering available its hitherto dormant wealth. This is effected by a combination of the latest improvements in science with the highest mechanical skill—requiring all the physical and mental energies—in short, bringing into play the highest attributes of man for the noblest purpose as well as the most prominent improvement of the day. We fully appreciate the exquisite skill and taste of the engravers and the occasional taste of the architects of the latter institutions, but, beyond this unimportant similarity we must decline acknowledging even a remote trace of further resemblance in their aims and effects, whether social, moral or political.

We will briefly recapitulate the principal reasons which have determined us to take ground against the adoption of this work by the State. The time required for its construction would be much, probably three times greater—the cost would be increased in the same ratio—the cost of transportation would be about double, owing to the great capital invested and to the reckless and extravagant manner in which State works are managed—reasonable comforts and accommodations are not to be thought of—the appointments will be, as they always have been, given to political hacks—when the enlargement has proceeded sufficiently far to absorb the entire surplus of the Erie Canal, the southern railroad must support the lateral canals, if the railroad be completed before the enlargement, of which we at least have little expectation, being firmly convinced that, if carried on simultaneously by the State, they will not be completed in 30 years—indeed we consider the adoption of the southern railway by the State to be the most efficient course its enemies could pursue effectually to defeat the project.

We are compelled to omit a part of the memorial of the New York and Harlem Railroad Company until our next, when we shall give it accompanied by remarks and interesting railroad statistics.

MEMORIAL OF THE NEW YORK AND HARLEM RAILROAD COMPANY.

To the Honorable the Mayor, Aldermen, and Commonalty of the City of New York, in Common Council convened,

Respectfully Showeth—

That your memorialists, in soliciting enactments in their behalf, deem it proper, in order to guard against misconceptions, to address to your honorable body a memorial, setting forth the views by which they are actuated. And in the performance of this duty, the directors deem it unnecessary to advert particularly to the causes which have retarded the full developement of their purposes, and the entire success of their company. They were such as are generally incident to undertakings of equal difficulty and magnitude. Their effects have principally fallen upon the enterprising individuals who projected and aided the construction of the work, and upon the stockholders who furnished the means.

The task, however, is now nearly accomplished. The plan which has cost so much toil and sacrifice, is carried through to the completion of a double track of railway from the City Hall at the Park, to Harlem River; and the causes heretofore operative in creating opposition and multiplying difficulties, have ceased, or soon will cease to exert any material influence.

This great work, therefore, cannot be dispassionately viewed in all its aspects, and its value remain unacknowledged.

Your memorialists deem it unnecessary to present arguments to prove the superiority of railroads over former modes of travelling, as they believe it already conceded, not only in the United States, where upwards of four thousand miles of railroads are now in successful operation, at a cost of eighty millions of dollars, but throughout Europe, where they are esteemed the most desirable mode of travelling, so far as comfort, expedition and economy are concerned.

Your memorialists, therefore, deem it only necessary to examine whether there is any cause to believe that the city of New York is, in its relations with this company, an exception to the system that now meets universal sanction and support, both at home and abroad, and especially in our sister cities of Boston, Philadelphia and Baltimore; where, it must be known to your honorable body, that railroads have been laid through and across some of their most busy and crowded thoroughfares, to the water's edge.

The Board have taken great pains to ascertain the feelings and opinions of the people generally of those cities, and especially those who own or occupy real estate along the streets through which the rails are there laid; and so far from finding dissatisfaction, they learn, on the contrary, that branches are solicited in streets other than those already supplied; the people's preference of rails to stages and omnibuses being thus unequivocally manifested.

Will New York, the commercial emborium of this great continent, become the first and only city to exhibit opposition to the continuance and extension of railroads within her limits?—an improvement, too, which ranks among the greatest of modern times, and which is destined to produce as great a revolution in the conveyance of passengers on the land, as steamboats have done on the water?

Your memorialists, with their knowledge of the reception of railroads in other cities, would respectfully inquire, what are the objections to the extension of the rails of the company, to such points in this city, on the North and East rivers, as the public and your honorable body may deem necessary for transporting the inhabitants from one extreme part to the other, with despatch, comfort, safety and economy? Especially, as it is generally admitted, that time is money, and that the attainment of greater speed and certainty, amounts in effect to a reduction of expense.

It will not, at this day, be denied, that the advantages of a speedy conveyance are often of greater value than the whole charges of transportation.

But your memorialists cannot conceal from themselves, nor hesitate to declare to your honorable body, that so far as they have been able to ascertain the character of the opposition to the extension of their rails, they believe the greatest objection to be, that which has become common, and we may add, popular—the denouncement of all incorporations, as "odious monopolies," however important to public accommodation.

It therefore becomes the duty of the Board of Directors, to examine the validity of this objection, and in doing so, they beg respectfully to represent to your honorable body, that they conceive there is cause to believe, that railroads, in large and populous cities, form an exception to the general rule, even admiting incorporations, to be "odious monopolies."

In proof of this position, your memorialists feel it necessary merely to refer your honorable body to the mode of constructing railroads—to the space they require—to their rapidity of conveyance—to the impossibility of turning out to the right hand or to the left—and to the necessity of uniform speed; clearly to indicate the impracticability of their indiscriminate use by our citizens, in the manner of the canal, the turnpike, and other highways.

If the Board are correct in this view of the subject, the conclusion seems irresistable, that the proprietors of a railroad must be the sole and exclusive carriers and regulators of the vehicles to be used thereon.

It follows, that if the city of New York is to enjoy the superior benefits of railroads, it can only have them, subject to these conditions.

Further, it should not be forgotton, that the rail cars occupy no more space on the public street, than would be occupied by any other vehicles used to perform similar duty; neither should we disregard the important fact, that this company are now conveying more than *one million two hundred thousand passengers per annum*, on a railroad constructed by them, and kept in order at their expense; by which, it is obvious, that a great saving accrues to the city treasury, the same number fo passengers conveyed in stages and omnibuses, subjecting the city to an increased expenditure, to keep in repair the pavements over which they would travel.

Your memorialists would further represent, that in viewing the work which this company has constructed, and looking at its present condition and probable future usefulness it appears to them but reasonable to inquire, who has been the gainer?

Is it the Stockholder? Is it the Farmer? Is it the Landholder? or is it the inhabitant residing contiguous to the route of the road?

In reply to these questions, it is with deep regret that your memorialists find themselves under the necessity of stating, that up to the present moment the stockholders have never received one dollar of revenue from the company, although they have long since contributed upwards of eight hundred thousand dollars in cash, toward the construction and completion of their present work.

The expenditures on this road, together with the preparations for using it, have amounted to about one million one hundred thousand dollars; and the company have been compelled to borrow the amount which was required beyond that paid by the stockholders—leaving them now in debt to the amount of two hundred and fifty thousand dollars. The receipts for fair, by the company, will amount, in the present year, ending on the 31st of December, 1839, to about one hundred thousand dollars; being sufficient to defray every expenditure, together with the annual interest upon the debt of two hundred and fifty thousaud dollars.

From this statement it is evident that there is no immediate prospect of a dividend for the benefit of the stockholders; and having thus far perseverd in good faith to complete their great and useful work, and also having conveyed upon the road, from its commencement in 1832, to the present day, *three millions eight hundred and ten thousand passengers*, by the safest mode and at the cheapest rate, they consider themselves deserving the favorable notice of the city councils. [To be continued.]

For the American Railroad Journal and Mechanics' Magazine.

BROOKLYN, DECEMBER, 13TH, 1839.

GENTLEMEN:

The interest that has long been manifested on the part of the residents on the northerly side of the Island for the continuation of the Long Island Railroad on the east of Hicksville in this direction, has induced those gentlemen to have recently a survey of this route made by permission of the company, in consideration of the amount of aid proposed to be given by the residents on the northern route in the event of its continuation on this side of the Island, and my report and estimates on the cost of this route accompany this communication which are at your service for publication.

Very respectfully, your obedient servant,

EDWARD SHOTWELL.

REPORT ON THE EXTENSION OF THE PRELIMINARY SURVEYS OF THE LONG ISLAND RAILROAD ON THE NORTHERN ROUTE.—TO MESSRS. JONES, BOLTON, SMITH, GARDINER, MILLS, &C., COMMITTEE ON BEHALF OF THE RESIDENTS ON THE NORTHERN ROUTE.

GENTLEMEN:

I have the honor to state that the examinations and survey of this route, have been completed to the extent anticipated by your instructions, and that an approximate estimate of the probable cost of graduation and masonry, for a single track railway has been based upon the results of these examinations. As the accompanying drawings and papers will exhibit the details, I offer the following report as embodying my views on the feasibility of the route.

In conformity with your instructions, the survey of the northern route, has been made from Hicksville, the present terminus of the Long Island railroad, through Woodburry, Huntington, and Smithtown, terminating in the vicinity of the latter place, where it forms a junction with the present located southern route.

A due examination of the topographical features of this route was made, prior to the commencement of the surveys, the results of which led me to a conclusion on the necessity of approaching the following points, in the projection of the survey of the east of Hicksville, as constituting the only feasible route existing on the northerly side of the Island, without too near an approach to the main shore, and having in view a connection with the present south route, in the vicinity of Smithtown. Cross the turnpike near Mr. Hewlett's tavern, and after reaching Carle's point, continued to Ketcham's Hill and effect a crossing of the Smithtown branch on the north of Messrs. Blydendergh's Mills.

In accordance with this opinion the surveys that have been prosecuted, embrace for the most part one line with its modifications.

Commencing at Hicksville, a prolongation of the present located line was made, of 500 feet on the east of the depot, where a curve of an easy radius was introduced, to gain a course for the entrance of a valley, about half a mile on the south of Woodbury, and four miles distant from the point of departure, where another curve of considerable radius but of short length was made. The direction then given the line was Carle's Point, which passed the summit of this valley as favorably as a tangent would allow of, and crossed the Jericho and Smithtown turnpike about 1000 feet on the west of Carle's Point.

After reaching Carle's Point on this line a distance of six and a half miles from Hicksville, a curve of a suitable radius was again made and prolonged into the course of Ketcham's Hill, a distance of four and a half miles from the latter place, when an offset of 200 feet south, was made in order to attain the lowest depression of these hills.

On reaching this point, the line was continued in the direction of the Smithtown branch, and crossed the turnpike one mile on the east of Commack, but on gaining the vicinity of the branch, an offset of 2200 feet on the north was found necessary in obtaining a crossing of the branch at the most favorable point for this line, the continuation of which would have passed on the south of the mills, and consequently come in contact with the mill pond and its branches.

The offset here made, terminated on the west of the branch, and after reaching the opposite side, a curve was made until I could gain for the continuation of the line, an east course, with a view of avoiding the mill pond and its auxiliary branches.

The prolongation of the course, here acquired by the curve on the east of he branch did not, however, wholly avoid the branches which flow into the mill pond. A circular bend of the swamp, a mile distant from the branch, flanks this line on the north, which is quite objectionable, because of the necessity of twice crossing the same swamp, and the line traversing a dividing ridge between some elevation above the general surface, on either side, an offset of 600 feet north on crossing this swamp was made, which, when connected, would entirely avoid it.

The same course was then preserved, crossing in advance another swamp of similar character but of less magnitude, until it reached the Smithtown and Islip road, due south of the Smithtown church in the vicinity of Esq. Hubb's, a distance of over two miles from the branch.

After which I gave the line a direct bearing, to gain an intersection with the southern route, in the vicinity of Mr. Carman Ferry's, crossing intermediately Beaver dam.

The distance from Hicksville on this line, is 20.70 miles, traversing a section of country varied in its topography, and encountering obstructions in the vicinity of West Hills, that render a portion of the line wholly impracticable, requiring a resort to gradients of 60 feet per mile, and the cost of graduation exceeding the limit of a reasonable expense. But the remaining portions of the line could be made subject to the limit of 40 feet, about seven miles of which, would require the maximum.

The second line has its commencement at Hicksville, and has been surveyed with an intention to avoid, as far as possible, the obstructions presented by the former line, to do so, it has been found necessary to adopt more curvature in the vicinity of Woodbury.

From Hicksville, the projection of this line has been made in the direction of the residence of Esq. Jones, for a distance of four miles, where a reverse curve, with an intervening tangent of 400 feet occurs, crossing the Cold Spring road twice, and turnpike directly in front of Mr. Hewlett's tavern, and continuing on the north of the turnpike, to a point one third of a mile on the east of the *toll gate*, where the line twice crosses a bend of the road, and intersects with the base line in its approach to Carle's Point, having intermediately two curves, one of which may be avoided in a location without an increase of expense.

From Carle's Point, the line pursues the course to Ketcham's Hill, and after reaching it, deflects to the south, but pursues a more easterly course than the former one, and crosses the turnpike at Gravelly Hill, and the branch on the north of Messrs. Blydenbergh's Mills, and at the same point with the base line, on a tangent of six and a half miles from Ketcham's

Hill, and after heading the branches of the Mill pond, the line deflects to the south of east, and crosses the base line near Esquire Hubb's, and continues to pursue a straight course with the exception of a slight offset to the southern route, crossing a bend of the swamp abreast of Smithtown, and the mouth of a valley near Mr. Hommediens, and ascending the ridge flanking this valley on the south, to Brush Plains, which the line traverses to the point of intersection on the 15th section of the 3d division of that route, being a distance of four and a half miles in advance of the branch.

The distance on this line from Hicksville is 21·91 miles, and on the southern route, 21·45 miles, making a difference of 0.46 miles against this route.

The increase of distance to the termination of the first division, properly chargeable to this second line, is 800 feet over the former one, and the difference of the two lines to their points of intersection with the south route, is equal to 1·21 miles.

The surface of the plains of Oyster Bay, traversed by this line on the east of Hicksville, favors very much the construction of the road, the undulations of which, are but trifling—the approaching grade, however, to Woodbury, amounts to 30·09 feet per mile, but becomes less for a short distance in advance, when it descends quite rapidly in the direction of Carle's point, the line traversing a number of spurs in the progress of its descent to the valley, which is more undulating than the plains, in its rear it does not, however, present any obstructions to the adoption of easy grades, until the vicinity of Ketcham's hill is encountered, the passage of which, requires the maximum rate of 40 feet, as in the descent from West Hills to Carle's Point, a plane of a mile in length on either side, is here necessary to overcome this elevation which, is the greatest attained on the whole line, being 265·43 feet above tide at Brooklyn, and 119·43 above Hicksville, a distance of 11·10 miles through the vicinity of Woodbury, will constitute the summit when graded.

The surface of the ground in advance of this former point is favorable to the adjustment of easy grades, having a descent towards the Branch in the direction of which it soon becomes depressed from the level of Hicksville, without again attaining the same elevation. The two last miles in approaching the branch require the application of the minimum rates of inclination, and is the most formidable section on the whole line, descending rapidly in the vicinity of the branch which is but a few feet above tide, and has an average width of 900 feet at this point, and apparently affords no better point of crossing, having the same descent in the same distance, and requiring an increased length of embankment.

The average cutting necessary in the descent, is about 22 feet, for a mile, and the average embankment, about 37 feet. In the ascent from the branch a grade line of 23.76 feet per mile, is all that is required, and falls below this for some distance in advance, until the ascent to Brush plains require 39·91 feet per mile, for over a mile and a half, this, however, is susceptable of much improvement in a location, by pursuing the course of a branch ravine which favors the direction of the line, a few hundred feet on the north, and the cutting may be somewhat diminished in the descent to the branch on a final location.

Exclusive of the curvature necessary at the points of diverging, there is required about 8000 feet of curved line, varying in radius from 2000 to 4000 feet, and divided into seven curves, about seven-eights of which quantity is located on the first division, extending to Ketcham's hill, and principally in the vicinity of West hills, and on the former line there is about

3500 feet of curved line of similar radius, and about an equal quantity on each division.

In the crossing of the branch near Smithtown, there will be required a bridge of not less than 200 feet span, and the foot of the embankment to be protected by a retaining wall, it may, however, be passed on wood work, and the cost somewhat diminished by this mode, if hereafter considered necessary, and the estimate for masonry has anticipated the cost of procuring rock of a suitable quality from the opposite shore. That required in culverts and drains, can be procured on the Island, suitable for rubble work.

The embankments on the first division will have a predominance, and on the second division, the excavation considerably.

The quantity of curved line that has been introduced on the first division in the vicinity of West Hills is only what is required by the occupancy of the same ground. But in my opinion a reduction of that quantity can be made much in favor of the character of the road, and without a material cost beyond the present route by diverging from Hicksville on a tangent, and crossing the turnpike on a curve, and continued in the rear of Mr. Hewlett's tavern, and intersect line No. two of this survey, at the bend of the turnpike on the east of the toll gate, and from thence become common to line No. two with but a slight deviation the entire route, or else attempt to gain Carle's point on a tangent, by the curve proposed at the first crossing of the turnpike. To encounter the ridge anticipated by the latter line, would be attended with a considerable expense, yet might be considered practicable in view of the continuation of the main line on this route, with these exceptions, subject to future survey. I have no hesitation in recommending the route as practicable within the limit of 40 feet for grades, and that the estimate will cover the cost of road formation.

The estimate for fencing, anticipates that portion which cannot be dispensed with, but if continued the entire route, it will be subject to an increase, and the estimate of graduation embraces a road way proper of fourteen feet in excavations, and fifteen feet in embankments, being the minimum width for a single track railway.

Annexed is a table of grades adopted on this route, the maximum rate being fixed at 40 feet per mile, and they will not suffer in comparison with a number of our railroads.

In conclusion, I but perform a pleasing duty in tendering, through you, my acknowledgements for the attentions and assistance of the gentlemen composing your committee.

All of which is respectfully submitted.

EDWARD SHOTWELL, *Civil Engineer.*

Huntington, December 10*th*, 1839.

NORTHERN ROUTE.

Estimate of cost of graduation. First division extends to Ketcham's Hill. 11·10. miles.

Clearing and grubbing,	1,580 00
Graduation,	47,200 00
Masonry,	7,160 00
Fencing,	6,425 00
	$62,365 00

Second division extends to southern route, 10·81 miles.

Clearing and grubbing,	2,160 00
Graduation,	64,425 00
Masonry in bridge and culvert,	15,195 00

Superstructure,	2,200 00
Fencing,	5,600 00
	$89,580 00

RECAPITULATION.

First division,	62,365 00
Second division,	89,580 00
	151,945 00
Add for turnouts 10 per cent.,	15,194 50
	167,139 50
Add for engineering and superintendance, 10 per ct.,	16,713 95
Total cost,	$183,853 45

Equal to $8,391 30 per mile.

Table of Gradients of the Northern Route.

No. of plane.	Length of each. Feet.	Direction.	Inclination per mile. Feet.	Elevation or Depression. Feet.	Total elevation above tide at Brooklyn. Feet.	LOCALITIES.
1	10000	ascent	13.20	25 00	171.00	Oyster Bay Plains.
2	5000	ascent	16.15	15.30	186.30	Ditto.
3	7400	ascent	30.09	42.18	228.48	
4	400	level	00.00	00.00	228.48	Cold Spring road.
5	4185	ascent	26.40	20.92	249.40	Turnpike.
6	12115	descent	39.91	91.58	157.821	Carle's Point.
7	1900	level	00.00	00.00	157.821	
8	4170	ascent	26.13	20.64	178.46	
9	5230	ascent	13.20	13.07	191.53	
10	2920	ascent	3.69	2.04	193.57	
11	5280	ascent	39.86	39.86	233.43	Ketcham's Hill.
12	5400	descent	39.91	40.82	192.61	Ditto.
13	4000	descent	20.06	17.68	175.13	
14	3900	descent	39.60	29.25	145.88	
15	5700	level	00.00	00.00	145.88	Commack.
16	2700	descent	17.42	8.91	136.97	
17	11100	descent	39.91	83.91	53.06	
18	600	level	00 00	00.00	53.06	Smithtown Branch.
19	1800	ascent	23.76	8.10	61.16	
20	4200	descent	21.12	16.80	44.36	
21	4000	ascent	13.20	10.00	54.36	Swamp.
22	2000	level	00.00	00.00	54.36	
23	9000	ascent	39.91	68.04	122.40	
24	2100	descent	31.68	12.60	109.80	Brush Plains.

Recapitulation of Grades.

2.007 miles, level.

0.550	level to 10 feet	per mile.	
5.100	10 to 20	"	"
2.000	20 to 25	"	"
1.582	25 to 30	"	"
1.800	30 to 35	"	"
8.862	35 to 40	"	"

Description of the Galvanic Telegrah at the Great Western R..ilway.—The space occupied by the case containing the machinery, (which simply stands upon a table, and can be removed at pleasure to any part of the room,) is little more than that required for a gentleman's hat box. The telegraph is worked by merely pressing small brass keys (similar to those on a keyed bugle,) which acting by means of galvanic power, upon various hands placed upon a dial plate at the other end of the telegraphic line, as far as now opened, point not only to each letter of the alphabet, as each key may be struck or pressed, but the numericals are indicated by the same means, as well as the various points, from a comma to a colon, with notes of admiration and interjection. There is likewise a cross (X) upon the dial, which indicates that when this key is struck, a mistake has been made in some part of the sentence telegraphed, and that an "erasure" is intended. A question—such, for instance, as the following —"How many passengers started from Drayton by the 10 o'clock train?" and the answer, would be transmitted from the terminus to Drayton and back in less than two minutes. This was proved on Saturday. This mode of communication is only completed as far as the West Drayton station, which is about 13½ miles from Paddington. There are wires (as may be imagined) communicating with each end, thus far completed, passing through a hollow iron tube, not more than an inch and a half in diameter, which is fixed about six inches above the ground, running parallel with the railway, and about two or three feet distant from it. It is the intention of the Great Western Railway Company to carry the tube along the line as fast as completion of the rails takes place, and ultimately throughout the whole distance to Bristol. The machinery and the mode of working it, are so exceedingly simple that a child who could read would, after an hour or two's instruction, be enabled efficiently to transmit and receive information.—*Observer.*

Manchester and Birmingham Railway.—Congleton Viaduct.—The first stone of the celebrated viaduct at Congleton, on the line of the Manchester and Birmingham railway, was laid with much ceremony on Wednesday the 26th September. Those of our readers who are interested in railway undertakings, know the magnitude of this work; but by those who do not, the following particulars will be read with interest. The viaduct is intended to run in a direction nearly north and south, and will cross the river Dane at a point about three chains below the extensive silk mill of Mr. Samuel Pearson. It will cross the Newcastle road at a point about a chain to the west of the corner of Dane street. In length, the viaduct will be 3078 feet, or nearly a mile, 31 feet in width, and twenty-seven feet between the parapets; the span will be 60 feet with 20 feet rise. There will be 42 arches, which are segments of circles. The greatest height from the river to the rails will be 98 feet 6 inches. The bases of the piers are intended to be of stone for about twelve feet in height above the ground; the imposts and parapets will also be of stone, and the rest of the structure of brick. The viaduct will contain about 61,000 cubic yards of brick work, and about 586,000 cubic feet of stone work, and is expected to be completed in two years and a half. The contractors are Messrs. John and Samuel Blakely of Manchester. The engineers in chief of the railway are Robert Stephenson and George Watson Buck, Esqrs., and W. Baker, Esq., a young gentleman of promising abilities, is the assistant engineer of the Congleton length—M. Buck stated that the viaduct would be the most gigantic structure ever attempted in this country—in this kingdom—or indeed in Europe, in modern times. It would be a thousand feet larger than the largest bridge of masonry in Europe, which was the *Pont du Saint Esprit*, over the Rhone. It would be more than three times the height of that bridge, and it would occupy six times its volume.—*C. E. & A. Journal.*

New Locomotive Engine.—Messrs. Peel, Williams and Peel, of the Soho Iron Works, Ancoats, have recently turned their attention to the manufacture of locomotive engines for railroads; and on Wednesday trial was made of their first engine, on the Liverpool and Manchester line. The general form and disposition of the parts of this engine resemble those of the Liverpool and Manchester and Grand Junction lines; the only difference being in the mode of working the valves. There are no eccentrics, but in place of them, two spur wheels staked on to the crank axle, driving two other wheels of equal diameter placed immediately over them, and running in a frame supported by a crank axle, so as to preserve the distance between the centres constantly the same, and unaffected by the motion of the engine on its springs. The wheels last mentioned are attached to a short axle or shaft, carrying at each end a small crank arm, which drives a connecting rod attached to the valve spindle. There is likewise a very important and creditable improvement in the construction of the striking lever for reversing the motion, which we are unable to describe intelligibly without the aid of a drawing. The results of the experiments on Wednesday, during a trip from Manchester to Liverpool, with the nine A. M. first-class train consisting of seven carriages each weighing five tons as reported by Mr. Edward Woods, the superintendent engineer, were most satisfactory. On the same day, the engine performed another experimental trip, from Liverpool to Manchester, with 25 loaded waggons, weighing in the gross, 133 tons 18 cwt. 2 qrs. Previous to this experiment, the "Soho" had been running a fortnight with passengers on the Liverpool, and Manchester line, and during that time Mr. Woods informs us "no failure has taken place, and the trains have usually been brought in *before their time.*"—*Manchester Courier.*

Alloy of Metals.—A curious and valuable discovery has just been made in the alloy of metals. A manufacturer of Paris has invented a composition much less oxidable than silver, and which will not melt at less than a heat treble that which silver will bear; the cost of it is less than 4*d.* an ounce. Another improvement is in steel; an Englishman at Brussels has discovered a mode of casting iron, so that it flows from the furnace pure steel, better than the best cast steel in England, and almost equal to that which has undergone the process of beating. The cost of this steel is only a farthing per pound greater than that of cast iron.

Simple Remedy to Purify Water.—It is not generally known as it ought to be, that pounded alum possesses the property of purifying water a large table spoonfull of pulverized alum, sprinkled into a hogshead of water, (the water stirred round at the time,) will, after the lapse of a few hours, by precipitating to the bottom the impure particles, so purify it that it will be found to possess nearly all the freshness and clearness of the finest spring water. A pailfull containing four gallons, may be purified by a sngle tea spoonfull.—*Doncaster Chronicle.*

The receipts on the Charleston and Hamburg railroad, for the month of November, amount to $65,000, being nearly 50 per cent. more than was ever before taken in any one month. During the period alluded to 15,000 bales of cotton were brought to market, which is double the quantity received in any previous month, and it is stated that the business of the road is now carried on with less machinery than was before used.

Central (Ga.) Railroad.—We present our readers with the 4th semi-annual report of the Chief Engineer—L. O. Reynolds, Esq.,— of the Central railroad in Georgia; which shows that that work, at least, is progressing to an early completion.

From this report it appears that the same spirit of extortion prevails in Georgia, among the proprietors of land, as in many routes in other sections of the Union.

It is surprising, yet true, that many persons owning property on contemplated lines of improvements, are exceedingly desirous to have the work pass their doors, *until* it is permanently located, when they discover as if by magic, that it is a great nuisance.

We would call the attention of the readers of the Journal to an article on this subject in No. 7 of this volume, by W. R. Casey, Esq., Civil Engineer, which gives a graphic description of this system of extortion. Mr. Casey lays it down as a *practice*, at least, if not a principle, that damage is usually increased in proportion to the benefit to be derived by the individual, from the operations of the company—whereas, the reverse should be the case.

Engineer Department, Central Railroad,
Savannah, November 1st, 1839.

To W. W. Gordon, Esq., President:

Sir—The period has again arrived when it becomes my duty to present you with a report of the operations of this department, and the condition and progress of the work under its management

At the date of my last report, the grading was under contract to a point 133 miles from this city, and 114 miles of it finished. The contracts have since been extended to 136 miles, of which 128 are graded. The line has been definitely located and prepared for contract to the Oconee river, a distance of 148½ miles.

The portion of the grading from the summit near Sandersville to the Oconee river, has always been regarded by many of our stockholders, as a most difficult and expensive part of the road. I take pleasure in assuring them that the cost of the excavation and embankment of the most expensive mile in that distance, will very little exceed $12,000, and the average of the 14 miles now ready for contract will not much exceed $5000.

The superstructure is completed for a distance of 93 miles, and we hope to be able to run our engines to the 100 mile station early in the month of January.

By the condition of our late contracts for grading, the contractor is to receive in payment 75 per cent in the stock of the company at par value and the remaining 25 per cent. in cash—prices at the estimate of the engineer. Several applications for further contracts on these conditions have been received, and I am under the impression we shall be able to let as much of the work as is desirable the present season, at these rates.

Most of the work during the past summer, has been in the low grounds of Williamson's Swamp, and although the extreme dry weather has been very favorable for its execution, it has had the effect of rendering some portion of the line unhealthy. The work has consequently been somewhat retarded by sickness among the men. We shall, however soon reach a more elevated and healthy country, and I do not apprehend any difficulty hereafter on this account.

The force at present on the line—consisting principally of blacks, with a large number of carts and horses, is equivalent to about 500 men.

The views expressed in my last report on the subject of the employment of slave labor, have been much strengthened by the experience of the last summer, for had the force employed consisted of whites instead of blacks, the sickness and mortality would doubtless have been great.

The few white laborers employed have suffered much in proportion to their numbers.

We have within the last six months experienced some difficulty, on the subject of the right of way; but it is to be hoped that time, in more fully developing the benefits of our enterprise, will dissipate the prejudices and convince the judgment of such persons as are honestly doubtful of its advantages, and for a remedy against those who are actuated alone by mercenary motives in their opposition, it is presumed that an appeal to the public through the proper tribunals, and in obedience to the laws of the land, asking for strict and impartial justice, will result in a righteous decision.

While on the subject of the right of way, it may be remarked, that in every case where a sale of real estate has taken place near the line, since the commencement of the work, the price has been much advanced, and in some cases to many times the amount that would have been demanded before the road was projected. In some instances the amount paid to the proprietor of the land for pine timber for the construction of the road, has exceded the price that the entire tract would have sold for three years ago.

In the absence of more extensive experience as to the effect of the road on the value of lands in its vicinity, that of others similarly situated may with propriety be invoked to aid us in our conclusions.

The President of the South Carolina railroad company in his semi-annual report of July 10th, 1837, page 10, says—"To give some idea of the advantages derived by those not immediately connected with the company, by the passage of the road through so great an extent of pine barren, a moderate estimate has been made of the additional value of these lands since the road was located, and it has been found that the advance within a mile of the road, and beyond the influence of the towns at each end, not including any thing within fifteen miles of either extremity, has been equal to the cost of the original construction of the whole road."

"The constant supply of timber for repairs, and wood for consumption, gives employment to hundreds on the line—these, and those with their families engaged about the road, would increase the number to *thousands* who have their support from this institution."

In the location and construction of the road, the most positive injunctions have been given to all persons entrusted with the management of the operations, so to conduct them as to do the least possible injury to the interests or property of persons along the line.

It may be further remarked, that in the commencement of the company's operations, when it was determined to pursue the "southern route" through the counties of Bryan, Tattnall, Laurens,, &c., the almost universal complaint in the section of country through which the road now runs, was, that their interests had been entirely neglected, and the best route rejected—and *vice versa* since the southern route has been abandoned, the same dissatisfaction has prevailed throughout that region. It was therefore a fair inference that the change would be at least, acceptable to the portion of country that is traversed by the road. To what extent our apparently just expectations are to be realized or disappointed, is not yet fully developed.

I have recently made an examination of the superstructure throughout the line, and am happy to be able to report that it is in excellent condition.

The advantages of a continuous bearing, by means of our broad stringpiece laid flatwise are daily more apparent. In colder climates, where it is necessary, and even unavoidable that the foundation should be laid so low as to be out of the reach of frost, such a bearing might not be admissible;—but in our climate we have nothing to guard against on this score; it is therefore, evident that the nearer we lay our foundation to the surface of the grade, the more accessible it is for the purpose of repair, renewal or adjustment.

The objection commonly urged against our peculiar plan of superstructure, arises from an apprehension, that the ribbon which immediately supports the plate rail, will give way and be crushed by the weight of the engine. We have been running burthen and passenger trains over the road daily for more than eighteen months and for some time past, from two to three trains per day, and with the exception of the renewal of the ribbon for a few miles on the lower end of the road for the purpose of substituting a different kind of connecting plate, I am confident there has not been one tenth of a mile renewed for the whole distance of 80 miles. I have during the past summer travelled over a great number of railroads, and have paid particular attention to the subject of the cost of maintaining track, I have seen no one on which the plate rail is used that can be kept in repair at a smaller cost than ours. The sides of the embankments are becoming covered with vegetation, and will in a year or two be entirely protected from the effect of rains.

The allignment of the road for the distance located, comprises 61 curved, and 62 straight lines.

The curves are all arcs of circles and may be classed as follows:—

Lenth of Radius.	Number of Curves.	Aggregate distance.
2,000 feet.	14	24,359 feet.
2,500 "	3	6,608 "
3,000 "	2	4,086 "
3,500 "	3	7,435 "
4,000 "	7	15,369 "
4,500 "	2	4,980 "
5,000 "	12	40,472 "
8,000 "	4	12,984 "
10,000 "	6	23,405 "
15,000 "	5	21,916 "
20,000 "	1	8,374 "
30,000 "	1	4,620 "
150,000 "	1	26,500 "
Total	61	201,109 feet.

Total length of curved line,	38 miles and 469 feet.
" " straight line,	110 " " 2,591 "
Distance located	148 miles 3,060

The last mentioned curve of 150,000 feet radius, and about five miles in length is, so far as any effect of resistance is considered, fully equivalent to a straight line, at any velocity. We may therefore with propriety state the proportion of straight line at two thirds the whole distance.

The gradients may be classed as follows:

	miles.	feet.
Level,	20	2200
Inclinations of 5 feet per mile and under,	43	1560

over 5 and under 10	22	3440
over 10 and under 15	14	5180
over 15 and under 20	12	940
over 20 and under 25	8	2360
over 25 and under 30	26	3020
Total	145	2860

The arrangement of the curves and slope grades, is such as to avoid, excepting in a few instances, the occurrence of a sharp curve on a heavy grade.

Water stations are established ten miles apart, or as near this distance as the circumstances will permit. At each station is a "turn out" about 800 feet in length, to allow two trains to pass each other. It is presumed that it will at a future day become necessary to place "turn outs" intermediately between the present ones.

In most instances store-houses will also be erected at the stations for the accommodation of the local business—and dwellings for the persons entrusted with the supervision of the road.

The amount expended on account of the road to this date is one million one hundred and eighty-seven thousand seventy-two 55-100 dollars.

The respective items of expenditure are as follows:

For grading, including bridges and culverts,	$518,463 11
" Superstructure,	137,293 61
" Iron rails, spikes plates,	167,711 22
" Right of way, houses and lots,	13,844 50
" Carpentry,	22,480 97
" Smithry,	13,323 63
" Negroes,	922 25
" Locomotive engines	40,016 05
" Lumber,	27,924 32
" Iron for smithry,	17,969 02
" Teams and forage,	18,910 48
" Drayage, freight, &c.,	2,974 85
" Repairs of road,	5,836 03
" Implements,	25,886 16
" Railroad cars,	24,886 70
" Depot at Spring Hill,	11,030 29
" Brickyard,	2,060 25
" Engineering,	92,969 31
" Transportation expenses,	10,964 41
" Miscellaneous expenses,	39,605 39
Total,	$1,197,072 55
From this amount may be deducted for implements, &c., on hand,	10,000 00
Nett expenditure,	$1,187,032 55

Our examinations since the date of my last report, have not developed any features in the character of the country, leading me to doubt the sufficiency of the sum estimated at that time for the entire completion of the road, and if the company were at this time in possession of the requisite amount of available funds, there would be no difficulty in having the road in operation to the city of Macon in eighteen months.

In our machinery, and transportation departments, we are gradually advancing towards the completion of a system commensurate with the extended business that will undoubtedly be attracted by our road. The works at the Spring Hill depot, comprising the erection of the requisite machine shops, engine houses, passenger houses, store houses, offices, &c., have progressed with less vigor than would have been desirable, in consequence of the difficulty of obtaining a supply of materials, and a sufficient force of mechanics during the summer season; no serious inconvenience has resulted from this circumstance.

In our motive power department, we have 5 locomotive engines, 4 of which are in good order, and one under repairs; 4 passenger cars, 13 close 8 wheel cars capable of stowing from 40 to 50 bales cotton each, 2 baggage cars and 8 open platform 8 wheel cars. It was supposed this would be sufficient to accomodate any amount of business that could reasonably be expected, during what may properly be called our first business season—while our road is only about half completed and has not yet approached within striking distance of the section of country from which we expect ultimately to derive our greatest business. We have, however, been obliged to keep every engine and car in constant requisition, for the transportation of merchandize from, and cotton to the city; and having been singularly fortunate in the regularity that our trains have run without accident, we have been able to do all or nearly all the business that has offered.

We are in daily expectation of the arrival from the north, of two additional engines, two 8 wheel passenger cars, and the requisite machinery for our shops.

Our mechanics will be kept constantly employed in the construction of freight cars, until we have a full complement for any immergency.

The effect of the road even at this incipient stage of its operations, on the trade and general prosperity of the city, is most manifest. Persons from remote counties, who have not visited the city before for years, have come here for their supplies. We have transported merchandize during the present fall for upwards of fifty different counties; and instances have occurred, when we have had in the same train, goods destined for thirty counties.

In confirmation of a remark in my last report relative to the healthiness of Savannah, is the fact, that amid the general prevalence of disease throughout a great portion of the southern cities, and in many parts of the country, during the past season; this city has enjoyed an entire exemption from any epidemic. No instance is known of a person having contracted disease by visiting the city from the country.

The present season has afforded abundant demonstration of the benefits that would result from the construction of the contemplated branch road to the city of Augusta. During the past three months, large quantities of merchandize have arrived here for that city—while the epidemic prevailed, wagoners could not be induced to go there from the head of our road. The goods were stored, and with the exception of a portion that have been shipped to Charleston to go up by the Hamburgh road, are now in store here.

The unusual drought has cut off all communication by the river, and now that the sickness is abaiting in Augusta, and the fall business is opening, it is almost impossible to appreciate the sacrifices and derangement of business that must result from these circumstances.

The immense amount of business that would accrue to both cities furnish a most pressing inducement for the early commencement of the road in question.

I will close this communication with a statement of the business of our road for the three months ending 31st October.

	Passengers.		Freight.		Aggregate.	
	No.	Amount.	Dolls.	Cts.	Dolls.	Cts.
August,	747	$1464 25	2108	77	3573	02
September,	688	1565 10	6278	49	7843	59
October,	875	2215 50	11844	99	14060	49
	2310	$5244 85	$20232	25	$25477	10

I am sir, very respectfully, your obedient servant,
L. O. Reynolds, *Chief Engineer.*

THEORY OF THE STEAM-ENGINE.

(Continued from page 338.)

Section II.—Of the velocity of the piston under a given load.

In the 6th section of the preceding chapter, we have demonstrated that during all its action in the engine, the steam constantly remains at the state of maximum density for its temperature; and we have shown that, accordingly, when the steam passes, in the engine, from a certain volume M′ to another volume M equally known, and that its pressure varies in consequence, and passes from the known pressure p' to another unknown pressure p, the pressure p may be determined by the following equation:

$$p=\frac{M'}{M}\left(\frac{n}{q}+p'\right)-\frac{n}{q}. \quad . \quad . \quad . \quad (c)$$

This preliminary relation once established, in order to embrace immediately the most complete mode of action of the steam, we will suppose an engine working with expansion and condensation, and with any pressure whatever in the boiler. Then, to pass afterwards to unexpansive engines, or to those without condensation, it will suffice to make the propper suppressions and substitutions in the general equations.

From what is already known of the proposed theory, the relation we seek between the various data of the problem, will be deduced from two general conditions: the former expressing that the engine has attained an uniform motion, and consequently, that the quantity of work applied by the power is equal to the quantity of action developed by the resistance; the second, that there is necessarily, equality between the mass of steam expended by the cylinder, and the mass of steam generated in the boiler.

Let P be the total pressure of the steam in the boiler, and P′ the pressure the same steam will have on arriving in the cylinder, a pressure which will always be less than P, except in a particular case, which we shall treat of shortly. The steam then will enter the cylinder at the pressure P′, and will continue to flow in with that pressure and to produce a corresponding effect, till the communication between the boiler and the cylinder is intercepted. The arrival of any new steam into the cylinder will then be stopped, but that which is already there will begin to dilate during the rest of the stroke of the piston, producing by its expansion a certain quantity of work, which will go to augment that already produced during the period of the admission of the steam.

P being, as has been said, the pressure of the steam in the boiler, and P′ the pressure it will assume on reaching the cylinder before the expansion, let π be the pressure of that steam at any point of the expansion. At the same time let l be the total length of the stroke of the piston, l' the portion traversed at the moment when the expansion begins, and λ that which corresponds to the point where the steam has acquired the pressure π. Lastly, let a be the area of the piston, and c the clearance of the cylinder, that is to say, the vacant space which exists at each end of the cylinder, beyond the portion traversed by the piston, and which necessarily fills with steam at every stroke; this space, including the adjoining passages, being represented by an equivalent length of the cylinder.

If the piston be taken at the moment when the portion of the stroke traversed is λ, and the pressure π, it will appear that if the piston traverse, moreover, an elementary space $d\lambda$, the elementary work produced in that motion will be $\pi a\, d\lambda$. But at the same time, the volume $a(l'+c)$, occupied by the steam before the expansion, will have become $a(\lambda+c)$. Hence, from the equation (c), indicated above, there will exist between the two corresponding pressures P' and π, the analogy

$$\pi=\left(\frac{n}{q}+P'\right)\frac{l'+c}{\lambda+c}-\frac{n}{q}.$$

Multiplying the two members of this equation by $a\,d\lambda$, we shall deduce

$$\pi\, a\, d\lambda=a(l'+c)\left(\frac{n}{q}+P'\right)\frac{d\lambda}{\lambda+c}-\frac{n}{q}a\, d\lambda.$$

This expression will give then the quantity of elementary work produced by the expansion, while the piston traverses the space $d\lambda$; and if the integral be taken between the limits l' and l, we shall have the total effect produced by the expansion of the steam, from the moment of its being intercepted to the end of the stroke: viz.

$$a(l'+c)\left(\frac{n}{q}+P'\right)\log\frac{l+c}{l'+c}-\frac{n}{q}a(l-l'),$$

an expression in which the logarithm is a hyperbolic one.

This quantity expressing the work performed in that portion of the stroke during which there was expansion, if we add to it the effect $P'al'$ produced during the anterior part l' of the stroke, or before the beginning of the expansion, we shall have for the total work developed by the steam during the whole stroke of the piston,

$$a(l'+c)\left(\frac{n}{q}+P'\right)\left\{\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}\right\}-\frac{n}{q}a\,l.$$

But the engine being supposed to have attained uniform motion, the work developed by the mover must be equal to that developed by the resistance. Representing by R the total pressure exerted on the unit of surface of the piston by virtue of that resistance, or rather by virtue of the divers resistances which take place in the engine, the work it will have developed in one stroke, will have for its expression, aRl. We must therefore have the analogy

$$a(l'+c)\left(\frac{n}{q}+P'\right)\left\{\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}\right\}-\frac{n}{q}a\,l=R\,a\,l \quad . \quad . \quad . \quad . \quad (A),$$

which is the first general relation between the different data of the problem.

This equation expressing that the work developed by the power, is entirely found in the effect produced, it will be remarked that, for the analogy to take place, it is not necessary that the motion of the engine be strictly uniform. It may be composed of equal oscillations, beginning from zero of velocity, and returning to zero again; provided the successive oscillations be made in equal times, and that the changes of velocity take place by insensible degrees, so as to suffer no loss of *vis viva.*

It must be observed also, that, if in this expression we make $l'=l$, which amounts to supposing that the engine works without expansion, the equation reduces itself to $P'=R$; that is to say, the pressure of the steam in the cylinder will, in this case, be equal to the pressure of the resistance against the piston, as we have already demonstrated directly for unexpansive engines, of which we spoke in the first chapter.

We have just obtained the first general relation between the data and the incognita of the problem. Let us now seek a second analogy resulting from the equality between the production and the expenditure of the steam. If S be made to express the volume of water evaporated by the boiler in a unit of time, and transmitted to the cylinder, this volume on reaching the cylinder, transformed into steam at the pressure P′, will there become, from the relation already given (*a*),

$$\frac{S}{n+q\,P'}.$$

This will then be the volume of steam, at the pressure P′, supplied by the boiler in a unit of time, in one minute for instance. On the other hand, $a(l'+c)$ being the volume of the steam expended at each stroke of the piston, if there be K strokes per minute, the expense per minute will be $K\,a\,(l'+c)$. But expressing by v the velocity of the piston per minute, we shall have also $v=K\,l$; which gives $K=\frac{v}{l}\cdot$ Whence the above expenditure will be

$$\frac{v\,a\,('l+c)}{l}.$$

Since, then, there is an equality between the production and the expenditure of the steam, we shall have the equation

$$\frac{S}{n+q\,P'}=va\,\frac{l'+c}{l}, \quad . \quad . \quad . \quad (B)$$

which is the second general relation between the data and the incognita of the problem.

Consequently, on eliminating P′ from the two equations (A) and (B), we shall have as the final relation sought,

$$v=\frac{S}{a}\cdot\ \frac{1}{n+q\,R}\left\{\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}\right\} \quad . \quad . \quad . \quad (1)$$

In this equation the logarithm $\log\frac{l+c}{l'+c}$ is a hyperbolic logarithm. As it is known that these logarithms are deduced from those of the tables, by multiplying the latter by the constant number 2·302585, or approximatively by 2·303, the term $\log\frac{l+c}{l'+c}$ might, for practical purposes be replaced by $2{\cdot}303\log\frac{l+c}{l'+c}$, in which log. would then express an ordinary logarithm. But as tables of hyperbolic logarithms are found in several works, and as besides, we shall give in the sequel, a table which will dispense from all research on this head, we will not here make any change in the formulæ.

This equation is less simple than that which would be obtained in the same inquiry, by supposing the steam to preserve its temperature through the whole of its action in the engine; but that supposition, though producing often but slight differences in the definitive results of the calculations, is not really exact, since it is incontestable that the steam changes its pressure during the expansion, and that the experiments quoted above prove that it changes temperature in a manner exactly correspondent. The last formula which we have presented, has then the advantage of taking this important circumstance into account, and consequently of being more accurate in the applications. Besides, if in equation (1) the effect of the change of temperature be annulled, the formula becomes the same that we have presented in the first chapter, supposing the preservation of the temperature of the steam.

In effect, we have seen, from equation (a,) that after the steam has assumed in the engine the pressure R, the *absolute* volume of that steam, which corresponds to the volume of water S, is given by the relation

$$\frac{S}{n+qR}.$$

On the contrary, when the steam is supposed to preserve its temperature, the volume varies in the inverse ratio of the pressure. If, then, we call m the relative volume of the steam generated at the pressure P of the boiler, a relative volume which can be known by the tables already given, it is clear that the absolute volume of the steam correspondent to the volume S of water will first be, under the pressure P, expressed by m S; and that, in passing afterwards to the pressure R, this volume will change in the inverse ratio of the pressures, that is to say, will become

$$mS\frac{P}{R}.$$

Therefore to pass from one law to the other, we must write

$$\frac{S}{n+qR}=mS\frac{P}{R};$$

or, what comes to the same, we must, in the formulæ already obtained, make

$$n=o, \text{ and } \frac{1}{q}=mP.$$

Then the equation which gives the velocity, becomes

$$v=\frac{mPS}{aR}\left(\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}\right);$$

which. for the case of unexpansive engines, or for $l'=l$, reduces itself to the following:

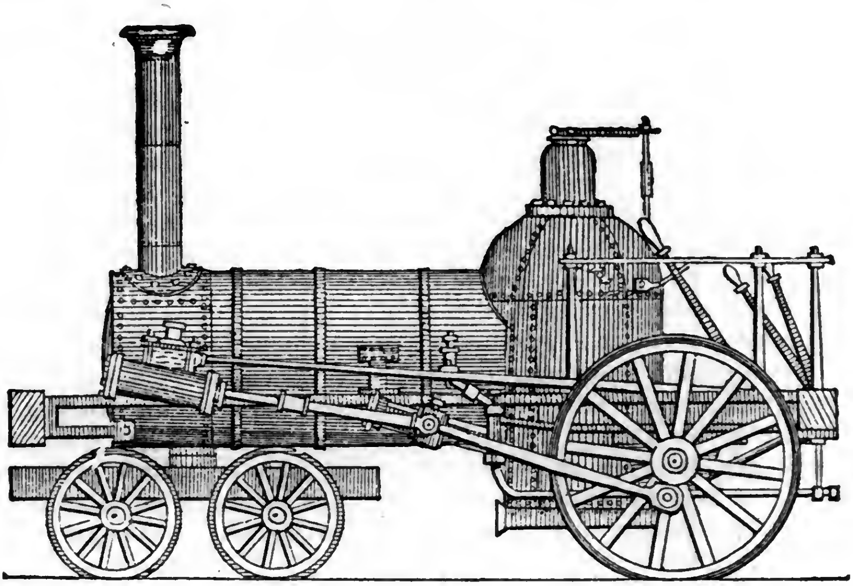
$$v=\frac{mPS}{aR}\cdot\frac{l}{l+c}.$$

And this is precisely the equation we made use of in the first chapter, if only we neglect in it the clearance of the cylinder c.

The quantity R contained in equation (1,) is the total resisting pressure which takes place on the unit of surface of the piston in the motion. But this resisting pressure is evidently composed of three parts, namely, the resistance arising from the motion of the load, which we will call r; that arising from the friction proper to the engine, which we will express by $(f+\delta r,)$ calling f the friction of the engine unloaded, and δ the augmentation of that friction per unit of the load r; and finally the pressure which may subsist on the face of the piston opposed to the arrival of the steam, which we will represent by p; the latter quantity p expressing the atmospheric pressure, when the engine is without condensation, or only the pressure of condensation in the cylinder, when the engine is a condensing one. The quantities r, f, p and δ, are besides, as well as R, referred to the unit of surface of the piston.

(To be continued.)

The Menai Bridge is undergoing a complete repair, having suffered considerable damage in the storm last winter. Government has granted 8,000*l*., but this is by no means sufficient.



BALDWIN, VAIL AND HUFTY,

[LATE M. W. BALDWIN.]

LOCOMOTIVE STEAM ENGINE MANUFACTURERS,

BROAD, NEAR CALLOWHILL STREET, PHILADELPHIA,

Beg leave to inform the Railroad Companies in Europe and in the United States, that their establishment is the largest in this country, being able to employ 500 workmen, and that they therefore can fulfill the greatest commands. From this manufactory have been delivered, and are ready to be delivered, up to the present day, the following Engines:

		No. of Engines.
Columbia and Philadelphia Railroad,	Pa.	26
Harrisburg and Lancaster,	"	6
Philadelphia and Trenton Railroad,	"	4
Philadelphia, Germantown & Norristown,		5
Little Schuylkill,	Pa.	2
Cumberland Valley,	"	1
Philadelphia and Reading,	"	2
Utica and Schenectady,	N. Y.	12
Rensselear and Saratoga,	"	2
Long Island,	"	2
Rochester and Batavia,	"	2
Buffalo and Niagara Falls,	"	1
Georgia Railroad and Banking Co.,	Ga.	12
Central Railroad, Savannah,	"	4
Monroe Railroad and Banking Co.,	"	2
New Jersey Railroad and Transportation Company,	New Jersey,	5
Elizabethtown and Somerville,	"	2
Morris and Essex,	"	1
Philadelphia, Wilmington and Baltimore, Railroad Co.,	Del.	4
Charleston and Hamburg,	S. C.	6
Detroit and Ypsilanti,	Mich.	3
Adrian and Toledo,	"	2
Detroit and Pontiac,	"	1
Boston and Providence,	Mass.	3
Boston and Worcester,	"	3
Elkridge and Annapolis	Md.	2
Clinton and Port Hudson,	La.	3
West Feliciana Railroad,	"	2
New Orleans and Nashville,	"	1
Madison and Indianapolis,	Ind.	3
North Cross Road,	Ill.	2
Commercial Railroad,	Miss.	2
Mississippi Railroad,	"	1
Wimington and Raleigh,	N. C.	2
Lake Wimico and St. Josephs,	Fa.	2
Mobile and Cedar Point,	Ala.	1
Tuscumbia and Decatur,	"	1
Housatonic Railroad Company,	Conn.	2
Island of Cuba Railroad,	West Indies,	3
		140

These Engines are of three different classes:

Class 1st.—Cylinder $12\frac{1}{2}$ inches diameter; stroke, 16 inches; Driving wheels, 54 inches diameter; Weight with water and fuel, 26,000 lbs.; without water and fuel, 20,250 lbs.

Class 2d.—Cylinders, 12 inches diameter; Stroke, 16 inches; Driving wheels, 54 inches diameter; Weight with water and fuel, 23,000 lbs.; without water and fuel, 19,000 lbs.

Class 3d.—Cylinders $10\frac{1}{2}$ inches diameter; Stroke, 16 inches; Driving wheels, 54 inches diameter; Weight with water and fuel, 20,000 lbs.; without water and fuel, 17,400 lbs.

These Engines are on six wheels, so arranged that one-half the weight is on the Driving wheels, which are placed behind the fire-box, the other half on a four wheeled truck, thus distributing the weight more equally than in any other construction. The wheels of the Engines have all wrought iron tires; the Tenders are four wheeled. One important advantage is the simplicity of their construction and arrangement, by which every part of the engine is perfectly accessible while it stands on the track. The improvement in the construction of the crank is one of *great importance*, being less liable to break, and when broken are easily repaired, not costing one half that of a double crank axle. Another advantage arises from having the fire box before the driving shaft, thus making a more equal distribution of weight, that wholly corrects the galloping or undulating motion peculiar to engines with the driving shaft before the fire box, and making them more easy upon the road than any engines now in use; weight, while, by a very simple device of throwing the weight of the tender upon the driving wheels of the engine or detaching it at pleasure, the machine is made to possess the advantage of a light, with the adhesion of a heavy engine, upon ascents when increased adhesion is required. In order to test their *comparative merits* with other engines, B., V. & H. suggests that a *regular account be kept of the expenses of repairs, distance travelled, work performed, and fuel used, by each engine*, for a year or more, which is the only way to get a correct data by which to judge of their respective merits. These engines are either crank axle or straight axle engines, but the manufacturers furnish the crank axled engine in preference, as they are much less liable to get out of order than the straight axled engines are, easier to themselves and to the road; and in case of accident by running off the track or being upset, the machine is protected by the frame. In fact, no instance is known where the wear (excluding accidents,) of the machines for one year has amounted to $300. In order, however, to avoid detention by accident, or wear and tear, the following duplicates should be ordered for each Engine:

1 pair Driving wheels, axle, and excentrics.
1 set of Tender wheels and axles.
1 set of Truck wheels and axles.
1 set of Brasses for working parts.
20 copper tubes.

They also furnish gratis, all the wrenches, tools, Jackscrews, hammers, etc., required for the general management of an engine.

The assertions of the manufacturers are sustained, first by the great number of written evidences of officers connected with 38 different railroads in the United States, who agree in giving the manufacturers the credit of making a superior and satisfactory machine;

Second, by the result of the examinations of Chev. de Gerstner, constructor of the first railroads in Austria and Russia, who has now a better knowledge of railroads and railroad management, than any other person in the United States, gained by ten months of laborious and successful effort, to collect information which has never been before obtained by any other person in this country;

And lastly, by the most useful improvements in Locomotive Engines being guaranteed to them by letters Patent, which renders any person infringing amenable to the laws. Among their patented improvements, are the following:

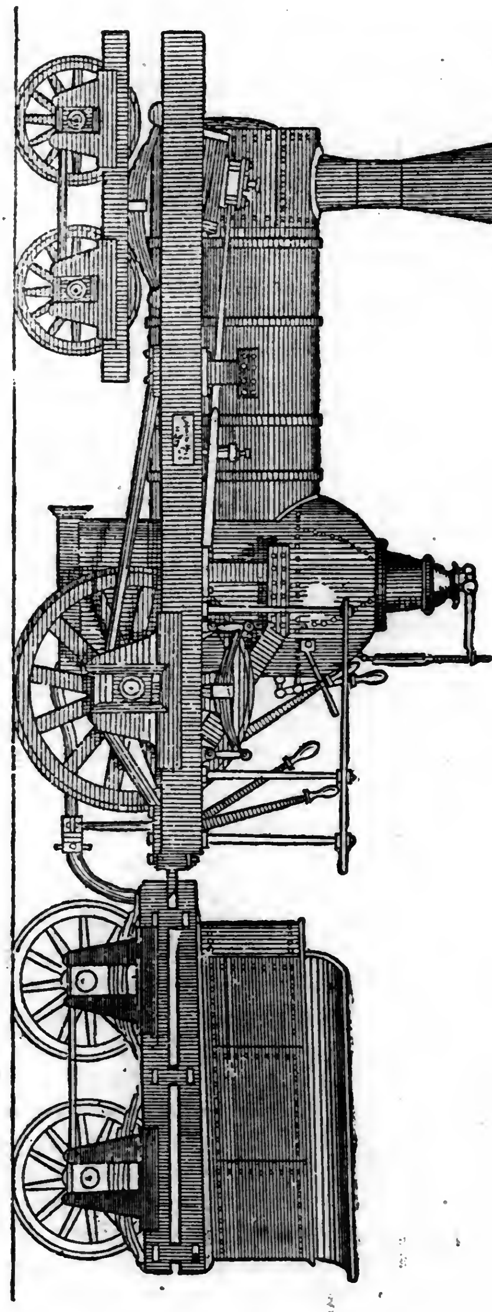
1st. The Ground Joints for steam tubes.
2nd. The Pump Guide and Cross head.
3rd. The Stirrup for confining the pump chambers.
4th. The Metallic packing stuffing Boxes.
5th. The Cylindrical Pedestal Boxes for driving and truck wheels.
6th. The Globe Seats for boxes of truck and tender wheels.

7th. The Ferrules on the outside of copper tubes.

8th. The connecting the truck with the driving wheels to increase adhesion.

9th. The Plan of throwing the weight of tender upon the driving wheels.

10th The Crank Axle, which avoids the liability to break.



TESTIMONIALS.

Having visited within ten months nearly all railroads in the United States, and having collected the most useful information concerning them, which I intend to publish during my further stay of one or two years in this country, I certify with pleasure that I received every where the best testimonials from the Presidents, Engineers and Superintendants of Railroads, in regard to the workmanship and the performances of Mr. Baldwin's Locomotives. Owing to the peculiar construction of these engines, I observe that they are remarkably easy to the road, even where light rails are used. I regard them, therefore, after a careful examination of the results obtained, as the best machines used on American Railroads, and recommend them strongly to all railroad companies in Europe. Should those companies apply to me I am willing to inspect the progress of the workmanship of the Engines ordered for Europe, and to report from time to time, on the state of the work to those companies. If they entrust me the bills of payment, I will keep them until the Engines are delivered on board the vessel, and save to the companies extra expenses.

(Signed) F. A. CHEV. GERSTNER.

Philadelphia, 13th Sept. 1839.

Extract from a letter from John Brandt, formerly superintendant of motive power on the Philadelphia and Columbia Railway, now superintendant of motive power on the Georgia Railroad under date of May, 1838:

"We have 24 of your engines on this road, several of which have been in use since the fall of 1834. Two of your 3d class engines commenced running February 22d, 1837, and travelled 55,695 miles up to the 1st May 1838, and cost for repairs during the above mentioned time one cent and eight mills per mile. Eight engines of the 1st class have travelled from the 1st January, 1838, to the 1st May, (four months) 49,469 miles, made 653 trips, drawing 16,836 cars. The cost for these four months I am unable to show, as our books are not posted, but can assure you that the expenses this year will be less than any former year. One of the 1st class, recently built, has drawn over the Columbia road, part of which has an ascending grade of 45 feet per mile, 35 loaded cars weighing 187 tons, equal to about 701 tons on a level, and travelled from 8 to 12 miles per hour, except on wooden track. This is the heaviest train that has ever passed the road."

Extract from a letter from James S. Shipman, Esq., resident engineer of the Long Island Railroad Company:

"We have two engines of class No. 3 of your manufacture, which have been in use since May, 1836. Their performance is worthy of the most unqualified praise. We carry as an ordinary load 15 freight cars, weighing five and a half tons each, and to show their efficiency we have frequently taken 20 cars without difficulty up an ascent of 35 feet to the mile, and have carried 4 *cars up a grade* 211 *feet per mile, for a distance of* 21,000 *feet.* The average speed for freight is 17 miles an hour, passengers 20 to 25. In the summer of 1837, they performed the distance of 162 miles each day, and, from the journal which now lies before me, that under this *severe usage* there was no failure in either of these engines for 6 months, which rendered a change in their usual time of running necessary, or occasioned any delay either in transportation of freight or passengers, I am fully satisfied that the cost for repairs does not exceed half that of a four wheeled engine, doing the same work."

John Cash, Esq., superintendant of motive power on the Norristown Railroad, writes:

"I take great pleasure in bearing testimony to the excellence of your engines. They are well adapted to *light or heavy* roads. With one of the small class, which has been in use nearly 3 years, I have drawn a train of 750 passengers, over grades of 32 feet to the mile, at the rate of 14 miles per hour."

Wm. C. Young, Esq., Superintendant and Engineer of Utica and Schenectady Railroad, writes:

"The twelve locomotive engines procured of you for this road, have answered their purposes effectively. Notwithstanding much has been said about improvements in such machines, I am not able to satisfy myself that ours are wanting in any particular."

James Elliot, superintendant of motive power on the Philadelphia, Wilmington and Baltimore Railroad, writes:

"After an experience of several years with locomotive engines on different roads, I am of the opinion that the engines of M. W. B. are easier upon the road than any engines in use, and that they combine more advantages than any locomotive engines within my knowledge. They have been constantly running for the last 18 months; the engine Brandywine has been running 265 days, at a cost for repairs of $65 17, and has lost but five days since she was put on the road. The Christiana has been running 165 days, at a cost of $20 for repairs. Their average speed is 24 miles per hour, including stoppages."

L. G. Cannon, President, and L. R. Sargent, superintendent of the Rensselaer and Saratoga Railroad Company, says:

"We have two of your locomotives which have been in use about 3 years. They work well in every particular, and I deem it but an *act of justice* to say that the manufacture and materials of each, have proved to be of the highest order, and I have evidence from the official reports of other companies, and my own experience here, that your engines will, in performance and cost of repairs, bear comparison with any engines made in this or any other country."

W. W. Woolsey, Esq., President of Boston and Providence Railroad Company, writes:

"We have three of your engines, which have been in use since June, 1836; we never have had occasion to put them to their maximum capacity. They have carried seventeen freight cars, of gross weight eighty-five tons, engine and tender *not* included, over the road at an average speed of ten miles per hour, and this over an ascent of five miles in length, one half mile of which is forty-two and a half feet per mile, the remaining four and a half miles thirty-seven and a half feet. They carry ten passengers and three baggage cars *very easily* over the road, at an average speed of eighteen to twenty miles an hour. Your engines give entire satisfaction."

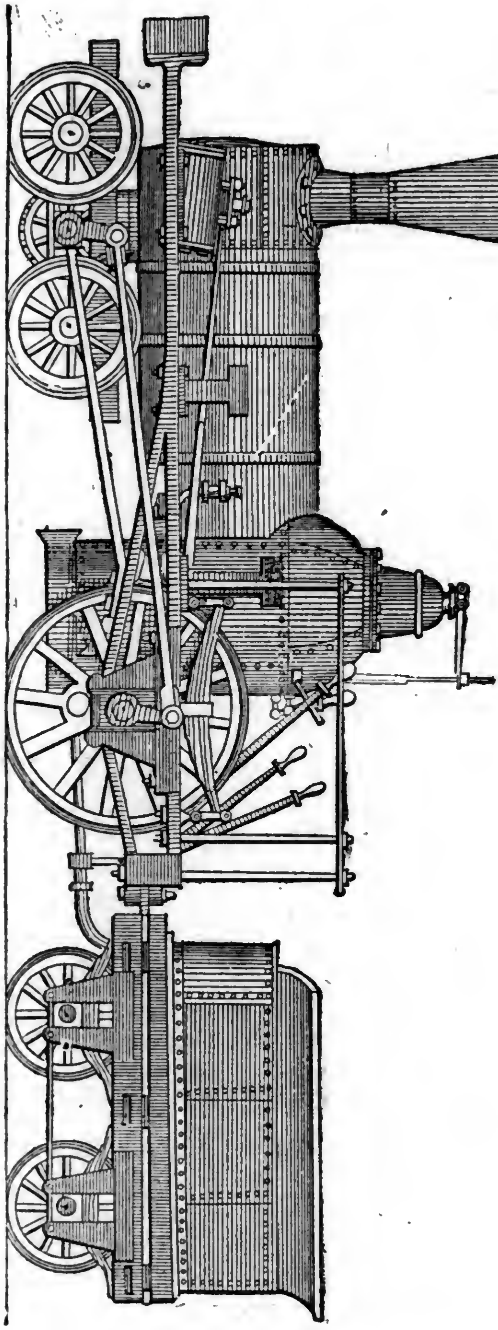
David Mathews, Superintendent of Engines and Machinery, on the Utica and Schenectady Railroad, writes:

"We have twelve engines in use on this road, and are all of your manufacture. They have been in use since August, 1836; and eight engines run about one hundred and fifty thousand miles per year, carrying about one hundred and fifty thousand passengers in cars which hold twenty-four passengers—eighteen cars of passengers and their baggage is considered a load for your engines running twenty miles an hour. We are five hours crossing the road, eighty miles, including fifteen stoppages. Your engines have performed well."

J. Edgar Thompson, Esq., Chief Engineer and general agent of the Geogia Railroad Banking Company, writes:

"We have in operation on the Georgia Railroad, six locomotives from

Baldwin's factory, all of which have given us *entire satisfaction*. The simplicity of their construction, and the excellent proportions and arrangements of the various parts of machinery, entitle them, in my opinion, to a decided preference over any other engines that I have examined, either of European or domestic manufacture."



H. R. Campbell, Esq., Civil Engineer, writes:

"One of your third class engines, the West Chester, this morning, June 8th, drew a train of *fifty-one loaded* cars from Schuylkill Bridge to Broad street, (4 miles,) passing several abrupt curves, some of seven hundred and fifty seven feet radius, and several ascending grades, one of which is 32 feet to the mile. The weight which I got from the weigh master of the road, to my own satifaction, was 284 1-2 tons, exclusive of the engine It exceeds any experiment I have ever heard of in any part of the world, and was apparently made without any preparation, for no one was present to witness it but the hands on the road and myself, who was casually passing."

L. A. Sykes, Esq., Superintendant and Engineer of New Jersey Railroad, says:

"We have five of your engines, third class, on our road, which have been in use and have given entire satisfaction. Our first engine was put on the road in December, 1835, and has been in constant use with the exception of a very few days; is now in perfect order, and apparently as good as ever. In simplicity of construction, small liability to get out of order economy of repairs, and ease to the road, I fully believe Mr. Baldwin's, engines stand unrivalled. I consider the simplicity of the engine—the management of the working parts—and the *distribution of the weight*, far superior to any thing I have ever seen, either of English or American manufacture, and I have now no hesitation in saying that your engines will do the same amount of work with much less repairs either to the engine or the track, than any other engines in use."

A. G. Thorn, Engineer Clinton and Port Hudson Railroad, writes:

"Your engines have given *entire satisfaction* to all persons interested, in every respect. Combining speed, power, and superior workmanship. The first engine which we received, commenced working December 31, 1837. The *cost of repairs up to July* 16, 1838, *had not exceeded one dollar.*"

S. Vail, Esq., Superintendant of Morris and Essex Railroad, writes:

"I am satisfied that in mechanical construction and proportions, simplicity, economy of repairs, and fuel, and on the amount of work which they will do, and the care to the road while running, the engines of Messrs. B., V. & H. are without a parallel in this country, or any that I have seen, which were manufactured in Europe."

Adam Hall, Esq, of New York, late Superintendent for the West Point Foundry Association, now at foot of Beach-street, New York, one of the first Engineers in this or any other country, writes:

"I have been acquainted with your engines (locomotives) since the first that you made, and I know from the experience that I have had of them, that they will do the most work, and cost less to keep them in repair, and are easier to the road than any other engines in use that I know of."

E. Harrison, Esq., Superintendent of Somerville and Elizabethtown Railroad, writes:

"We have two of your engines, one of which has been in use since 1st January, the other since February, running 60 miles per day, and thus far have operated remarkably well, and from our experience we do not believe that we could have done better at any other manufactory of engines in this country or in Europe."

W. Brown, Superintendent of motive power Vicksburg Railroad, says:

"The Mazeppa engine, one of your manufacture, has run 5,265 miles, and cost only $15 for repairs; included in that is a new tender spring."

John Naglee, President of Philadelphia and Trenton Railroad, writes 5th June, 1839:

"I consider your engines, when built with proper care in regard to selection of materials, equal to any built in the United States, and far preferable to any I have seen of English manufacture."

The Virginia, an Engine made by M. W. Baldwin, run between March 21, 1837, and January 1, 1838, 19,019 miles, and cost on an average 1 cent and 2 mills per mile, for repairs. Whole cost, $238 50.

The Paoli, another of Baldwin's engines, run during the same period, 18.043 miles, and cost for repairs on an average 1.6 cents per mile. Whole cost, $296 31.

The whole of Baldwin's engines run collectively 132,157 miles, and cost the State 2 cents and 3 mills per mile for repairs, including accidents.

It should be observed, that the road is a continuous succession of curves, some of which have a radius of 500 feet.

(Signed,) JOHN BRANT,
Superintendent on the Columbia and Philadelphia Railway.

The Superindendent of motive power on the Rochester and Batavia Rail Road writes:—"We have two of your engines of the smallest class which have been running 3 years. The grades on our road are as high as 45 feet, with curves on those grades of 1000 feet radius. Our cars weigh 3 tons, and we take from 20 to 25 loaded cars, and we make our trips of 32 miles in 2 hours including stoppages. I have had experience in managing locomotive engines for 5 years, and have no hesitation in giving your engines a decided preference before any that I have yet used or seen.

(Signed,) WM. HAYDEN,
Rochester, N. Y. July 3d, 1839. Superintendent of Motive power.

James Baggs, Superintendent of Motive Power on the Erie and Kalamazoo Railroad writes,

Sir,—I have been acquainted with your engines since the fall of 1835, part of which time I have had charge of them on different roads as Chief Engineer, and I feel free to say, that yours are the best engines in use, combining speed, power and superior workmanship, and will do the same amount of work with less repairs, either to the engine or the road, than any others that I have ever seen or used.

(Signed,) JAMES BAGGS,
June 27, 1839. Chief Engineer, Erie and Kalamazoo Railroad.

Benjamin Briscoe, Superintendent of Motive Power Central Railroad, Michigan.

Gentlemen,—We have three of your third class engines on this road, 2 of which have been running since January, 1838, and have given entire satisfaction; the third has run, since June last, sixty miles per day, and has not lost a trip for want of repairs. We have two engines manufactured by others, but we can only place confidence, while running, on yours, and I believe them superior to any manufactured in this country or in Europe.

(Signed,) B. BRISCOE,
Superintendent of Motive Power, Central Railroad, Michigan.
August 10, 1839.

John Lodge, Superintendent of Motive Power, Monroe Railroad Geo.

I have had several of your engines placed under my charge as master machinist upon our Railway, and I am pleased to say I have found them admirably adapted to our Railroad, and they are capable of doing a large amount of work at a small cost for repairs.

Monroe, Geo. July 16, 1839. (Signed,) JOHN LODGE.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

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RAILROADS IN CITIES.

The recent memorial of the Harlem Railroad Company, to the Corporation of the city of New York, praying for leave to extend a branch of their railroad through certain streets of the city, has attracted the attention of the public, and we feel certain that it will be more fairly discussed than on previous occasions, when similar propositions have been made.

From the earliest construction of railroads in this country, there appears to have been more or less prejudice entertained against their continuation thorough large cities, and consequently, in some cases, at least, important roads were suffered to terminate at points far removed from the centre of business, and not generally accessable without the aid of carriages and omnibusses. The result of these arrangements has, in many cases undoubtedly been a serious injury to the prospects of the work.

Among the reasons given against granting permission to lay rails, or run cars in large cities are the following:—The great danger supposed to arise from using locomotive engines, both on account of the fright they are uniformly said to give to horses, and the risk of running over persons crossing the street. In the next place it was urged, that even if horses were used, too much of the public highway would be taken up by the rails, and that for general purposes, any street so occupied by a railroad, would be entirely useless—to the greal injury of the property fronting upon it, or in its neighborhood. A third, and to some persons, insurmountable objection, was the encouragement offered to a monopoly interfering with the free and illimitable rights of citizens.

At the time that these objections were first brought forward, they were considered, by many, as unanswerable, and although great changes have taken place in public feeling, and new light has been thrown upon such subjects, there are doubtless those who, to this day, continue in the disbelief of the propriety of any such arrangements. We had ourselves formerly entertained an opinion unfavorable to any such imagined encroachments upon the public comfort, safety or rights, but from an attentive examination of the subject, and from the results of the experience of several places in which city railroads have been tried, we cannot but believe that there is a great balance in favor of this mode of transit. Philadelphia and Baltimore, as well as New York, had made the experiment some time since, and now we believe the practice has become quite general. In this city, which, from its great size, furnishes an extreme case, we have had the daily observation of the working of the Harlem railroad, and in speaking on the subject, we shall refer to the operation of the principle in this case.

Let us now consider the objections above named and then proceed to an examination of the advantages which may be adduced on the other side of the question.

The necessity for the use of a locomotive in streets exists in but few cases. It is not contemplated by any one, to introduce engines into the very heart of populous cities, but as it is proper and necessary to use them in the vicinity of towns and in their less crowded parts, we shall stop to consider the difficulties said to be inseparable from their employment. The danger to be apprehended from frightening horses, is greatly exagerated, and it is a fact worthy of notice, that they very soon become accustomed to the noise and unaccountable motion. This every one must have noticed upon a line of road which has been for some time in operation. We remember watching, with no little curiosity and amusement, the various expedients used upon the Long Island railroad, to disguise the engine in approaching Brooklyn. Among others, a sort of jacket was provided for the bright part of the works, and another for the smoke pipe; and for this or other reasons, various arrangements of the train were made, the locomotive sometimes being behind the cars. After all, it seems to us, that the horses were as little disturbed by the undisguised engine, at the head of the train, as by any other arrangement. In fact, after a while no difficulty whatever occurred, and we have seen spirited horses driven along side of the engine for some time without betraying any symptoms of fear. The noise of the exhaust steam seems to have the most effect to create terror, but we believe that various contrivances for remedying it have been made. The danger of running over passengers is also much less than is generally imagined, except in cases of wilful carelessness, we might almost say, madness. The perfect control under which a steam engine can be kept, at *low velocities*, renders it far superior, as a means of locomotion, to horses in ordinary wheel carriages. A locomotive under the guidance of a steady engine-man, is decidedly safer than a pair of unruly horses, driven by some dandy who is as ignorant of his art, as of managing the steam engine itself—yet who would think of excluding the latter from the highway. Moreover, the risk of accident, small as it is, is confined to a small portion of the street, which the engine never leaves.

As to the objection that railroads are encroachments upon the public streets, we have only to appeal to experience to answer it. It is found that when the cars are not passing, the street is, to all intents and purposes, as free and unincumbered, as without the rails—while the cars themselves take up no more room than ordinary conveyances, and not so much as a large hay wagon—no one would think of excluding hay wagons from the city, yet they not only travel through the streets, but make regular stands of certain parts of the city, to the undoubted inconvenience of many citizens. Business of all kinds seems to flourish in the neighborhood of city railroads, stores and dwellings are let for higher prices, and property is permanently improved in value, and we feel certain, that no case can be found, in which property near such rail tracks, *used for constant travel*, has diminished in value. The danger to passengers is extremely small, and much less than from ordinary vehicles.

In answer to the third objection, we do not intend to discuss the question of monopoly, convinced, as we are, that a corporation under suitable limitations, is far less of a monopoly than a fire engine company, who, in defiance of law, and at the peril of life and limb—to say nothing of corners of steps, and flag stone—scour not the middle of the street, but the side walks. It must be remembered, that in a large city, every means of public conveyance must be regulated by law, and the number of carts, omnibusses, porters, etc., limited. Now we have at once a monopoly, and one more onerous to the public than a railroad company could possibly be. Nothing can equal the absolute certainty with which all regulations of municipal police, can be enforced upon a railroad, while carriages and omnibusses enjoy a monopoly of lawlessness, and in fact, form the greatest nuisances in our large cities.

But a consideration of the other side of the question will open to us a view of many real advantages and permanent benefits to a city from the use of a well managed railroad. There can be no doubt that the termination of all extensive line of road, in the very centre of a large city, will be a great source of increase of wealth. But no such road should be allowed to lay its rails within the streets of a city, without opening accommodations to that part through which it passes, by running freight cars. All the disadvantages that really attach to such matters, belong as well to the least travelled, as to the most travelled road—while all the benefits belong only to the latter. Some persons entertain strange notions of public convenience, and we have heard those in the councils of our city who were for removing the various steam boat landings as far as possible from each other, in order that strangers might be *compelled* to traverse a larger portion of our city—for whose benefit? why, for that of the hack driver. This sort of reasoning is not unlike that by which we suppose the good people of New York (opposed, as they are, to monopolies,) arrived at the propriety of their present custom, of giving up their residences and taking new ones on the first of May—by which custom, every one is inconvenienced except the cartmen, porters, house cleaners, and last, but not least, landlords, who enjoy the monopoly of having the remainder of the population at their mercy and therefore get from them as much as they please and do as little as they can.—Even to these scrupulous people a railroad is no longer a bugbear, for while it facilitates immediate access to the very centre of the city—instead of *straining* the population through the various streets—it likewise facilitates the egress from the centre to the outskirts and fully returns what it had carried in.

In their memorial, the Harlem railroad company mention a circumstance which to us appears worthy of very attentive consideration, viz:—that they are now carrying over one million of persons annually, entirely at their own expense, they keeping the street in order and doing their own repairs. I we only consider, what it would cost to transport one million of persons by omnibusses, (confessedly the most destructive of all vehicles to pavements,) we can imagine the gain of the city. But again, this traffic costs the people less than any other method of conveyance, the fare being at an average of about three-fourths or even one-half that of the omnibusses.

Railroads have justly been called *democratic* institutions, they are for the people, and rich and poor alike derive the advantage from them. In fact, the benefit to the poorer classes is one of our best arguments. How many laborers, living at a distance from their place of work, can, for a trifle, be transported thither, without loss of time or strength. We have no doubt, that calculation would show an incredible amount of labor saved in this manner to the city in each day.

We might go on to multiply arguments in favor of that view which we have taken of the question, but our design has been rather to excite the attention of others than to exhaust the subject.

In conclusion we may remark, that from the orderly and accommodating demeanor of all attached to the Harlem railroad, we feel convinced, that the design of the company, to afford every convenience to the public, will be fully carried out. By the gradual change to eight-wheel cars, a saving will arise to themselves, and increased comfort to travellers, and we have no hesitation in saying, that if the prevailing spirit is carried out in the management of the company, they will be justified by the amount of travel, before long, in resorting entirely to eight-wheel cars.

We wish the company all manner of success and prosperity in their undertaking, and hope that they will realise the reward of their public spiritedness and good management, as they certainly will at no very distant period.

NEW YORK AND HARLEM RAILROAD.

By a memorial, the publication of which was commenced in our last, we learn that an application is to be made by this company, to the corporation of the city for permission to lay a track from the main road in Centre, through Canal street, to the Hudson river; and thereby to accommodate a greater number of citizens than they are now able to do. We were, we must confess, not a little surprised, on reading the memorial, to find that the company, which has labored so long, so perseveringly, and at such an enomous expense to construct a road, by which the *people are* accommodated, and which may with great justice and truth be termed a "Democratic establishment for the convenience of the many"—should still ask to be permitted to increase their outlay to extend their road, for the benefit and convenience of others, under the discouraging circumstances of their case—to wit, 1st, that the stockholders have never yet received any dividend; and, 2nd, the untiring opposition of a portion of this community to the laying of rails through the streets; we were, however, the more gratified to learn their determination to continue "onward" in their course, notwithstanding the difficulties and prejudices to be encountered *and overcome*—as they *certainly will be* overcome—until they shall have extended at least one track to the water's edge.

It is not our intention to enter into a labored argument, at this time, to show the great error, we may say *injustice to themselves*, committed by the citizens in their persevering opposition to the extension of rail tracks into the different sections of the city—as we have *no doubt* of the ultimate success of the system—a system, which will tend as much to the *civilization, harmony* and well being of mankind, even, we had almost said, as the discovery of the art of printing. We will, however, endeavor to show a few of the benefits resulting from the introduction of railroads, and then ask those who oppose them, what may we not *eventually* anticipate from them, if, in 10 years, so much has been accomplished, even in their unfinished and *unconnected* condition; and, in the face of such opposition to, and prejudices against their entering large cities, and thereby forming a connection with other roads.

It is not surprising that a portion of our citizens, who see only one side of the picture, should oppose them; but it is singular to us, or would be, if we did not understand the difficulty of divesting ourselves of pre-conceived opinions—often formed without sufficient knowledge of the facts—to see those whose business must have been benefitted by the extension of a line of tracks, petitioning for the removal of the very means which brought customers to their door; the removal of which will most certainly turn them in another direction. It, however, only adds one more to the numerous instances in which we see people mistake their own interests, and which they only appreciate when too late to be benefitted by the knowledge.

It may, perhaps, in the present mode of laying the rails, be objected to them, that they incommode other vehicles in crossing the tracks; and also that they now interfere with the stages, and will eventually interfere with the cartmen—and, therefore, should not be extended to the rivers, nor be permitted to connect with other roads. So might it have been objected to the introduction and use of carts, that they interfere with the *porters* and *hand cartmen;* and to the stages, that they took passengers from the hackney coaches. These latter, however are objections not sustainable, as the streets are not designed *alone* for carts, stages, and coaches; nor have cartmen any *exclusive* right to the carrying trade in cities; nor stages and hackney coaches to the carrying of passengers; but the greatest good, and convenience of the greatest number of people, and amount of business should in this, as in other matters, be consulted as far as may be. by giving people a choice in the mode of doing their own business in their own way; and especially for the convenience of travellers, who ought not to be compelled to employ an extra conveyance, and be subjected to the extortion and abuse of hackmen, as is too often the case in large cities, to get from one railroad and steamboat to another—and as to the former, *the mode* of laying the tracks that will beyond all question be improved so as to permit carriages to cross them without difficulty.

It is also true, at least so far as we have been able to ascertain, that railroads for transportation and travel have in all cases added to, instead of detracting from the business of carts and coaches—by increasing to an astonishing amount, as will be seen, the business of cities; and it appears to us that instead of being a disadvantage, their extension will be a great and direct advantage, by increasing the quantity, and at the same time, reducing the average distances to which the loads are to be carried on carts, thus enabling the same force to accomplish more useful effect.

We will not, however, attempt here to argue the question, but give the remainder of the memorial to which we allude, together with some interesting railroad statistics which were selected for the last number but excluded by other articles.

MEMORIAL OF THE NEW YORK AND HARLEM RAILROAD COMPANY.

(Continued from page 16.)

Your memorialists, therefore, most respectfully pray your honorable body to grant this company permission to continue their rails from Centre street, through Canal street to the North River.

Your memorialists would here remark, that if this privilege be granted to the Harlem Railroad Company, they are convinced it would greatly benefit every portion of the island, and particularly a large mass of daily laborers; nor should it be forgotten, that the advantages it confers will be common to all classes of our citizens, of every lot and condition in life. Further, to use the language of Chevalier de Gerstner, a distinguished engineer of Austria, who speaking of the Belgian railroads called them "a popular, democratic establishment, receiving the approbation of the people and every intelligent man."

It is indispensable that residents far from the centre of business, should be able, in a cheap and expiditious manner, to reach their places of trade.—The lower part of the city is constantly changing from dwelling houses to stores; and as this change takes place, the inhabitants, together with the increase of our population, are compelled to remove either to the upper part of the city, or to the adjoining towns and villages.

The island is narrow, and your honorable body accommodate with ferries, almost an unlimited extent, those who reside in places beyond your jurisdiction, and who often, to the inconvenience of the commerce of the city, have great facilities for coming into and leaving it, and who are exempted from personal taxes, and many other burthens; while sound policy would seem to indicate that the most approved modes of conveyance should be adopted for traversing our city, from one extreme point to the other, presenting for public use, attractions equal, at least, to those offered by our neighbors of Boston, Philadelphia, Baltimore, Brooklyn and Jersey city, and thus, by affording inducements to the inhabitants of neighboring states to remove within our precincts, augmenting our population and wealth, and contributing to the expense of the city government.

But, in addition to all this, it should be borne in mind, there are other, and, perhaps, stronger reasons in favor of the extension of our rails, to the North and East rivers, where ample accommodation may be afforded for all commodities intended for exportation.

Your memorialists believe that this road is but the first link in the main chain of that mighty and measureless system of internal communication, which, connecting with the New York and Albany Railroad, commencing by its charter, at the termination of our own work, and branching throughout our State, throughout New England, and to the whole interior of the Great West, will be rendering those immense inland communities tributary to this State and its metropolis!

This, then, opens other and wider prospects of incalculable value.—Where must all the passengers borne on all these gigantic avenues of internal communication be finally concentrated? Will not the surplus productions of this vast interior, be poured into this, its great commercial emporium?

And will not this, our city railroad, become the first section of that great central avenue through which these rich streams of agricultural and manufacturing productions are destined to flow, not only for the use and benefit of our own citizens, but millions for export to other States and other nations? Surely, then, your honorable body cannot but feel the importance of allowing our railroad free access, at the most eligible points, to that ocean, where these innumerable commodities of our country may be borne to every clime.

If this view of the future usefulness of our work be correct, and your memorialists cannot doubt it, our road does not merit the resentments, jealousies, and sectional prejudices sought to be excited against it. On the contrary, the work, completed by individual enterprise, unaided by the funds of the state or the nation, forming the first link in the stupenduous chain of our magnificent system of internal improvements, and, perhaps, the most difficult and expensive of the whole series, deserves the countenance and support of every liberal and enlightened mind.

In conclusion, your memorialists believe, that a simple reference to the unexampled extension and macthless prosperity of our city as the triumphant result of a free water communication with all parts of the world, furnishes an irrisistible argument in behalf of an equally free railroad communication, as scarcely less essential to individual and general prosperity.

By order.

SAMUEL R. BROOKS,
President of the New York and Harlem Railroad Company.
New York, December 2nd, 1839.

DUBLIN AND KINGSTON RAILWAY.

The Dublin and Kingston railway is a passenger railway only, yet it is proposed to bring it into the city, even to and above the river, and to do so, it is proposed to remove nearly 40 houses.

This is, at present, wholly a passenger railway, about 6 miles in length. The public road traffic, previous to the construction of the line, was carried on principally by cars, besides which, there were many private carriages, saddle horses, and other conveyances. To ascertain the amount of previous traffic, persons were employed to note the number which passed between six o'clock in the morning, and nine o'clock at night, for 37 weeks, *i. e.*, from the 14th of February to 30th October, and the result was, 29,256 private carriages, 5,999 hackney coaches, 113,945 private jaunting cars, 149,754 public jaunting cars, 20,070 gigs, 40,485 saddle horses, and 58,297 carts.

From the amount of general traffic, thus ascertained, the estimate of probable railway traffic was made up on public cars only, viz:—

37 weeks,		149,754 cars
15 weeks at same rate,	60,711	45,533
Deduct 25 per cent. for difference of season,	15,178	
Number of cars,		195,287
Allowing four persons to each,		4
Annual number,		781,148
Estimated increase,		390,574
Total		1,171,722

Which, at 6*d.* each, amounts to an annual revenue of 29,293*l.*

The actual numbers conveyed since the opening, December, 17th, 1834, have been,

	Passengers.	£	s.	d.
From December 17th, 1834, to March 1st, 1835,	136,829	4,177	9	8
From March 1st, 1835, to March 1st, 1836,	1,097,971	31,130	6	8
From March 1st, 1836, to March 1st, 1837,	1,184,428	31,901	5	10

The general daily average number of passengers being about 3000.

BRUSSELS AND ANTWERP RAILWAY.

The Brussels and Antwerp railway also is used mostly for passengers, and has establishnd the truth of the remark that the establishment of railways is for the convenience of the *people*, by increasing the number of passengers the first year, from 80 to 563,000, and the 2nd year to 872,000.

This is a union of two lines from Brussels to Mechlin, distance about 13½ English miles, and from Mechlin to Antwerp, about 14¾ English miles.

The total number of passengers carried on the road between the two extremes, was about 80,000 annually, conveyed in from 15 to 20 dilligences, besides canal passengers, the number of which is not stated.

The line from Brussels to Mechlin was first opened 7th May, 1835; and the number of passengers conveyed by it to the end of Aprid, 1836, was 563,607; and from the first of January, 1836, to 31st December, 1836, the number conveyed amounted to 872,893.

The other part of the line, from Mechlin to Antwerp, opened May 1st, 1836, and from that time to August 15th, the number of passengers (long and short stages) was 369,452; and from August 1st, to October 31st, 256,673, making a total of 626,125 passengers, of which 187,233 traversed the whole distance. The remaining part went only to intermediate stations.

Similar results are witnessed here, and yet we find a *few of the people* opposing the extension of the tracks in this city, because they say it is a "monopoly!"—true it may be termed a monopoly, not, however, for the benefit of the stockholders, who have not in seven years received a penny of dividend, but the *monopoly* is to the poor man, the business man, the infirm, and the indolent, who can ride 2 miles for 6*d.* every five minutes, from 7 A. M. to 8 P. M.

In other cities, railroads are extended through different streets to the water; there are turnouts for the purpose of permitting the cars to pass directly into the store houses to load and unload, so that the greatest beneficial effects may result from the least labor. Thus it *should* be, and thus it *will eventually* be here, when the real advantages of this mode of communication are better understood, and duly appreciated. The greater the opposition of the few, the more certainly will the people—the multitude whose conveniece they are—require their extension, not only through *Canal*, but through other streets also to the rivers.

INTERNAL IMPROVEMENTS OF NEW YORK.

In the enlargement of the Erie canal, two leading objects were proposed to be obtained.

1st. To accommodate the supposed great increase in trade,

2nd. To cheapen transportation.

The Erie canal was originally constructed forty feet wide upon the surface and four feet deep. The locks fifteen feet in width, and ninety feet in length, inside measurement, with an average lift, a little less than eight feet, and capable of being navigated by boats carrying 50 to 60 tons. According to the plan for the enlargement, the dimensions of the canal are to be increased to seventy feet in width, at the surface, and seven feet in depth, with locks, seventeen feet in width and one hundred and ten feet in length in the chamber—the lifts of the locks remaining nearly the same as originally established, viz:—a little less on the average than eight feet, and capeble of being navigated by boats carrying from 100 to 150 tons.

The original cost of the canal did not vary much from	$8,000,000
Since its completion (in 1835,) about $400,000 has been expended annually in repairs and superintendence, nearly one-third of which has been appropriated towards making the canal better than it originally was; that is, in the erection of new bridges—the raising and rebuilding old ones in a more permanent manner—the widening and rebuilding aquaducts, and wastweirs—the construction of inside slope or protection walls—the widening and deepening the channel, &c.—amounting in all probably to	$2,000,000
Total cost of the Erie canal, at the time of commencing the enlargement,	$10,000,000
It is now proposed to expend in making the enlargement throughout the whole extent, viz: 363 miles, according to the estimate rendered last winter to the Legislature, nearly	$25,000,000

The first estimate for the enlargement, was $12,500,000 nearly. In making this estimate the great difficulties of the undertaking were not fully comprehended. The second was in like manner defective, though approaching nearer the truth. Unless the plan shall be materially changed, the cost will, in all probability, exceed the last estimate, by $5,000,000

Making a total of $30,000,000

It is obvious, that the benefit of this improvement cannot be fully realised until the canal is enlarged throughout its whole extent. At the rate at which the work has thus far progressed it will occupy full ten years. There should, therefore, be added to the above sum the interest on money expended from year to year, until it is completed, which cannot well be estimated at less than $10,000,000

Total cost of the enlargement, $40,000,000

To which add the original cost of the canal, which is merged in the enlargement as above stated, $10,000,000

Gives a total of $50,000,000

which the Erie canal will cost the State when the enlargement is completed on the plan contemplated.

By the aid of the steamboat tax, the auction tax and the salt tax, the original cost of the Erie canal has been provided for. Without this extraneous aid, the canal, with its boasted business and revenue, would barely have paid the interest on its cost, repairs and superintendence, and the State would now have been in debt for an amount equal to its cost. This assertion will doubtless surprise many, but it is nevertheless true, that if the Erie canal had depended upon its own revenue for the liquidation of its debt and payment of the expenditures necessary to keep it in operation, it would now have been in debt to an amount equal to its original cost. For the proof of this, see the report of the comptroller, January, 1839.

It is now the intention to add to the cost of the Erie canal nearly $40,-000,000, in effecting an enlargement of its channel, which expenditure we shall demonstrate is not required by any reasonable anticipations of the increase in trade, which will necessarily pass upon it; and not warrented by any other advantages which are likely to accrue from it.

From the completion of the Erie canal to the period when the enlargement of its channel was contemplated, viz:—in 1835, the increase in the amount of transportation had been rapid, exceeding very greatly all previous calculations. Upon the eastern portion of the canal where the press of business was the greatest, the number of lockages were very nearly equal to the capacity of the locks, and hence the apparent necessity of some further provision for the anticipated increase in the business either by doubling the locks, or by an enlargement both of the locks and the channel of the canal.

This anticipated increase in the trade has not since been realised. By the comptrollers report, above referred to, it appears that the number of tons of freight coming to tide water on the Erie canal for the four past years is as follows:—

1835	753,191 tons.
1836	696,337 "
1837	611,781 "
1838	640,481 "

From which it appears, that the tonnage for 1838 is about one-sixth lers than for 1835.

The preponderance of the trade on the canal is in the direction of tide water, in the ratio according to the report just referred to, of 4½ tons descending, to one ton ascending. There is consequently no necessity for an enlargement of its channel to accommodate the *ascending* trade or that going west.

The descending trade is composed mainly of the productions of the "forest" and "agriculture."

The number of tons of the former coming to tide water in 1835 was 540,202, in 1838 it was 400,877 showing a decrease of 139,325 tons—the number of tons of the latter in 1835 was 170,954, in 1838 it was 182,142 showing an increase of only 11,188 tons. That is, the *increase* in the agricultural products for the four years mentioned was only *one fourteenth* part of the *decrease* in the products of the forest for the same time. In this proportion it will require, *at least, fifty* years for the increase in the agricultural products to equal the falling off in the products of the forest in *four* years! Should therefore the latter continue to decline in the same or even a less ratio than heretofore the canal, instead of being *more*, will for some years to come, be *less* crowded than it has hitherto been.

That there will be a considerable falling off in the product of the forest, there is little doubt. The whole number of tons of every description of freight coming to tide water in 1838, was 640,481, of which 400,877 tons or nearly two thirds was from the forest and composed almost wholly of timber, boards, scantling and ashes. These, therefore, so far as tonnage is concerned, are now the prominent items of transportation upon the canal.

All of the more valuable timber within reach of the canal is nearly removed, and will not be replaced any considerable portion of it, by a seccond growth. This is strictly true of the pines, hemlock, spruce and tamarack, which constitutes the bulk of the timber conveyed to market.

In addition to this, lumber of various descriptions has already attained a price in market, owing to its scarcity, which brings it in competition with the timber from the Carolinas, Georgia, Maine, and New Brunswick. From the first named States is now obtained a large portion of the more valuable timber used in house and ship building in the City of New York. Much of the timber used in the construction of railways in the northern States is also obtained from the same source. The portions of the State of New York in which any considerable amount of timber is to be found are the northern and south-western. That from the former finds a very direct route to market through the Champlain canal. That from the latter, in consequence of the cheap descending navigation of the Alleghany and Ohio rivers passes off in that direction—and what will surprise many who are not conversant with the course of business in that section of the country, is used to a very considerable extent in the construction of buildings in Indiana and Illinois.

Those who are acquainted with the business upon the Erie canal know that there is a very great difference in the tonnage or transportation on its eastern and western divisions. From Albany to Buffalo, the tonnage may be said to decrease almost in an arithmetical ratio. The extreme western portion of the canal is in fact in a similar condition as it regards business with the lateral canals, compared to them, it is like the spindle-top of a tree compared to its branches. Much has been said of the unproductiveness of the lateral canals,but the fact seems to have been overlooked that the western portion of the Erie canal is open to the same objection. The Oswego branch, terminating at Lake Ontario, is 38 miles in length. The estimates of cost and reports of the Comptroller show that the nett receipts from this branch from the business passing upon it, are greater, compared with its cost, than the corresponding receipts, from an equal extent of the extreme western portion of the Erie canal terminating at lake Erie. By this statement we do not mean to be understood to say that the business is the greatest on the Oswego canal, but that relatively to its cost, the nett receipts are the greatest and hence the most profitable. That the business upon the Erie canal is much the greatest on its eastern than upon its western sections is evident from the fact already adduced, that two thirds of the tonnage descending to tide water, is the product of the forest, nearly all of which, by reference to the Comptroller's report, is brought to the canal east of the Seneca river. The points where most of the lumber is received are at the junctions with the Cayuga and Seneca and Oswego canals and with the Oneida Lake canal near Rome.

West of Montezuma or Syracuse the Erie canal is far, *very far* indeed from needing enlargement to accommodate any anticipated increase in the trade upon it. This part of the Erie canal embraces an extent of about *one hundred and ninety miles*, or more than one half of the whole extent of the canal.

The estimated cost of the enlargement of this portion, not having the report at hand to refer to, cannot be stated with precision, but it can not, it is imagined, vary much from about three-eighths of the whole cost, or according to what is shown above, about *fifteen millions* of dollars. The expenditure of this sum will not, as in the case of the construction of a new work enhance the value of real estate, and other property in its vicinity. It is in fact, a work most completely of supererogation, not needed for the purpose designed, and will, if persisted in, serve only as a monument of the folly of its projectors and advocates, and prove a cause of deep and lasting regret.

Other reasons may be adduced why the enlargement of the Erie canal is not required, to accommodate the prospective business upon it. These with our remarks upon the effect of the enlargement, in reducing the cost of transportation, will be reserved for another communication.

FULTON.

The following *legal* opinion, as to the right of the Common Council to permit the laying of rails in the streets, will be found both interesting and useful.

CASE FOR COUNSEL.

The Board of Aldermen of the city of New York, at their meeting on the 30th December, 1839 passed the following resolution:

By Alderman Purdy—Resolved—That the Counsel of the Corporation report to this Board, his opinion upon the right of the Common Council to permit the Harlem Railroad Company, or any other chartered company, to use the centre of the public streets for private purposes and individual gain, so as in any respect to abridge the use of the public therein.

The resolution passed by the Board of Aldermen upon which I am desired by the Harlem Railroad Co. to give my opinion, purports to inquire whether the Common Council have a right "to permit the Harlem Railroad Company, or any other chartered Company, to use the centre of the public streets for private purposes and individual gain, so as in any respect to abridge the use of the public therein."

If I should confine myself to answering this inquiry in the shape in which it is put, I should probably say that the Common Council have no such right. But it is obvious that the language of the resolution does not reach its own purpose and such an answer would therefore be illusory in respect to the inquiry really meant.

This resolution by coupling the Harlem Railroad Company with "any other chartered company," assumes that in respect to using the centre of the public streets, the privileges of all *chartered companies* might be alike, which neither follows as a matter of course nor is legally true; and by designating that use to be for *private purposes* and for individual gain, it begs the very question upon which the determination of the matter rests.

I presume the object of the resolution was to test the right of the Common Council to permit the Harlem Railroad Company or any other chartered Railroad Company, to lay rails and run cars over the centre of any public street; and in this view of the subject I have no hesitation in saying not only that the Common Council have such right, but that if (all things considered) they should deem that public convenience would be promoted by such permission it is their duty to grant it.

The character of a chartered railroad company in respect to the *public* or *private* nature of its purposes admits no longer of a question. Those companies belong to that class of corporations, such as turnpikes, ferries, canals and bridges, when the *uses* are all public, although individuals may be benefitted. The general principle that all such enterprises are *for public use and accommodation*, although undertaken and conducted by private corporations, or even by individuals, has been repeatedly decided both in the State Courts, and the Supreme Court of the United States; and in this State that principle has been extended to chartered railroad companies by the Court of Chancery in the case of Beekman vs. Saratoga Railroad Co., 3d Paige, Rep. 45, and by the Supreme Court in the case of Bloodgood vs. Mohawk and Hudson railroad Co., 14th Wendell, Rep. 51. In those cases the right of railroad companies to take private property on making just compensation against the will of the owner, was fully and ably discussed; and that right was established on the ground that such companies are incorporated for public convenience. The question of private or individual gain (or possibly loss) has nothing to do with the subject. It is merged in the consideration of public benefit.

I therefore take the following grounds:—

1st. Railroads are made and conducted by chartered railroad companies for the purpose of affording better accommodation to the public for travelling and transporting property from place to place, than they could otherwise enjoy.

2d. The very end for which streets are laid out, is that the public may have the greatest facility for such travel and transportation of property, by such modes of conveyance as may best answer the purpose.

3d. The power of regulating the use of the public streets of this city rests with the Common Council, and they are bound so to exercise that power as that the public may derive the greatest amount of benefit from such use.

From which I draw this conclusion; that if the public will derive a greater amount of benefit or convenience from having a railroad in operation through any street, than they could enjoy without it, the Common Council have clearly a right to allow a chartered railroad company to make and conduct one through such street. It is within the compass of their duties so to do.

The resolution supposes that such use of a street by the railroad company may in some respect abridge the use of the public therein.

This is a point upon which any one may from observation or experience form his own opinion; but be it as it may, it cannot effect the question of the *right* of the Common Council although it might influence their discretion in the exercise of such right.

The power of regulating, necessarily carries with it the power of abridging an indiscriminate use of the street. What is the effect of the ordinance requiring carriages, &c., to keep on the right hand side, but to abridge and limit the use of the street? If the Common Council have no authority to restrict the public in the use of the streets, what right have they to lay off side-walks for the exclusive use of foot passengers and prevent carts and carriages from coming therein?

The answer to all this is, that the convenience, comfort and safety of the public is protected and promoted by such restrictions. The greatest good is thereby afforded to the greatest number, and to attain this, the particular inconveniences of the few must be disregarded. If public health or convenience should dictate the expediency of making a canal for boats in the centre of a public street, (as was at one time the project for Canal street,) surely the inconvenience which a portion of the inhabitants might suffer from being deprived of the power of crossing at any part of the street, and travelling over the centre of it with carriages, could not prevail against the advantages to the whole as a community from such a measure.

It all results, then, in this—If the advantages to be derived by the community from the use of a railroad in any street of the city, should preponderate over any public disadvantages with which such use might be attended, it is the duty of the common council to give their consent to such use; if otherwise, to withhold it. The matter does not involve a question of *right* on the part of the common council, but presents one for their judgment and sound discretion.

R. Emmet.

Jan. 6, 1840.

The following extracts from the 2nd report of the British commission on a general system of railways in Ireland, "on the influences of railroads in developing the resources of a country," are so true, yet so little understood by the multitude, that we give them a place in the Journal, with the hope that they may find their way into some of the daily papers of this city, and thus reach those who ought to understand the subject better than they now appear to.

ON THE INFLUENCE OF RAILWAYS IN DEVELOPING THE RESOURCES OF A COUNTRY.

Experience testifies that increased facilities of intercourse between distant places, and more especially between sea-ports, and the interior of a country, are among the most effective means of extending civilization, with its attendant lights and benefits. Together with the opportunities of communication, a desire to take advantage of them is diffused, and this readiness will be more decided, and the important results to be expected will follow more promptly, in proportion as the means thus presented shall combine security with convenience, and despatch with both.

The proofs and instances which sustain this assertion are not confined to the case of any one country or district; although they are more observable in communities where the resources of wealth and commerce, already possessed by the inhabitants, enable them to turn every advantage, as it arises, to immediate account. In England, wherever new channels of communication have been opened—either between different parts of the interior, or the interior and the coast, or between different sea-ports one with another, or with other countries—these opportunities have invariably been embraced without delay; and the changes so produced have been, on that account, the more striking. In less favored countries, the abitity to profit by the occasion does not always exist, but must be acquired by degrees; consequently, improvement also will be gradual, and its first manifestations the more tardy.

The degree to which intercourse is not merely promoted but actually created by the facility of accomplishing it, could be scarcely credited, but for the numerous and authentic examples which establish the fact. The omnibus traffic, of modern introduction, between different parts of London and its principal suburbs, is a familiar instance which immediatedsuggests itself. There is a constant succession of those conveyances, to and fro, through all the leading avenues and streets of the metropolis, and their number is increasing daily: yet, in addition to these frequent means of transfer from east to west, small steamers are continually plying between Westminster bridge, Hungerford market, Dyer's wharf, and the Surrey side of London bridge; by which many thousand persons are withdrawn every day from the omnibus traffic; while below London bridge the number of passengers, by steam vessels, down the Thames--also an introduction of recent date—amounts to several millions in the year.

We learn that each of the two Greenwich steam packet companies carried, last year, about 400,000 passengers; that the Woolwich old company, calling at Greenwich, carried more than 100,000 Greenwich passengers, besides 192,000 to Woolwich; and the New Woolwich company carried nearly 100,000 passengers between Woolwich, Blackwall and London bridge. To these are to be added the many thousands who pass those places to Gravesend, Margate, Ramsgate, Southend, Dover, Herne bay, &c., &c.; and, above all, the multitudes, greatly excedingly one million, who, during the last year, passed by the railway to Greenwich, while the public conveyance on the high road scarcely appeared diminished in number or in the frequency of their journeys.*

These may possibly be regarded as peculiar cases, incidental to the immense population of the great metropolis; but similar results are found to occur, in a proportionate degree, in places quite beyond the circle of that influence.

A writer on statistics (G. R. Porter, Esq.) relates, that two generations back "there were no means of reaching London from Horsham, in Sussex, but on foot, or on horseback—the latter not practicable in all seasons.—Horsham is 36 miles from London—and the journey between the two places now occupies less than four hours. More than thirty coaches pass through it daily, to and from the metropolis, in addition to private carriages, post chaises, &c. The traffic of goods, chiefly coal and agricultural produce, carried on in the district of which Horsham is the centre, exceeds 40,000 tons in a year; besides which, the road is constantly covered with droves of cattle, and flocks of sheep."

This result has been obtained by a rise of only the first degree in the scale of improvement, namely, and excellent road, without even a canal. It is the effect of improved communications on a country of rich soil, and bears analogy to what has taken place in many parts of Ireland.

By referring to our notes, A and B, it will be seen, that on the Stackton and Darlington Line the passenger traffic, prior to the establishment of the railway, amounted only to 4,000 persons in the year; it now exceeds 16,000. On the Bolton Line the average weekly number of passengers is 2,500, whereas the number of coach journeys out and in per week, which the railway has superseded, amounted only to 28, carrying, perhaps, on a weekly ave.age, about 280 or 300 persons.

* We believe it to be a fact, that thirty years back, the only public mode of conveyance between Woolwich and London was by coach; and two coaches, each leaving and returning twice in the day, were then deemed sufficient for the whole passenger traffic of that place. There are now omnibuses leaving twenty-four times, and returning as often, in the day; and a still greater number of vans and single horse coaches, running, as they fill, to Greenwich only whence most of the passengers proceed by railway, steam boat or omnibus, to London.

On the Newcastle and Carlisle road, prior tc the railway, the whole number of persons the public coaches were licensed to carry in a week, was 343, or, both ways 686; now the average daily number of passengers by railway, for the whole length, viz., 47½ miles, is 228, or 1,596 in n the week.

The number of passengers on the Dundee and Newtyle Line exceeds, at this time, 50,000 annually; the estimated number of persons who performed the same journey, previous to the opening of the railway, having been 4,000.

Previons to the opening of the railway between Liverpool and Manchester, there were about 400 passengers per day, or 146,000 a year, travelling between those places by coaches; whereas the present number, by railway alone, exceeds 500,000.

In foreign countries the results arising from the same cause are equally if not more striking. The number of persons who usually passed by the road between Brussels and Antwerp was 75,000 in the year; but since the railroad has been opened from the former place to Malines, it has incressed to 500,000; and since it was carried all through to Antwerp, the number has exceeded a million. The opening of a branch from Malines to Termonde, appears to have added 200,000 to the latter number; so that the passenger traffic of that railroad, superseded a road traffic of only 75,000 persons, now amounts to 1,200,000.

It is remarkable, that on this, as on most other railroads, the greatest number of passengers are those who travel short distances, being as two to one compared with those who go the whole distance. This appears from a statement read by Mr. Loch, before the Statistical Society of Manchester, showing that between April 30th and August 15th, 1836, 122,417 persons travelled the whole distance, and 244,834 short distances; chiefly to and from Malines. He further states, that "nearly one-third of the whole revenue of the railway is derived from travelling to and from Malines, and paying a fare of about 60 centimes or nearly sixpence sterling." On the same authority we learn another fact, most deserving of attention in calculating the probable success of a railway in such a country as Ireland, viz:—that nearly three-fifths of the whole revenue of the company are derived from passengers of the lower class, paying a very low fare.

The following list of railroads in the State of New York, now in successful operation, is extracted from the Governor's Message. From this list it will be perceived that there is but one line of railroad in the State exceeding 47 miles in length, to wit—the line from Albany to Auburn, which line in truth consists of four distinct companies—making together 170 miles of continuous rail-track, and which in our view of the subject completely refutes the generally entertained opinion that "railroads ought not to be extended into, or *through* cities." It is well known to the thousands who have travelled from Albany westward to Utica, Syracuse and Auburn, that rails are laid through, or across, the principal streets in most of these populous places; and that even locomotive engines are used upon them without injury, or as far as we are informed, serious inconvenience to the citizens or country people who assemble there on business, in great numbers, at particular seasons of the year.—

The railroads consist of "a continuous line of railroad from Albany to

Auburn, 170 miles; a similar line from Lockport to Lewistown and Buffalo, 47 miles; a railroad from Rochester to Batavia, 35 miles; a railroad from Schenectady to Saratoga Springs, 21 miles; a railroad from Troy to Ballston Spa., 25 miles; a railroad from New York to Harlem, 8 miles; a railroad from Brooklyn to Hicksville, on Long Island, 27 miles; a railroad from the termination of the west branch of the Chemung canal to the Tioga railroad in Pennsylvania, 14 miles; a railroad crossing the ridge between the Susquehanna at Owego and the Cayuga lake at Ithaca, 29 miles; and a railroad from the line of Massachusetts at West Stockbridge, to the city of Hudson, 30 miles. These roads have all been constructed and are managed by companies.

NEW MODE OF PRODUCING COPIES OF MEDALS AND METALIC ORNAMENTS.

A curious, and we conceive, extremely valuable discovery has been lately made by a gentleman named Spencer, of Liverpool, by which he appears to be enabled to obtain fac-simile copies in coper, of medals and other subjects in relief, by means of voltaic electricity. We have perused a paper read before the Liverpool Polytechnic Society, in which a variety of experiments are detailed relative to this discovery, some of which appear to have been highly satisfactory; whilst others not so successful have yet developed facts which may be eminently useful in directing the adaptation of this discovery to various departments of the arts.

Without following Mr. Spencer through the several experiments which he has detailed to the Society, we may state generally certain results at which he has arrived, and the means by which he has obtained them.

It appears that from a long investigation of the phenomena of electro-chemical science, Mr. Spencer perceived that voltaic electricity afforded the means of conducting copper from a solution of sulphate of copper in the voltaic battery, and depositing it in mass in its metallic state upon other metallic surfaces, placed within the range of the electric action. To render this process useful, it is necessary to bring the operation completely under command, in order that the metal deposited may be made to arrange itself in such forms as shall be conducive to the productions of works of art.

In order to effect this, attempts were made by depositing the copper, through the voltaic agency, in raised lines or ridges upon the surfaces of metal plates, which might be capable by their relief, of being employed for surface printing (as stereotype plates.) This was partially accomplished, but the most successful attempts appear to have been the production of fac-simile copies of medals.

The means adopted in this case, were two discs of sheet lead, and having the medal placed between them, were submitted to pressure, either in a stamping or rolling press, which caused the lead to take the counter impressions of the two faces of the medal, each as a matrix. In these leaden moulds, when so prepared, copper wires from the voltaic battery were inserted, and the two faces, or hollow matrixes, being then put together, and the galvanic process carried on, the copper became deposited in a few days in the mould, and ultimately filled the mould, producing eventually a mass of deposited metal in the identical shape and exact fac-simile of the original medal.

If the moulds were separately employed, of course the two faces of the medal would be obtained separately, and might after a thin coating or shell had been deposited in each, be backed or filled up by some easily fusible metal.

When copies are to be taken from bronze or other figures, it is proposed to take casts in plaster, and to coat the internal surfaces of these casts with leaf gold. Or metallic foils may be pressed on to the external surfare of the figure, and its shape so taken,—which moulds being submitted to the voltaic process, as above stated, the copper will be deposited in the exact form of the original.

It will be perceived that we have not attempted to go into any minute details of the manner of conducting this curious operation, or of explaining its extensive adaptations; we have not yet seen any of its productions, but we hope to be enabled shortly to lay before our readers further particulars of the discovery, and of its useful appropriation to many of the purposes of art to which we conceive it will be found applicable, and form a new and valuable feature in practical science.

As it may be more satisfactory to give the author's own words as to his process, we quote a portion of his paper in which he says, "In September, 1837, I was induced to try some experiments in electro-chemistry, with a single pair of plates, consisting of a small piece of zinc and an equal sized piece of copper, connected together with a wire of the latter metal. It was intended that the action should be slow; the fluids in which the metalic electrodes were immersed, were in consequence separated by a thick disc plaster of Paris. In one of the cells was sulphate of copper in solution, in the other a weak solution of common salt. I need scarcely add, that the copper electrode was placed in the cupreous solution—I was desirous that no action should take place on the wire by which the electrodes were held, together, and to attain this object I varnished it with sealing wax varnish, but in so doing I dropped a portion of the varnish on the copper that was attached."

"The operation was conducted in a glass vessel; I had, consequently, an opportunity of occasionally examining its progress, when after a lapse of a few days, metallic crystals had covered the copper electrode;—with the exception of that portion which had been spotted with varnish, I at once saw that I had it in my power to guide the metallic deposition in any shape or form I chose, by a corresponding application of varnish or other non-metallic substance."

"I had been long aware (of what every one who uses a sustaining galvanic battery with sulphate of copper in solution must know) that the copper plates acquire a coating of copper from the action of the vallens, but I had never before thought of applying it to a useful purpose."

Then follows the details of experiments, the results of some of which we have stated above, and hope to return to this subject with further particulars of the process and its achievements, on a future occasion.—***Repertory of Arts, Sciences and Manufactures.***

"A DESCRIPTION OF THE TURNBRIDGES ON THE HEREFORDSHIRE AND GLOUCESTERSHIRE CANAL."—By Stephen Ballard, A. Inst. C. E.

In taking to pieces the old turnbridges on the Herefordshire and Gloucestershire canal, the author observed that the spikes used to fix the planks down to the carriers had caused the decay of the timber; that the balance weights of stone confined in a box under the planks kept the timber very moist; that the timbers near the ground where there was not a free circulation of air, and the wood wherever it was pierced with iron, were decayed.

In the bridges now described, no spikes are used to fix down the planks, but the planks are held in their places by two flat rods extending the whole length of the planking. The author then describes in detail, by reference to the drawing accompanying the communication, the peculiar method of construction which he has adopted. The planks are five-eigths of an inch apart, so that dirt and wet may not lodge in the joints. The bridge is balanced by two stones hung at the ends of the swing poles of about 6 cwt. each. The four principal carriers are supported by three cast-iron bearers fixed to a grooved circle, which rests on cast-iron balls, running in another grooved circle. By this construction no planks are pierced with spikes; the box of stones is got rid of, and a free access of air is obtained; and the peculiar causes of destruction to which turnbridges are exposed, are it is conceived in a great measure obviated.—*Transactions of the Institution of Civil Engineers.*

RECEIPTS ON THE HARLEM RAILROAD.—Fare for passengers for

December, 1838,	\$3,819 32
do. 1839,	5,108 02

Showing an increase the last month of \$1,288 70 over the corresponding month of the previous year, equal to $33\frac{1}{3}$ per cent.

The receipts on this road for the last three years are as follows, viz:—

Fare from January 1st,	to	December 31st,		1837,	55,622 18
do.	do.	do.	do.	1838,	79,794 74
do.	do.	do.	do.	1839,	99,811 23

The increase of receipts, comparing 1838 with 1837, is \$24,172 56, or 44 per cent., and of 1839, compared with 1838, is \$20,006 49, equal to 25 per cent. increase.

This statement exhibits conclusive proof of the growing usefulness to the public, of this road.

It is in fact but the first link in the main chain of that mighty and measureless system of internal communication, which, connecting with the N. York and Albany railroad, commencing by its charter, at the termination of the Harlem railroad, and branching throughout our State, throughout New England, and to the whole interior of the Great West, will be rendering those immense inlaid communities tributary to this State and its metropolis.

It is even quite evident that railroads are destined to produce as great a revolution in the conveyance of passengers on the land, as steamboats have done on the water.

BUNNETT AND CORPE'S CONCENTRIC STEAM ENGINE.

S*ir*.—In theletter of your correspondent (Mr. Macdonald) relative to our patent Concentric Steam Engine which appeared in your last number, the conclusions he has drawn are so erroneous, that we shall feel obliged by your insertion of this in the following number.—While he admits that the result of the trials of the modes of applying the power by the tables published in your former numbers, which shows a gain of more than two to one, are correct, and might naturally have been expected, he asserts that one main feature in the case has been overlooked, viz., that the consumption of steam is equal to the power gained; this is quite at variance with the fact, as we shall endeavor to show. We have now just completed a high pressure engine on the concentric principle, the piston of which is 12 inches broad and 8 inches deep, containing 96 square inches, the crank throw is 9 inches, the stroke consequently 18 inches, the outer curve of steam chamber, an arc of a circle, 2 feet 4 inches in diameter, the inner curve 1 foot diameter. Now supposing this chamber to be completely filled with steam at each stroke, allowing for the concentric form, it would contain 1872 cubic inches. A cylinder on the vertical or horizontal principle of the same area of piston would require 1728 cubic inches to fill it, (which is the extent of the difference, as any increase of the radius of curve tends to reduce it,) just one-twelfth less than the concentric engine, whose gain of power by its direct application, as shown by the tables, he does not dispute. This is supposing that all the steam it is possible to admit, is thrown into the cylinder at each stroke of the piston, but it is admitted by most engineers that all the steam thrown into the cylinder after the piston has completed two-thirds of its stroke is useless and detrimental, by the arrangement of our slide valves, we effectually cut off the steam at two-thirds of the stroke, which cannot be effected by the present locomotive engines with the single slide, therefore taking one-third from 1872, the quantity of steam we should actually use in the concentric engine at each stroke of the piston would be 1248 cubic inches, considerably more than ¼ *less* than the present engines, to say nothing of waste by exhausting the steam in the passages, which we entirely avoid. It is, we conceive, no fault in our concentric engine, that it does not differ in principle from the best engines of the day. We have only sought by new forms and combinations to get a more direct application and consequent increase of power; how far we have succeeded, we shall shortly be enabled to show by an engine of about 10 horse power that we are erecting on our premises at Deptford, for the purpose of testing its power, consumption of fuel, etc. Pending that trial it was not our intention of troubling you or your readers with any communication on the subject, but (adopting your correspondent's words,) we are inclined to believe that the appearance of this letter may be useful at least to us, in counteracting whatever erroneous views may have been formed by the perusal of your correspondent's communication. We remain Sir, your obedient servants,

Bunnett & Corpe.

"OBSERVATIONS ON THE PRESENT MODE OF EXECUTING RAILWAYS, WITH SUGGESTIONS FOR A MORE ECONOMICAL, YET EQUALLY EFFICIENT SYSTEM, OF BOTH EXECUTING AND WORKING THEM."— By Francis Wishaw, M. Inst. C. E.

The author at the commencement of this paper alludes to the principal causes of the great differences between the original estimate and cost of railways. Among these he enumerates the imperfect knowledge of the strata, which occasions the cuttings and embankments to be formed with slopes, which are dangerous, and add to their cost—the imperfect formation of the embankments. especially in clayey soils, which in the opinion of the author ought to be carried up in layers or courses of from 1½ to 2 yards in thickness, sufficient time being allowed for subsidence before the next layer is added—the cost of stations, which in some of the great lines forms a considerable proportion of the whole cost.

The author then proceeds to suggest means for effecting a considerable saving in the original cost of railways, a certain method of preventing accidents by collision, a saving in the annual expenditure, and a better adaptation of the locomotive engine to its work.

With these views, he proposes a single line of rails—that the line should be divided with intermediate engine stations, three on the London and Birmingham for instance, the engines at each being suited to the prevailing gradient of the district. Thus a line of railway may be more easily laid out, as one or two unfavorable inclines will not affect the working of the whole. At each station there must be a small portion of an additional line of rails, and also at other convenient intervals. The mode of working such line is as follows:—Engines are to start simultaneously in each direction from the terminal and intermediate stations. These engines will pass each other at one of the portions of the double line, and the engine being reversed and taking the other train, will return to the station from whence it started, when another exchange of trains takes place. Thus there is a regular interchange of loads throughout the day, and each engine is confined to its own portion of the line, and it is impossible that a collision can take place. Equal accommodation would be afforded to the public, and the engine-man, from being always confined to the same small portion of the line, would be perfectly conversant with every part of it. The saving which would on this system be effected on the original cost is estimated at more than 5000*l* per mile.—*Trans. Ins. C. E.*

Western and Atlantic Railroad.—The committee on internal improvement in the Georgia legislature, have reported strongly in favor of the State's completing the Western and Atlantic railroad to Ross' Landing on the Tennessee river. The cost thus far to the State, has been $1,614,357. It is estimated that the work may be completed for $559,705, for which the contractors are willing to receive the State bonds in payment.

The committee also recommend the adoption of a resolution granting to the Hiwassee railroad company the privilege of extending their railroad into the territory of Georgia, with the fullest permission to said company to select their own route and point of connection with the Western and Atlantic railway. If we mistake not, a resolution was adopted at the last session of the Georgia legislature pledging the faith of the State to construct a branch connecting the two roads. The distance would be only about fifteen miles.—*Nashville, (Ten.) Banner.*

RAILWAYS.

Few works on the subject of railroads have been published, which enter so much into the necessary and important detail of the construction and management of that species of public work, than the one now before us by Lieut. Peter Lecount, R. N.

The necessity has long been felt for a well digested work upon those subjects, which the merest tyro in the profession immediately recognizes as desiderata in the usual treatises upon such subjects. The present volume, though nominally a reprint of an article in the Encyclopedia Brittianica, is much enriched by additions upon the most inportant topics. We shall from time to time give our readers selections from those portions of the work most novel in their character, and commence in the present number with an extract upon the subject of railroad accounts and statistics, together with the introduction of the work.

In treating of the construction and mode of working railways, we shall confine ourselves principally to those which are intended for the transit of passengers and goods, and which are now opening so vast a field for the improvement of the human race; an improvement, in fact, entering into all the relations between man and man, and which no one, be he ever so sanguine, can venture to fix a limit to.

From the middle of the seventeenth century various contrivances have been in use for decreasing friction on roads, particularly near the collieries in the north, such as laying down tracks of wood and stone for the wheels of wagons; it having been found that the much greater quantity of work performed by horses on these tracks, or, in other words, the less number of horses required to do a given portion of labor, more than repaid the expenses attendant on forming the tracks. These, in general, gave way to the flat or tram rail, made of iron; but the improvements were very slow, and at last were only applicable to certain circumscribed localities and materials for carriage.

Possessing little general interest, and cheifly benefiting individuals, the attention they attracted was principally confined to the parties immediately connected with them. But how different is the prospect now before us, since we have seen the magnifient creations of George Stephenson? Pack-horses are still the only mode of transit for traffic in many parts of the world; and within seventy years this was the general mode of conveyance for the carrying trade to Yorkshire and Lancashire from the west of England and Birmingham. In the year 1830, when the London and Birmingham railway was projected, the expense of constructing it was stated at six thousand pounds per mile with one line of rails, which were to be worked by horses, and warranted to go eight miles an hour; now the public are complaining of going *only* twenty miles an hour, and we have a right to expect, that at no very distant period, this velocity will at least be doubled; in fact, at the rate improvements have been advancing for the last few years, we know not where to place a limit of increase in speed.

It is of these splendid creations that we have here to speak. We shall show the method of conducting a modern railway, from its earliest commencement, through all its various stages in each department, both in and out of doors, up to the period of its final completion; and shall end by explaining the method of setting it in full operation, pointing out, in each division of the labor, those modes of proceeding which will most conduce to a satisfactory result, and marking those things which practice has shown should be avoided; collecting the contrivances and appliances which have been found useful, from whatever source they may be derived, and setting a beacon upon shipwrecks, that they may become other men's landmarks.

At page 336 he says.—" The last department which we shall describe is not the one of the least importance. It is that in which all the statistical details are wrought out; it deals in final quantities and prices, and in ratios. With the duties of this department, may be advantageously united the very essential branch of making and registering all experiments. The statistical details of railways are now becoming of such importance, that the government should undertake to publish them in a connected form. In the meantime, each company should, for their own sake, keep an exact register of them, to accompany their half-yearly reports. The Liverpool and Manchester company set an excellent example, in this respect, for several years and it is to be regretted they have not continued to issue these valuable docments, in order that the degree in which the expenses lessened as the road became consolidated, and the management of a new and unusual undertaking became better understood, might have been ascertained.

Nothing will tend more strongly to keep down the expenditure of railways than the free publication of these statistics; bad management must then become apparent, and the evil, once known, cannot fail to be remedied. It will be like the publication of the duty done by the steam engines in the Cornish mines; every one will be continually stimulated to keep pace with those companies who show themselves to be the most efficient in their business; and the relative value of the respective managers will become apparent. At present we have no statistics for long lines. This state of ignorance, it is hoped, will not continue.

Numberless experiments are yet required to determine the laws which should govern railway practice; and by far the greatest portion of these could be conducted with but little, if any expense, beyond that of a mere registration of passing facts; the value of others, again, would amply repay the outlay which would be necessary in order to make them. Railways have now been in operation eight years, yet we have no generally recognised constant quanties applicable to their daily practice; friction, cohesion, power, consumption of fuel and water, wear and tear, expense of principal and secondary stations, cost of management, and many other equally important items, are all variously stated and in part assumed; so that new undertakings are, to a great extent, laboring in the dark for want of receiving that assistance which would be in all cases beneficial to both givers and receivers.

This department should be in operation from the first commencement of the railway, and during its progress should be employed in keeping an exact account of the state of the respective works; the quantity and price of all materials used in the construction of the railway; comparing these with the estimates; comparing the work done with the time in which it ought to have been done; keeping detailed accounts of each of the articles composing the permanent way; testing all the rails as they are received, examining the merits of new inventions and improvements, and all other matters of a similar nature; but when the railway is opened, the most arduous duties will commence, and we are satisfied railway statistics will never be placed on a proper footing, till government undertakes the business, and issues out printed forms to be filled up by each company.

The statistical department should be a confidential one, and no person except the principal should be able to arrive at final results. These should embrace every branch of expenditure, and should be made out and registered every month, and printed every six months; being reduced, whenever it is possible, to the rate per passenger per mile, and per ton per mile respectively, for passengers and goods; with the reasons for any increase or decrease. This periodical statement would be a powerful incentive to economy, and at all times it would be seen, whether or not the money expended preserved its proper ratio with the work done.

The statements which should be shown by this department, would fall into two principal heads; first, the expenditure and receipts, under the head of passengers and goods, in all their details; and next, a classification of these details; those cases where the expenditure is of a general nature, being dealt with accordingly. For instance, the maintenance of the permanent way should be apportioned between the coaching and carrying departments, in the ratio of the weights carried by each of those departments and the relative velocities. The police, switchmen, gate keepers, general office establishment, rents taxes, interests on loans, &c.. should be apportioned according to the ratio of profit in each department, this ratio being taken exclusive of these items.

The details should show the expenditure in the coaching and carrying office establishments, guardes' wages, porters' wages, brakesmens' wages; expense of cartage, distinguishing horse keep; wages repairs, &c.; duty on passengers, gas, water, oil, grease, tarpaulins, ropes, slings, &c.; for, in each case, the coaching and carrying departments separately. The general office disbursements, including direction, advertising, printing, law salaries, &c.; all given separately. The maintenance of way, including engineers' and clerks' salaries, mens' wages, cost of ballast, carriage of ditto, cost of repairs to permanent way, as well as that of relaying, the cost of new articles, &c. The locomotive expenditure should be shown in coke, carriage, water, gas, wages to engine-men, firemen, laborers, and mechanics, oil, grease, waste, tools, wood, iron, brass, copper, and the nature of the repairs; which should also be shown in the coach and carrying repairs.

The number of miles travelled by the engines in each department; the number of tons of goods, gross and nett, carried one mile, classed according to the rates of carriage; the number of passengers carried one mile, the classes being distinguished; the weight of every train, the expenditure of fixed engines in detail, the cost of inclined planes, their gradients, velocity of the descent with definite weights and carriages, the flexure of rails and resistance to rolling, comparing the method by pendulum wheels with others; and, generally, every item of expenditure, under whatever class it may arise, which can lead to a comparison with that of other railways similarly circumstanced.

Having thus given every detail respecting the cost of working the line, the next step should be to classify them, so as to give the outlay per passenger and per ton per mile, under the several heads of coaching and carrying departments; the proper proportion of all the other items being placed against the coaching, or the carrying, as the case may be. It will then be desirable to give, per passenger, and per ton per mile, respectively, the cost of porterage, police, coach repairs, wagon repairs, office expenses, locomotive power, and maintenance of way; coke, repairs, wages and water, as respects the engines, being given separately, as well as collectively: and the wages, ballast, carriage, materials and tools, in the maintenance of the way, distinguished in like manner, the whole being reduced to a series of tabulated forms, so as to present at one view, all the statistical facts connected with every operation on the whole railway.

If we look back at the rapid progress which we have made in the science of locomotion during the last half-dozen years, and at the degree of comfort and accommodation, which, in conjunction with rapidity of transport, have been afforded to the public, at, in most cases, so very moderate a cost, the strides by which we have attained our present advanced position, are certainly sufficiently gigantic; but if we look forward, it requires but little of the gift of divination to perceive, that in a very few years more, a still greater change will take place, more particularly in the essential article of comfort. In a mode of transit so essentially new, and in which all our previous machines and appliances had to be completely reorganized, and numerous inventions of almost every kind were to be produced at a moment's call, to meet the various difficulties and wants which were continually arising out of such a novel mode of conducting the business of travelling in what may be called the wholesale way, it has been singularly fortunate, that in almost every instance, the various railway companies have kept on the safe side, that is to say, they have not done too much. They have erred on the best side they could commit an error on; they have been too cautious. It seems as if it required a certain time merely to travel at twenty miles an hour, and let the mind sober down a little before much else could be attempted. This feeling may now be rapidly expected to give way, and we shall find that as confidence is acquired, all the requisite arrangements will become consolidated in much more perfect and improved forms.

There is nothing now which ought to be more attended to by railway companies, than keeping their fares down; and this has in most instances been very much neglected. When parties possess such a complete monopoly as a railway, they should be particularly careful not to show it.—

The expenses in many instances are certainly very great, and the companies have much to suffer in their progress through Parliamen, and the rough grinding they have generally received from the rapaciousness of landowners. Accidents, too, must happen, estimates will be exceeded, and these sources of expenditure must be met by a corresponding rate of price; but when the railways are made, the feeling seems to be too general among some of these proprietors, that this is the moment for making reprisals upon the public for all losses, vexations, mishaps and mistakes.

In some cases railways have charged more for the carriage of passengers than the stages or mails did, trusting to beat them on the question of time only. In fact the receipts are great; a certain sum must be set aside for a good dividend, and the rest is to be spent somehow or other. The same thing is observable in the statistics of the road trusts, many of them largely in debt, yet spending their money on fancied improvements, instead of getting out of debt, and then lowering the tolls.

The effect of this on travelling is fully shown in the report of the Irish Railway Commission. For instance, the travellers from Brussels to Antwerp by railway in the year 1836 were 872,893, whereas those on the Liverpool and Manchester railway for the same year were only 522,991, being the largest number for any year since the opening. Now, the population of Brussels, Antwerp and Mechlin was 209,200, while that of Liverpool, Manchester and Warrington was 586,812, considerably more than double, or the ratio of population was as 2·327 to 1, while that of the travelling was only as ·599 to 1. We must seek for the solution of this problem in the respective fares of the two companies. In the Liverpool and Manchester railway, Mr. Pambour states, that there are 13 first-class trains to 16 second class: and as the last class hold most passengers, suppose we omit the mails, and say $\frac{13 \times 5{\cdot}5\text{s.} + 16 \times 4\text{s.}}{29} = \frac{135{\cdot}5}{29} = 4{\cdot}6724$ shillings, the average fare. We have no means of ascertaining the numbers on the Brussels railway, but if we take the dearest and cheapest, and compare them in the same ratio as we did the others, we shall have $\frac{3{\cdot}50 \times 13 + 1{\cdot}20 \times 16}{29} =$ $\frac{64{\cdot}70}{29} =$ 2 francs 23 cents per passenger on the average, or about 1·784 shillings, or 4s. 8d. in the one case, and 1s. $9\frac{1}{4}$d. in the other, or, allowing for the value of money in the two countries, about double the price; and this double price is accompanied with only one-fourth of the travelling, the ratio of population to that of travelling being very nearly 4 to 1. A still stronger case is that of the Paisley canal, were the fly-boat fare is 1d. per mile. Here, with a population of 262,725, the passengers in 1835 were 373,290, while in the same year, with a population of 486,812, the Liverpool and Manchester railway had only 473,849 passengers. The railway company from Paris to St. Germain's has tried the experiment of low prices with complete success; their greatest reduction of fares was at the station of Nanterre, where they were lowered from $7\frac{1}{2}$d. to 5d. and the result was, that 12 days, ending the 4th December, 1838, at the low fares, compared with 12 days ending November 22, at the high ones, showed an increase of 839 passengers; and although the diminution in price was 34 per cent., the increase in the amount received was $16\frac{1}{2}$ per cent. We therefore strongly recommend that fares should be moderate, or it will form the best plea in the world for the establishment of competing lines; and it should be remembered that railways will to a certain extent drive vans and waggons off the road, which were the ordinary vehicles for the travelling poor, and they ought to have a substitute if it were merely an open box without seats. Soldiers are generally conveyed at 1d. each per mile, and their baggage at 3d. per ton per mile; this is less than half what is charged on some railways in second-class carriages.

The annexed extract shows the difference in the cost of railroads in England and in this Country.

Lieut. Lecount says, that "Railways with two lines of rails in very favorable situations have been completed for 10,000*l.* per mile in England. This, however, must be taken as the exception, and not as the rule. Under very unfavorable circumstances they have cost 50,000*l.* per mile; and of course there will be found an expense per mile at all differences between these two, which may fairly be taken as the extreme limits. Now it is certain, that with a line 80 miles in length, a traffic of 75 tons of goods per day each way, or with 35 tons of goods and 60 passengers per day each way, the railway, if even constructed for 12,000*l.* per mile, which will rarely happen, would not afford a dividend of more than a quarter per cent., and (our numbers throughout meaning daily each way) it would require 100 tons of goods, or 160 passengers, or 50 tons of goods and 80 passengers, to pay 1 per cent.; 125 tons of goods, or 200 passengers, or 62 tons of goods and 100 passengers, would but little exceed $1\frac{3}{4}$ per cent.; and it would take 200 tons of goods, or 320 passengers, or 100 tons of goods with 160 passengers, to pay $4\frac{1}{4}$ per cent.

The Americans have such facilities for these constructions, that 1600 miles of railroad have been made in that country, (a good deal of it, however, being only single line.) at an average cost of only 5081*l.* per mile; whereas in England the mere permanent way alone would amount to 4400*l.* per mile, if the rails were 45 lbs. to the yard, and laid upon longitudinal timbers; 4900*l.* per mile, with rails 42 lbs. per yard, having chairs and cast iron supports between them, on longitudinal timbers;—5300*l.* per mile, with rails 42 lbs. per yard, on blocks 3 feet apart; 4,800*l.* per mile, with the same sized rails on wooden sleepers; 5600*l.* per mile for 62 lb. rails, on blocks 4 feet apart, and 5100*l.* for the same rails on wooden sleepers; 6000*l.* per mile for rails of 75 lb. per yard on blocks 5 feet apart, and 5500*l.* per mile for the same on sleepers. These prices do not include laying the way, ballasting and draining. Thus we see that the mere cost of the permanent way in this country, averaging 5200*l.* per mile, exceeds that of the whole expense of a complete railway in America; and 75 lb. rails on blocks and sleepers, including laying, ballasting, sidings turnplates and every expense, has exceeded 8000*l.* per mile.

(To be continued.)

THE HONORABLE EAST INDIA COMPANY'S STEAM SHIP, THE "QUEEN."

The fine vessel, which is of the same class as the government steamers, Medea Phœnix, Salamander, and Rhadamanthus, was built at Limehouse by Messrs. Curling and Young, the celebrated builders of the British Queen and President, and fitted with a pair of engines of 110 horse power each, by Messrs. Seaward & Co., of the Canal Iron Works. She is furnished with Hall's patent condensers, with apparatus for supplying the boilers with distilled water to make good the waste. The slides are of Messrs. Seaward's patent. The armament consists of four 32 pounders, besides two long guns of 8 inch calibre, one forward and the other aft, intended to carry hollow shot; they move upon slides and fixed pivots, which enables them to take a much wider range than the ordinary carriage can give.

The following are the principal dimensions of her hull and machinery:

Length between the perpendiculars,	173 feet.
Breadth within the paddle boxes,	31 "
Breadth over all,	40 "
Depth of hold,	19 ft. 6 in.
Builder's Tonnage,	$766\frac{83}{94}$ tons.
Weight of the hull	511 "
Diameter of the cylinders,	56 inches.
Stroke of the pistons,	5 feet.
Diameter of the air pump,	28 inches.
Length of stroke,	2 ft. 6 in.
Area of the steam passages into the cylinders,	60 square inches.
Area of the education passages,	95 "
Number of tubes, 6 ft. long and ½ inch diameter in the two condensers,	2500 "
Diameter of paddle wheels,	22 feet.
Length of the floats,	8 "
Depth of the outer board,	10 inches.
Depth of the inner,	12 "
Advance of the outer board before the inner one,	8 "
Number of pairs of floats on each wheel,	20 "
Number of boilers,	2
Number of furnaces,	6
Length of boilers,	14 feet.
Breadth of the two boilers,	21 ft. 6 inches.
Weight of the engines,	220 tons.
Weight of the boilers,	42 "
Weight of the water they contain when filled,	30 "
Weight of the coal carried,	240 "
Which at 16 tons per diem is sufficient for	15 days.

On Thursday the 24th ult. the "Queen," with a party of naval and scientific gentlemen on board, made an experimental trip from Blackwall down the river as far as Greenhithe. When she was got under way, we perceived that the *Archimedes*, which was lying a little farther down the river, had her steam up, and was ready for a run. Accordingly, as soon as we were nearly on her quarter, she started, and the two vessels maintained nearly the same relative positions for some time, until we stopped to take a party on board, when the *Archimedes* shot a-head, and as she drew about 5 feet less water than the *Queen*, she was enabled to keep nearer in shore, so as not to feel the full influence of the tide. Notwithstanding this advantage the *Archimedes* did not seem to gain upon us, by which we judge her speed *through the water* to have been rather less, or at least not more than ours. The *Archimedes* returned without having proceeded so far as Erith, or having ascertained her rate through the water; but, by comparison with the speed of the *Queen*, as found at the measured mile in Long reach, we should suppose it to have been about 9½ statute miles an hour. As she passed us on her return she fired a salute of two guns, we suppose in token of victory. We then proceeded to Long reach, where we noticed the time of running a mile, first against both wind and tide, then with both in favor. The results were as follows:

Time of running the mile against the tide	9′3″
Time of running the mile with the tide	4′44″

whence we deduce the speed of the vessel over the ground.

Against the tide,	6.32 miles
With the tide,	12.68 "
Mean speed, independent of the tide,	9.5 "

The number of revolutions of the wheels per minute, with wind and tide in favor, was $19\frac{1}{2}$—against wind and tide, $18\frac{1}{2}$, which shows that the difference of speed *through the water* must have been *more than* half a mile an hour.

The mean draught of water was about 14 feet 6 inches, and the dip of the floats 3 feet 9 inches; but, as the ship had "a list to starboard," the dip of the larboard wheel was a little less, and that of the starboard wheel a little more than the above; which accounts for the fact, that the back-water from the latter was rather considerable, while there was nothing but a slight fall of spray from the former, through which the wheel was distinctly seen.

The pressure in the boiler before the experiment, was 5 lbs. on the square inch, but just before we arrived at the measured mile, it had fallen to $4\frac{7}{8}$ lbs. The gauge on the starboard condenser marked $29\frac{3}{16}$ inches of mercury, and that on the larboard condenser $29\frac{11}{16}$; the oscillations were seldom greater than $\frac{1}{8}$ of an inch, sometimes even less. The motion of the engines was during the whole trip remarkably smooth and regular.

Having finished the above experiments, we were summoned to an elegant and substantial cold collation, which had been prepared by our hospitable entertainers, the Messrs. Seaward, and the day passed very agreeably, in spite of the weather, which was by no means such as to enhance the pleasure of an excursion by water.

ON STEAM BOILERS AND STEAM ENGINES.—By Josiah Parkes, M. Inst C. E.

In a preceding communication the author had treated of the amount of evaporation in different kinds of boilers in common use: in the present, he treats of their peculiar and relative merits as evaporative vessels; the laws which regulate the amount of evaporation for assigned heated surfaces; and the practical rules whereby the performance of boilers may be tested. The water evaporated and fuel consumed, had been tabulated in the previous communication; the author now gives the dimensions of the several boilers—the area of the grates—the area of heat-absorbing surfaces, and the rates of combustion and evaporation. The connexion of the boiler with the engine as regards the proportion of boiler to engine power, is reserved for consideration in a subsequent communication; the attention is now confined to the influence of the proportions of the parts on the performance of boilers for a given weight of coal. Evaporation may be considered as the measure of the useful effect obtained from any weight of fuel, or, together with the duty done by an engine, the measure of the useful effect of a given weight of water in the shape of steam. The author insists on the importance of ascertaining with accuracy the weight of the water, which in the shape of steam has passed through the cylinder of an engine. The weight of water, or quantity of steam, requisite for producing a given effect or duty, was the subject of continual research by Smeaton; and the basis of Watt's discoveries.

The author being led to make observations on evaporation twenty years ago, soon perceived that the completeness and rate of combustion, the proportion of the grates to the combustion effected upon them and to the whole heat-absorbing surface, were important elements in evaporative economy. These elements, in the author's own experiments at Warwick, where slow combustion was pushed to nearly its furthest limit—in those of Smeaton at Long Benton—of Rennie and Watt at the Albion Mills—of M. de Pambour on the locomotive engine, in which intensity of combustion and evaporative power are at their highest limits—of Nicholas Wood on the Killingworth engine—and of Mr. Henwood, and others, on the Cornish boiler—are the data for the analysis of the evaporative effects; the true causes of which in the several experiments, the author now attempts to develope. The authentic facts here recorded of the working of boilers and engines of established credit and notoriety, will enable the employer of any boiler or engine to compare his practice with specimens of acknowledged and well-attested merit.

The results derived from the above data are arranged in a tabular form, so as to exhibit at once the relation which any one property and the several parts of the boiler bear to any other, and to the effects produced, the amount and activity of the combustion (to which the author assigns the term *calorific forces,*) and the modifications it experiences by the structure and disposition of the several parts.

There are also certain quantities and relations which exert a peculiar influence over the results, which, being rightly ascertained, are exponential or indicative of the practice of each particular boiler; these Mr. Parkes calls the *exponents* of that boiler, and are as follows:—

The quantity of coal burnt under a boiler in a given time,—the quantity burnt on each square foot of grate per hour,—the quantity of water evaporated per square foot of heated surface—and the number of pounds of water evaporated by a given quantity of coal. Besides this, the influence of *time*, that is, the time of duration of any given portion of heat about a boiler, and about equal areas of surface, demands our most attentive consideration, and is especially treated of at the close of the paper. It appears most distinctly, that the boilers tested as to their merit by their respective evaporative economy, arrange themselves in the inverse order of the rate of combustion—the Cornish boiler being greatly superior to all the others when tested in this manner, as well as also as in respect of time is selected as the standard of comparison, whereby to mark the scale of descent from the highest point of excellence yet attained in evaporative economy. For this purpose, then, the Cornish results are considered as unity.

The value of the exponents for the Cornish, Wagon and Locomotive boiler respectively, are collected together in the following table, which will serve to show at one glance the respective values of the boilers on this comparison.

Boiler.	lbs.				
Cornish	1·0.	of Coal burnt under one boiler		in 44·08.	seconds.
Wagon	1·0.	of ditto	ditto	in 16·57.	ditto.
Locomotive	1·0.	of Coke	ditto	in 6·45.	ditto.
Cornish	3·4.	of Coal burnt on each square foot of grate per hour.			
Wagon	10·7.	ditto	ditto		
Locomotive	79 3.	of Coke	ditto		
Cornish	1·0.	of Water evaporated by 1 square foot of heated surface per hour from 212°.			
Wagon	7·1.	ditto	ditto		
Locomotive	12 0.	ditto	ditto		
Cornish	11·8.	of Water evaporated by 1 lb. of coal from 212°.			
Wagon	8·8.	ditto	ditto		
Locomotive	7·2.	ditto	1 lb. of Coke,	ditto	
Locomotive	5·4.	ditto	1 lb. of Coal,	ditto	

The Cornish boiler possesses some peculiar advantages, both as regards structure and the practice of slow combustion, since, by the former, great strength is attained, and, by the latter, time is given for the complete combination of air with the heated fuel, for the transmission of heat through the metal, and for the escape of the steam through the water. The plates of the Cornish boiler are usually $\frac{1}{2}$ an inch thick, whereas those of a low pressure boiler are usually one fourth to five sixteenths of an inch thick; thus a much larger extent of surface is necessary to transmit a given quantity of heat in a given time in the former than in the latter case. The Cornish engineers allow seven times as much surface as in the general wagon boiler practice, for the evaporation of equal weights of water in equal times, and twelve times as much as in the locomotive; from which there is a gain of from 30 to 40 per cent. in the former, and of 64 with coke and 100 with coal in the latter case.

The wagon boiler has great disadvantages of structure, being ill adapted to resist internal pressure, liable to collapse, and greatly affected by incrustation. According to the above table, which exhibits the mean of eight experiments, the combustion is $2\frac{1}{2}$ times more rapid per boiler, and 3 times more rapid per square foot of grate per hour, and the rate of evaporation is 7 times greater than in the Cornish. The loss of heat, the Cornish being unity, is $24\frac{1}{2}$ per cent.

The construction of the locomotive boiler is so very different from that of every other species of evaporative vessel, that no strict analogy can be drawn betwixt it and any other. From the above practical results it appears, that the rate of combustion per boilor is nearly 7 times, and per square foot of grate per hour 23 times more rapid—that the rate of evaporation from equal surfaces 12 times more rapid than the Cornish boiler—the loss of heat, the Cornish being unity, 51 per cent.

The author discusses at length the varying circumstances connected with different boilers, and the corresponding influence on the above results, and particularly the system of management by which he was enabled with a wagon boiler to approach the Cornish results. The table accompanying this paper will frequently enable the intelligent employer of a boiler to ascertain the best proportion of parts, and the best practice. For, having decided on the quantity of steam he requires, he knows the quantity of fuel which will generate it if he adopts the measures of surface and proportions of parts, which have given relative effects; or he can ascertain whether his present practice be good or defective. Notwithstanding the great stride which has been made in the economy of fuel by the Cornish engineers, the sources of waste are still great, and we may hope for great advances in evaporative economy, when combustion as a science and practical art has received the attention which it merits.—*Trans. Ins. C. E.*

THE ARCHIMEDES STEAM VESSEL.

Our readers will probably recollect that the *Archimedes*, a remarkably fine formed vessel of 230 (?) tons burden, fitted with a pair of engines, of 45 horse power each, manufactured by Messrs. Rennie, and the screw propeller, as applied by Mr. Smith, was first tried early last summer, and that the experiments were suspended, in consequence of the unfortunate bursting of one of the boilers. At that time the screw consisted of one whole turn of a single thread, 7 feet in diameter, and 8 feet pitch. The boilers have now been replaced by two new ones, manufactured by Messrs. Miller and

Ravenhill; and at the same time a modification has been introduced in the form of the propeller. It consists now of two half turns of a thread, 5 feet 9 inches in diameter, and 10 feet pitch, placed diametrically opposite to each other on the propeller shaft, so as to occupy a space of only 5 feet in the length of the vessel.

These alterations being completed, an experimental trip was made down the river to Gravesend, on Monday, the 4th ult., and the result was considered highly satisfactory. We regret that we were unable to be present, as we can, therefore, only speak from information we have collected since.

We understand that she run from Gravesend to London bridge, a distance of 28 to 30 miles, which was accomplished in two hours, both wind and tide being favorable. No conclusion can, however, be drawn from this result, respecting the comparative performance, on account of the co-operation of the wind and tide; but the mean speed of the vessel through the water was ascertained during the trip, by noting the time in which she ran a mile, first with, and afterwards against the tide.

The results of the experiment were the following:—

Time of running the mile with the tide,	4′32″
Number of revolutions of the engine shaft *per minute*,	22
The speed over the ground was, therefore, *per hour*,	13.2 miles.
Time of running the mile against the tide	9′5″
Number of revolutions of the engine shaft,	23
Speed over the ground	6.6 miles.
The mean speed through the water was thus	9.9 "

The mean number of revolutions of the engine shaft was 22½ per minute which, multiplied by 5⅓ (which Mr. Smith informs us is the multiplying power of the wheel work, which communicates the motion from the engine shaft to the propeller), gives 120 for the number of revolutions of the screw per minute. If the screw were moving through a solid body, it would advance the length of its pitch in each revolution, or 1200 feet per minute, which is the same as 13.6 miles an hour; but since the vessel, and consequently also the screw only advanced at the rate of 9.9 miles an hour, there must have been a recession of the screw through the water, in the direction of the shaft, equal to 3.7 miles an hour. The proportion of the available power of the engines effectively employed in propelling the vessel was, therefore, 72.7 per cent., the remaining 27.3 per cent. being expended in obtaining the necessary resistance to the propeller.

Mr. Hearapath, in his report in the Railway Magazine for the 19th October, has committed an error of 1.1 mile an hour to the disadvantage of the performance, in consequence of taking the mean time of running a mile, and finding the corresponding speed, instead of taking the mean of the speeds with and against the tide. We believe the latter to be the method usually followed; but, in case there may be any doubt as to its correctness, it is easily demonstrated thus.

The speed with the tide is equal to the velocity of the vessel through the water (which is required to be determined,) added to the velocity of the tide which is an indeterminate quantity. Also the speed against the tide is equal to the velocity through the water, diminished by the velocity of the tide. If, therefore, we call the former V and the latter v, we shall have

$$\text{Speed with the tide} = V + v$$
$$\text{Speed against the tide} = V - v.$$

By adding these two quantities together, v is eliminated, and we find that the speed with the tide, added to the speed against the tide, is equal to twice the speed through the water.—*Trans. Inst. C. E.*

AMERICAN
RAILROAD JOURNAL,
AND
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In last No. of "Fulton," page 41, 26th line from top, for "1835," the date of the completion of the Erie Canal, read 1825.

INSTITUTION OF CIVIL ENGINEERS.

Feeling as we do, a deep interest in the formation of an American Society of Civil Engineers, we have always warmly seconded any endeavors to bring about a successful organization of the profession in this country. It has been with us a favorite topic, and in our intercourse with the members of the profession, we have been frequently urged to move in the matter.

During a tour through several neighboring States, we had received so many solicitations to represent the united opinion of a large number of Engineers, as to the necessity for a concert of action throughout the profession, an embodiment of the whole information on subjects connected with Civil Engineering, and a means of occasional but free inter-communication—the true and legitimate objects of a Society of Engineers—that we had resolved to give as far as it was in our power, a view of the desiderata for such an organization, with a *proposed* outline of a constitution, which should be in fact an adaptation of the constitution of the English Institute, to our more extensive country. It was urged that such a measure was necessary to the elevation of the professional standard in the United States; and that being in communication with a large number of Civil Engineers, we could more conveniently obtain an expression of their opinions.

While taking the preliminary steps we, received intelligence of a meeting which proposed a convention for this very purpose. Of course we made no further move in the matter, than to publish the official proceedings of this convention and its committees. We must confess that a convention has always appeared a questionable mode of obtaining a satisfactory organization. Many individuals, who from various circumstances might be prevented from attending, and yet who entertained opinions from which valuable hints might be obtained, are thus excluded from taking a part in any organization which might take place, and would feel a natural indifference towards making any further effort to introduce rules and regulations which they might consider absolutely necessary. Besides this, the effort to connect with institutions already established immediately introduced feelings of party spirit, which should have no place in the formation of a society of Engineers, and which belonged only to those preexisting institutions. Many thought that the Civil Engineers of the United States, thus organized, would become in fact a mere section of some local society. These notions, whether incorrect or not, undoubtedly had an influence.

We had hoped however, that these preliminary difficulties might be avoided, and the project prove successful. Such however, has not been the case. The official reports of proceedings have hitherto been published in this Journal, but although the result was known, we have not, until just now received the official announcement of the non-adoption of the proposed constitution, and consequent termination of all action.

We give, (page 81,) a communication from Mr. Miller, with the final correspondence.

From a perusal of them, we are satisfied that many of the gentlemen dissenting from the proposed constitution, are warmly in favor of an efficient organization, and would willingly unite on the common ground of the improvement of the profession.

Before concluding, we must remark, that there appears to be a mistake as to some of the objects proposed. Although a library, and collection of maps, models, etc , are very desirable, yet at first they are not attainable, and are not therefore to be made prime objects. A much more useful and far more practicable object, is to obtain a concentration of the influence and information of the profession, together with a concert of action. What we want first of all, is, an investigation into the improvement system, as modified by our peculiar circumstances in a national point of view; descriptions and details of individual works; statistics of works in operation; the elements of a judicious, economical and safe system of management of railroads, canals and steamboats, upon which subjects the opinion of an intelligent body of engineers would have the greatest weight, as a basis for legislative action when necessary, but which would go far to do away with any such necessity; and lastly the cultivation of science in all its bearings upon Civil Engineering, in which we doubt not, the members of the profession in the United States are fully able to co-operate with their transatlantic brethren.

These are the ends to be kept in view, and yet to be accomplished with ease, if properly taken up. It is not necessary nor is it practicable that every member shall at any one time be in personal attendance although this occasionally is desirable and not difficult of execution. Members can appear by their communications and receive the benefit of all that is offered without personal attendance.

We give place with great pleasure to the communication of Mr. Miller, and invite attention to the subject with the hope that we shall receive many other communications on the subject, which we shall as cheerfully insert.

For the American Railroad Journal and Mechanics' Magazine.

INTERNAL IMPROVEMENTS OF NEW YORK. NO. 2.

Facts sufficient were adduced in the last number to demonstrate that the enlargement of the Erie canal to the size proposed is not required to accommodate any possible increase in the tonnage passing upon it for some years to come. It was there shown that the business on the western portion of the canal has thus far fallen far short of its capacity.

It was also shown that the revenue from the whole canal had not, up to the date of the last report of the comptroller, been more than sufficient to defray the interest on its cost, together with the expense of repairs and superintendence. This being true of the whole canal, it requires no labored demonstration to show that its western portion is yet *very deeply* in debt to the State for its construction and maintenance, and in this respect is in the same predicament with the lateral canals. Upon the eastern portion, although at one period the business was nearly equal to the ability of the canal with single locks to accommodate, yet as the ratio of decrease in the products of the forest has far exceeded and is likely to exceed for some years that of the increase in the products of agriculture, there is no positive necessity for an enlargement, to accommodate the business that is likely to pass upon it. The correctness of this view of the subject is farther confirmed by the effect which the completion of the line of railway from the Hudson to the Lakes particularly that extending from Albany to Buffalo, will have upon the business of the canal.

The distance from Albany to Buffalo by the canal is	363	miles
By the several lines of railway as chartered it is	320	"
Difference in favor of railway,	43	"

From Albany to Auburn 174 miles, and from Rochester to Batavia 30 miles, making in all 204 miles, the line of railway is completed, and in operation. Of the remaining 116 miles, 78 are under contract, and the remainder will ere long be constructed. The period is therefore, very near at hand, when there will exist a continuous line of railway from the Hudson to Lake Erie parallel with, and for most of the distance situated in the immediate vicinity of the Erie canal.

The effect of the railway thus far has been to drive the packet boats from the canal and to give by the consequent diminution of lockages a relief to the canal fully equivalent to about 30 per cent. of the agricultural products, which, together with the rapid decline in the product of the forest, already explained, will place the period when the canal shall be doing business to the extent of its capacity, still more remote than was stated in my last number

Previous to the construction of the railway the *line* boats, as they are termed, conveyed a great many passengers, and were provided with cabins for their accommodation. This branch of the business is becoming less profitable, and hence more boats in proportion are constructed after the plan of what are termed the *lake* boats, which are designed for the transportation of freight only. The effect of this change is to enable a less number of boats to convey a greater amount of tonnage, and thus diminish relatively the number of lockages. The locks being the only points where any obstruction exists upon the canal, a very great relief is reasonably anticipated from this cause. Much relief may also be expected from another source. The portion of the product of the forest which obstructs most the navigation, viz. the round and square timber which is conveyed in rafts or floats, is the portion which, in the great falling off in that branch of transportation, will probably most rapidly diminish. If in addition to this, a diminution be made in the tolls upon lumber, the rates being less at that season, viz. in midsummer, when the canal is the least crowded, the transportation of that article may be so regulated as to accommodate other articles requiring a more speedy transit, and at the same time add materially to the capacity of the canal.

That there is a very considerable difference in the transportation upon the canal at different periods of the navigable season there is no doubt. It is certainly desirable to afford every facility for the expeditious conveyance of freight to market. But there is no doubt that by a proper arrangement of the tolls, sufficient inducements may be offered to those interested to alter the periods of transportation of particular articles in such a way as to greatly equalize the business of the canal. Without, however, any such arrangements, there is reason to believe that any extraordinary increase in pressure in the business will be relieved by the line of railway already described.

It is true, indeed, that the legislature in the plenitude of its wisdom has prohibited the transportation of freight on a portion of the line of railroad from Albany to Buffalo, and on other portions exacts a tribute, equivalent to what the State would have received had the freight passed upon the canal. Assuming this policy to be based upon principles which are correct in the abstract, (which is far from being conceded,) there is no good reason why the restrictions may not be removed at those times, when the canal is incompetent to do the business that may be thrown upon it. Such an arrangement would afford great relief to the canal in times of pressure should such times ever occur, and if not found adequate, it is easy to show it to be for the interest of the State, and of all concerned, to *give* to the railroad companies whatever is necessary to induce them to undertake the transportation, rather than incur the enormous expense of the enlargement.

The dimensions of the Erie canal as stated in the previous communication are 40 ft. width at surface and 4 ft. in depth. From information derived from those who navigate it, there are portions of it which do not exceed 3 to 3½ ft. This is owing to the locks not having been excavated to the proper depth in the first instance, or to the subsequent accumulation of mud in the canal or perhaps to both causes combined. As to the fact of an insufficient depth at particular points there appears to be no doubt, and can only be attributed to unfaithfulness on the part of the original contractors, or to the remissness of the superintendents. This deficiency in the depth, is sufficient to make considerable difference in the capacity of the canal so long as there are portions, however limited in extent where the depth does not exceed 3 to 3½ feet, the depth of draught and consequent load of the boats must correspond thereto, even if the remaining portions have a depth fully equal to or greater than the standard of four feet. For boats of the kind now used in navigating the Erie canal an increase in the load of about 16 tons produces an addition to the depth of draught of about six inches. By giving to the canal a uniform depth of water equal to what was contemplated viz. 4 feet, which may unquestionably be done without great expense, it is easy to perceive that its capacity for business will be much augmented. By this improvement alone the increase in its capacity may safely be estimated at 25 per cent. The capacity of a canal to accommodate the business of a country is limited when the speed of the boats and time of passing the locks are given :—

1. By the depth of its channel.
2. The length and breadth of its lock chambers.
3. By the number of locks.

The length of the lock chambers as already stated on the Erie Canal, is 90 feet. The boats average about 75 or 80 feet in length. By adding to the length of the chambers 15 or 20 feet, which might easily be done without disturbing the present walls or the foundation of the locks, the boats may be lengthened the same amount, and their tonnage increased in the same proportion, giving to the canal a capacity one fifth greater than it now possesses. Upon those portions also where the pressure of business is the greatest, additional locks, if required, could be constructed which when the improvement is made at all necessary points, would, with the other improvements mentioned above, give to the canal a capacity sufficient to accommodate two and a half to three times the amount of trade now conveyed upon it. These improvements could have been made gradually without interfering with the navigation and might have been embraced in the ordinary course of repairs, without necessarily increasing very much the annual expenditures for that object, and thus have left to the State a nett annual revenue to be applied to other objects of undoubted utility of more than half a million of dollars.

As a farther evidence that the canal is not yet doing business to the extent of its capacity, it may be remarked that in prosecuting its enlargement thus far, most of the labor expended upon it has been directed to the erection of the mechanical structures—the materials for which, comprising timber and stone to a great amount, are in almost every instance transported for a greater or less distance on the canal. This great increase in the transportation, which of course is temporary, has caused no sensible inconvenience or obstruction to the navigation, and affords conclusive evidence that when the imperfections in the navigation above described and remedied the canal will afford abundant accommodation to the business for some time to come.

The remarks thus far made in relation to the probable future business of the canal, have reference more particularly to the trade between the seaboard and the interior. There is another branch of business not the less important, which increases with the population and the development of the internal resources of the State. This is the internal trade of the canal consisting of the interchange of commodities between the several districts through which the canal passes. The canal, stretching as it does through a region of country of more than 300 miles in extent, the different portions of which are characterized by a great difference in soil and climate and in agricultural, mineral and manufacturing resources, there naturally exists an interchange of those productions of each, constituting an extensive internal traffic which will continue to increase. Making, however, all due allowances for the future increase in this branch of business and allowing also for the increase and decrease from the other sources and causes mentioned, we are forced to the conclusion that very many years will elapse particularly if the canal is improved as suggested, before it will be crowded with business to the extent of its capacity.

So far, therefore, as the plea for the enlargement to the great dimensions proposed of 70 feet width and 7 feet depth, and the necessity of expending from 30 to 40 millions of dollars to effect it, is based upon the inadequacy of the canal to accommodate the anticipate dtrade upon it, it has no foundation in fact. How far this vast expenditure is warranted by the other reason which has been assigned in a reduction in the cost of transportation is a question which we shall endeavor to answer in the next number.

FULTON.

For the American Railroad Journal and Mechanics' Magazine.

REMARKS ON THE ABSTRACT OF DR. LARDNERS PAPER "ON RAILWAY CONSTANTS, ETC.," PUBLISHED IN THE CIVIL ENGINEERS AND ARCHITECT'S JOURNAL FOR OCTOBER, 1839.—By W. R. Casey, Civil Engineer.

Dr. Lardner has made a series of experiments to determine the amount of resistance offered to railway trains by the atmosphere, as well as the value of the "friction," the two resistances forming what has generally been called in this country, the "traction." His conclusions are precisely those of Mr. Wood, which Mr. Brunel considered impossible and against which he urged several objections which went to show the incorrectness of Mr. Wood s deductions as well as the little reliance to be placed in his experiiments, rather than to point out where the error lay. An attentive perusal of Dr. Lardner's paper led me to examine Mr. Wood's statements and Mr. Brunel's objections more closely, and, though Mr. Brunel failed to point out the grand source of error, it appears to me, that the late experiments of Dr. Lardner fully confirm the views of Mr. Brunel and other practical engineers, and offer abundant proof of the utter fallacy of nearly all his own deductions as well as those of Mr. Wood. In all these papers the experiments are detailed with great minuteness, but the opinions of the writers are given unaccompanied by the reasoning or calculations by which they arrived at these conclusions, so that to decide on their merits we are under the necessity of going through a formal investigation ourselves, instead of merely following them and judging of the accuracy of their mode of calculation.

We will commence with the grand error of Dr. Lardner and Mr. Wood. The latter gentleman states in his Report:—

"The force exerted by 15 6-10ths tons down an inclination of 1 in 96 is equivalent to 364 pounds, and as this was the weight of the train in the first experiments, it follows that such a coach train moving at 31 miles an hour suffers a resistance of that amount, which includes both friction and atmospheric resistance.

Again, the force exerted by 18 ton 1 cwt. down the same inclination is 421 12 pounds, and as the train having this weight moved with a uniform velocity of 32 1-4 miles an hour down the plane, this was its resistance at that speed."

Dr Lardner says:—

"The last experiment with a train of eight coaches, weighing nearly forty tons, shows that, in a dead calm, the resistance of *that train at* 31½ *miles an hour amounted to the eighty-ninth part of its weight; whereas the common estimate of the resistance of such a train at that speed has been hitherto about the* 250*th part of its weight!* This fact alone, were it unconnected with any others, would sufficiently illustrate the enormous extent of error which has prevailed hitherto in such estimations in railway practice."

Neglecting the difference between the length and base of the inclined plane under consideration as insignificant in its effects, nothing can be more true than, that the ratio of the length of the plane to its altitude represents strictly the ratio of the weight of a body on this plane to the force with which gravity urges or rather draws it down the plane. Consequently a body on a plane whose length is to its altitude as 89 to 1 will (omitting friction) be held in equilibrio with gravity on that plane by a force equal to the 1-89 o its weight—in other words, the force down the plane is equal to the resistance, and both are equal to 1-89 of the weight of the body left free to the force which gravity is able to exert on an inclination of 1-89.

Now, what is the result of gravity in the experiment just quoted from Dr. Lardner's paper? The force of gravity on an inclined plane of 1-89 or, which is the same thing, the 1-89th part of the weight of the 8 coaches (40.75 tons) *generates and keeps up a velocity of* 31-4 *miles per hour*, overcomes the friction and the resistance of the atmosphere. Dr Lardner and Mr. Wood consider the entire force of gravity to be expended in counteracting the two latter resistances, and entirely overlook that portion of the force or of the height of the plane which generates and keeps up the velocity. Suppose at the foot of the plane of 1-89 another plane inclined in the opposite direction, then the train of coaches descending with a velocity of 31-4 miles per hour would ascend this second plane till the momentum derived from the first plane was destroyed by the counteracting force of gravity on the second, and it is the *difference* between the height of the starting and stopping points on these two planes, not the absolute height of the first nor yet its angle of inclination, which expresses the resistances from friction and from the air. It will readily be observed, that this reasoning supposes the coaches to start from a state of rest, and that the length of the first plane does not exceed that required to generate the maximum velocity on that inclination. All this is admirably explained in the inexhaustible and incomparable work of de Pambour; but another illustration may not be unacceptable. If we knew the distance down a plane of given inclination, over which a train of cars must pass to attain the maximum velocity which gravity is capable of generating on that plane, it would be easy to determine what part of the height of the plane was due to the velocity, and the remainder would of course give that due to the friction and resistance of the atmosphere. This was not necessary in de Pambour's method, and Dr. Lardner and Mr. Wood merely ascertain the maximum velocity which a certain inclination can produce, immediately inferring that the resistance at that velocity, is as the height of the plane to its length. Careful experiments would be necessary to furnish the necessary data to determine the absolute value of the resistance by the method proposed, but in the absence of these, the principle can be explained by means of one of de Pambour's experiments, (Chap. III. Sec. 4.)

The plane, on which the experiments were made, descends 34·61 feet in a distance of 3300 feet at the rate of 1 in 95·3 or 55·4 feet per mile, after which it only falls 4·47 feet in 7,920 feet. The first 3300 feet evidently form the distance, by passing over which, the train acquires its velocity, while the small descent from the foot of the 1 in 95·3 aids in diminishing the effect of gravity and the other resistances in bringing the train to a state of rest. Now, the *average* velocity, deduced from the time of starting to stopping, was 12 miles per hour, and, were the resistance of the atmosphere, like that arising from friction, constant, the maximum velocity might be assumed at 24 miles per hour, but we will assume 25 per hour, as the velocity generated by descending an inclination of 55·4 feet per mile a distance of 34·61 ft. in the vertical, and consequently 95·3 times that distance or 3300 feet in the horizontal direction.

A velocity of 25 miles per hour is equal to $36\frac{2}{3}$ feet per second and "the height due to this velocity," calculated by the well known formula $s=\frac{v^2}{2g}$ is 20·8 feet. That is to say, a body must fall from a state of rest through a space of 20·8 feet to acquire a velocity of $36\frac{2}{3}$ feet per second, or, which is the same thing, must descend an inclined plane whose height is 20·8 feet, the length of the plane being immaterial, for we are neglecting the resistances of friction and of the atmosphere. We will therefore suppose the length of this second plane to be also 3300 feet; then we have two planes of equal length, the one 34·61 feet high and capable of generating a velocity of $36\frac{2}{3}$ feet per second, *besides* overcoming the resistances of friction and of the air; the other 20·8 feet high also capable of generating a velocity of $36\frac{2}{3}$ ft. per second where these resistances do not exist. Subtracting therefore the height of the second plane 20·8 feet from 34·61 feet, the height of the first, and there remains 13·61 feet = 1·242 of the height of the plane, =1·242 of the force down the plane, as the value of that part of the force of gravity which is exerted in overcoming the resistances of friction and air, the remaining portion, or 20·8 feet,=1·158 of the force down the plane, being expended in generating the velocity of 36·66 feet per second. According to Dr. Lardner and Mr. Wood the *entire* force of gravity down the plane was required to overcome the resistances, for, though their experiments were not similar to this, it is just as evident that a certain degree of force is necessary to *keep up* as to *generate* motion. The professional reader will see at a glance that the *assumed* velocity of 36·66 feet per second, or 25 miles per hour, may or may not be true, may be more or less, without in any degree affecting the general principle. The mere ratio of the height to the length of the plane and the velocity which gravity can generate on that plane are not sufficient to determine the value of the resistances, for the force of gravity not only overcomes these resistances, but creates a momentum equal to the weight of the body multiplied by the velocity, and it is this momentum which de Pambour subtracts from the whole height of the plane, the remainder being the value of the resistance.

We have just seen, that by assuming 25 miles per hour as the maximum velocity of a train of cars, descending from a state of rest, through a horizontal distance of 3300 ft. on an inclined plane of 1 in 95·3, the value of the retardive forces are 1·242, and the value of the accelerating force of gravity is 1·158 of the force down the plane, or expressing them in terms of the height of the plane, are as 13·61 ft. and 20·8 ft. respectively, instead of the former alone being represented by 33·69, or 2·5 times greater than the value deduced from the rough approximations introduced to simplify the explanations by means of numerical quantities.

Great as is the difference between this hypothetical case and Dr. Lardner, we shall, however, find that experiments on a large scale, or "facts," show that the actual difference is much greater.

Before referring to De Pambour, it may not be improper to state, that the only experiment of Dr. Lardner, from which any approximation can be made, is that in Table VIII, where a descent of 180 ft. carries the train 44,193 ft., at an average velocity of 19·6 miles per hour; thus giving the total resistance$=\frac{180}{44193}=\frac{1}{245\cdot5}$. It is evident, however, that the total actual resistance must have been less than this, for a *uniform* velocity was attained on the 1·177, consequently that portion of the height of the plane *below* the point where the maximum velocity was acquired should be subtracted from the total descent. This most important point is, however, not given. De Pambour, with his usual sagacity, started his trains from a point only 50 chains from the foot of the plane and, as the total distance run by them is only two-thirds of that run by Dr. Lardner's trains, it is clear, that the former on arriving at the foot of the plane had *not* reached their maximum velocity, while the latter, even when starting from a state of rest, acquired the very same velocity as when commencing the descent of the plane with a speed of 30 miles per hour. I will also here observe, that de Pambour's *formula* is, to use Dr. Lardner's language, "founded on the supposition that the resistance is independent of the speed," but, in making the *experiment*, the resistance of the air on the descending, or accelerating plane is *nearly* counteracted by the resistance of the air on the almost level or retardive plane, and indeed Dr. Lardner himself fully acknowledges this principle when advocating his undulating railway and to which we shall subsequently refer.

In the third chapter of De Pambour we find that an engine, tender and 17 cars, in all 94·96 tons, ran over a distance of 11,262 ft.; the vertical difference between the termini being 39·10 ft.; thus giving $\frac{1}{288}$ of the weight or 7·78 lbs. per ton (2240 lbs.) or 18·3 ft. per mile, as the value of the friction, atmospheric resistance, resistance of the working parts of the engine, resistance occasioned by the 9 switches, besides that arising from the irregular motion of the carriages, when, instead of being drawn by the engine with the connecting bolts tight and the carriages comparatively steady, each individual carriage is subjected to the action of gravity, and, as their resistances are all different to a continued series of jerks and pushes, which would altogether justify a diminution of the resistance, in ordinary cases, to less than 7 lbs. per ton of the load, exclusive of the engine. After deducting the ascertained friction of the engine in the above case, the total resistance of the load was 7·21 lbs. per ton, at an *average* velocity of 12 miles per hour, and, as the resistance of the atmosphere increases as the square of the velocity, there will be some loss on account of the difference in the time during which the train runs down the 3300 ft., and that during which it comes from its maximum velocity to a state of rest on the nearly level distance of 7,962 ft. All these considerations point to a lower value of the total resistance, at an average speed of 12 miles per hour, than 7 lbs. per ton. In the experiment just quoted from De Pambour, all the retardive forces were encountered, except that arising from the "additional friction" of the engine, when drawing a load on a level or up an inclination, and it is not improbable, that the increased steadiness owing to the tightness of the connecting bars may be equivalent to this trifling resistance.

The details of an experiment with a very large load were given in the Railroad Journal. Vol II, New Series, p. 187, from which the narrators, Messrs. W. S. Campbell and Ross Winans, Civil Engineers, deduce the entire resistance as less than 7 lbs. per ton on a level with a velocity of 20 miles per hour. Unfortunately, however, there is a discrepency which I find impossible to reconcile, without supposing certain attendant circumstances which should not have escaped professional observers. It appears from the following quotation, that with the steam *on*, the velocity was uniformly 1 mile in 3¼ minutes for 2 consecutive miles, then, with the steam shut *off*, the next mile was passed in 3 minutes; so that curvature or the wind or some derangement created a resistance which, with the friction etc., the engine was able to overcome at the rate of 1 mile in 3¼ minutes, and this being removed, the train acquired an increase of speed, without *any* steam; the inclination being 18 ft. per mile throughout.

"With the valves in gear, the engine, when the steam was admitted to the cylinders proceeded, without slipping or any other interruption, to put the whole train in motion; and after passing over a level of 800 feet, entered a grade descending 3 7-10 feet per mile, of performing the first mile in 6 minutes; the 2d mile in 4½ minutes; the 3d mile (the grade having changed to 18 feet per mile) in 3 1-4 minutes; the 4th mile 3 1-4 minutes. When the road being perfectly straight. and still descending at the rate of 18 feet per mile, the steam was shut off with the view of ascertaining the influence of gravity on the velocity of the train. In this manner the 5th mile was performed in 3 minutes, showing an accelerated velocity, and that the resistance of the train, even at a velocity of 20 miles per hour, was less than 8 lbs. to the ton,

The resistance from friction, when a train is equilibriated, on an inclination of 18 feet per mile, would be about 7-64 100 lbs. per ton. but as the train was accelerated, it is obvious that the resistance to traction on the Reading road is less than 7-64 100 lbs. and probably not more than 7 lbs. per ton."

Dr. Lardner says in the "abstract:"

"From this and the former experiments, it may therefore be inferred that the mere form whether of the front or hinder part, or the mere magnitude of frontage, produces no practical effects upon resistance; but that, by increasing not the frontage only, but the *whole volume* of the train, a material effect is produced.

It had been found contrary to what was first expected, that by increasing the number of carriages in the train, that portion of the resistance which must be ascribed to the atmosphere was increased. It appeared at first view, that the chief, if not the only source of atmospheric resistance was to be found in the frontage or maximum transverse section. The experiments, however, are entirely incompatible with any such supposition. Had such been the case, the trains of six and eight carriages ought to have acquired a considerably greater velocity in descending the inclined planes, than the trains of four carriages, which was not the case."

"It has been stated confidently in print and at public meetings, by men reputed to possess information in practical science, that the atmospheric resistance has long been known, not perhaps with perfect accuracy, but that tables, giving a near approximation, have been published by different eminent men. and are to be found in most elementary works; that calculations founded on these tables, of the resistance of the atmosphere may be made, and that such calculations would give more correct results than such experiments as have now been described. As such statements are calculated to mislead, Dr. Lardner had no hesitation in declaring that they are utterly unfounded. No details exist, nor have any experiments ever been made by which the resistance of the air to a train of railway carriages could be obtained by any calculation whatever; nor was the amount of such resistance ever suspected, even by the persons who have ventured to utter such statements, as have been here proved to exist."

We will apply the ordinary rules used by "men reputed to possess information in practical science," to the only experiment Dr. Lardner made to determine the effect of frontage, Table IX; for in the experiment recorded in Table V, the frontage of the coach is not given.

The uniform or maximum velocity on 1-177 with a frontage of 24 square ft. was 22·75 miles per hour, and with a frontage of 47·8 square ft. 17 miles per hour; and the velocities at foot of 1-265 were 19·5 and 8·5 miles respectively. Now, $\overline{(22{\cdot}75)^2 \times 24}$ is to $\overline{(17)^2 \times 47{\cdot}8}$ as ten to eleven nearly, a very close approximation in such a case: and $\overline{(19{\cdot}5)^2 \times 24}$ is to $\overline{(8{\cdot}5)^2 \times 47{\cdot}8}$ as 26 to 10. Other experiments, however, are just as contradictory; for instance, in Table I, a load of 27·5 tons descends a plane of 1-89 at the rate of 32·3 miles per hour, with an *adverse* wind, and a load one half greater, 40·75 tons, descends the same plane at the rate of only 31·4 miles per hour in a *dead calm!* These discrepancies prove, not the absence of proper care in conducting the experiments, but that the resistance of the air has so little influence on railway trains under ordinary circumstances of wind, load and speed, that it is difficult to determine it experimentally; and I believe that it has for the last 7 or 8 years been much oftener over-estimated than underrated.

I am under the impression, that the traction might be determined with considerable accuracy by merely adding to De Pambour's observations that of the velocity at the foot of the plane, and then calculating the height due to the velocity as already explained. We have seen that an experiment of De Pambour's gave the value of *all* the resistances at 7·78 lbs. per ton, or, $\frac{1}{288}$ of the weight of wagons, tender and engine, determined on the established principle in mechanics, of "virtual velocities." In attempting to illustrate a somewhat different mode of applying the same principle to this experiment, the velocity acquired by descending 34·6 ft. on an inclination of 1 in 89 was assumed at 25 miles per hour, which gave the traction $=\frac{1}{342}$ of the load on a level, while the experiment gave only $\frac{1}{38}$. The velocity at the foot of the plane was probably 28 or 30 miles per hour, which would give the resistance per square foot of frontage equal to about 4 lbs. The lower parts of the engine reach within a few inches of the rails and the column of air, obstructed by the engine and the first coach which is generally 8 ft. high, cannot well have a less transverse section than 48 or 50 square feet, making the entire resistance in calm weather $=200$ lbs. at the maximum velocity, or, taking 20 miles per hour as the speed offering the *average* resistance, $=100$ lbs, and, assuming only $\frac{1}{2}$ this resistance for *all* the other wagons, that is $\frac{1}{17}$ for each, we have a resistance of 150 lbs., or nearly 2 lbs. per ton, which, deducted from 7·21, leaves the friction $=5·21$ lbs. per ton, or, entirely omitting all atmospheric resistance, except that due to the frontage (100 lbs.), the friction will be about 6 lbs. per ton.

On Dr. Lardner's hyphothesis, that "mere magnitude of frontage produces no practical effects upon resistance, but that by increasing not the frontage only, but the *whole volume* of the train, a material effect is produced," the calculation would be thus:—we *know* that the atmospheric resistance is very nearly $\frac{1}{2}$ lb. per square foot at 10 miles per hour, that it increases rather faster than the square of the velocity, as $(.)^{2\cdot06}$, and that it also increases somewhat with the surface; hence, at 20 miles per hour, with a frontage of 50 ft. we are *sure* that, in calm weather, the atmospheric resistance will be 100 lbs. Now, add to this the resistances of the other 16 carriages estimated at only 50 lbs. each $=800$ lbs., add the 100 lbs. for frontage, and we have the total resistance, from the air alone equal to 900 lbs. even supposing it to increase only *half* as fast as the volume of the train, when the entire resistance was *determined* by actual trial not to be more than 620 lbs.

There is yet another way of proving that the resistance is as the frontage. Dr. Lardner, in Table I, cites one experiment where a side wind reduced the speed from 26 to 17 miles per hour; but this must have been a very moderate wind, as it has been known for years, that a strong side wind will nearly stop a train, when, with the same wind ahead, the resistance is comparatively slight. This is because the side of a train offers from 20 to 60 times the surface of the transverse section, and *proves* that the atmospheric resistance increases with the frontage. The *magnitude* of the train is the same in both cases, consequently the resistances should be equal, yet Dr. Lardner's single experiment shows a difference of one-half, with, probably a very moderate wind. That the resistance is as the frontage, has been determined by actual experiment, as well as its value and law of increase *very nearly*—indeed, for all practical purpose, in railroad engineering, this subject may be considered as thoroughly understood.

Without presuming to claim any thing more than a very rough approximation to the truth by these ordinary modes of calculation, they are yet quite sufficient to point out the extraordinary errors of Dr. Lardner and Mr. Wood, and had these statements not been issued forth with such confidence as to lead many implicitly to believe in them, or, had Mr. Brunel pointed out the great source of error, I should not have dwelt thus long in endeaving to show, that Dr. Lardner has signally failed in his attempts to prove, that the resistance of the atmosphere has been *underrated*, that the *frontage* is unimportant, and that the resistance increases as the *volume* of the train.

It is well known that, beyond a certain speed, even a very small increase of velocity is attained with the greatest difficulty, and this has led many to believe, that the resistance of the atmosphere was the retarding cause. M. de Pambour, in August last, attained a velocity of 55·4 miles per hour (R. R. Journal, Dec. 1839, p. 384,) on the Great Western railway, with an engine having wheels 7 ft. in diameter drawing the *tender only*, and was unable to go beyond this, *because*, the pump could not feed the boiler; and it will be found in all cases, that the difficulties in reaching great velocities are owing to the *proportions* of the different parts of the engine being regulated with a view to average work, and not to isolated performances. An engine capable of exercising a power of traction of 800 lbs. at 20 miles per hour, could very easily be geared so as to maintain a uniform velocity of 100 miles per hour on a straight road, but would be of no *use*.

The entire subject is more curious than useful, or even interesting, and, as from variations in the course of the wind, and changes in the direction of the road, the current of air acts almost always obliquely, the angle of incidence must be introduced into the calculation, the spaces between the carriages must be considered, the ratio of the retardation to the pressure of the flanches against the rails must be ascertained experimentally, and, in short, the investigation must, if possible, be as tedious, and embarrassing, as its results must be useless in practice, and vapid in perusal.

Dr. Lardner mistakes friction for "traction," in which latter sense it is always used by de Pambour, for, in assuming the "friction" at 8 lbs. per ton, he, (de P.) means that to represent the average *total* resistance of an ordinary train, say 40 to 60 tons, moving at the rate of about 20 miles per hour. By taking a larger train, 86 tons, and applying the ordinary calculation we have seen, that it leaves the friction at 5 or 6 lbs. per ton, the same result as that obtained by Dr. Lardner, Mr. Wood, and Mr. E. Woods the engineer of the Liverpool and Manchester railway.

We have, however, much better proof here of the actual value of the friction, properly so called. For the last three or four years, fire wood has been carried on the Lowell railway on trains of 6 or 8 cars, descending grades of 8 and 10 feet per mile for the distance of 4 or 5 miles by the force of gravity only, *after* being set in motion at the head of the inclination. This I state on the authority of Charles S. Storrow, Esq., the engineer of that railway, to whom I am indebted for a letter containing some other particulars of the work, but as he informs me, that he intends, during the ensuing summer, to make some experiments on this subject as well as to give a detailed account of the peculiar construction of the road, all I could now say would only serve to detract from the interest of the communication we may expect from one of our ablest and most accomplished engineers, without in any degree aiding the present discussion.

As the cars do not stop on the inclination of 8 ft. per mile$=\frac{1}{660}=3{\cdot}4$ lbs. per ton nearly, the friction cannot exceed that proportion. The cars are loaded with 2 cords of wood each, which would present a frontage of about 32 square feet and, including the platform and wheels, in all about 40 square feet. This, with a velocity of 5 or 6 miles per hour, would create a resistance of about 5 lbs. or 1 lb. per ton for the *first* wagon, and with a velocity of 20 miles per hour would create a resistance of 80 lbs. or 16 lbs. per ton for the first wagon or $2\frac{2}{3}$ lbs. per ton for 6 wagons of 5 tons each. Adding to this the 3·4 lbs for friction and we have 6·06 lbs. per ton for the friction and atmospheric resistance, supposing the 5 wagons, next to the first, to be in *no degree* retarded, which appears impossible. Now, if for this latter consideration and the jolts which will occur on the best roads at great velocities we allow 1 lb. per ton only, we have 7·06 lbs. per ton for the traction on the Lowell railway at the rate of 20 miles per hour. This is only one pound more than estimated by de Pambour 5 or 6 years since.

With a speed of 31·5 miles per hour, and a frontage of 40 square feet, the resistance of the air in a calm will be 4·96 lbs. per square foot or 6·61 per ton for a load of 30 tons, and, adding the friction 3·4 lbs. per ton,$=10{\cdot}01$ lbs. for the traction, entirely omitting the resistance of all except the first wagon; or 11 lbs. per ton if we allow $\frac{1}{40}$ of the resistance of the first to each of the other 5 wagons. This is $\frac{1}{203}$ of the weight instead of $\frac{1}{89}$ as assumed by Dr. Lardner. There is consequently no difficulty in accounting for the common estimate of from 9 to 11 pounds per ton, with velocities of from 20 to 30 miles per hour by the ordinary mode of calculation.

It may not be improper to add, that the Lowell railway is considered by many, including G. W. Whistler, Esq., our most experienced railway engineer, as superior to any other road in New England and, "a fortiori," to all others in the United States;—for Old and New England are the only parts of the old and new worlds where the railway feels, as yet, "at home."

Dr Lardner says:—

"That a railway laid down with gradients, from sixteen to twenty feet a mile, would be for all practical purposes nearly if not altogether, as good as a railway laid down, from terminus to terminus, upon a dead level. The grounds on which he advanced this doctrine were, that a compensating effect would be produced in descending and ascending the gradients, and that a variation of speed in the train would be the whole amount of inconvenience which would ensue; that the time of performing the journey, and the expenditure of power required for it, the expense of maintaining the line of way, and supplying locomotive power, would be the same in both cases; that, therefore, he thought that no considerable capital ought to be expended in obtaining gradients lower than those just mentioned. He stated that he was assailed with the most unsparing ridicule when he advanced this doctrine, and that up to the present hour, so far as he knew, it had never been adopted or assented to by any practical man in the country.

One of the strongest objections urged against Mr. Brunel's gradients was, that, with the loads and velocities of practice, any diminution of gradients below the angle of friction was not attended with sufficient advantages to justify the additional expenditure, and the London and Birmingham railway was quoted as an example. On this latter road the principle was fully adopted and carried out by Mr. Stephenson, and has been repeatedly advocated in this country, on the ground, that the greatest load in practice should not exceed one half the *maximum* power of the engine. This is only one of those thousand circumstances which influence the engineer in his final decisions, and of which he is not to be held ignorant, because he has neither time nor inclination to write long treatises on them.

"The speed in ascending and descending the several gradients and the mean between them is exhibited in

TABLE X.

Gradient.	Speed. Ascending.	Speed. Descending.	Mean.
One in	Miles per h.	Miles per h.	
177	22·25	41·32	31·78
265	24·87	39·13	32·00
330	25·26	37·07	31·16
400	26·87	36·75	31·81
532	27·35	34·30	30·82
590	27·27	33·16	30·21
650	29·03	32·58	30·80
Level			30·93

"He said, that on this table it is scarcely needful to make a single observation. It is quite evident, that the gradients do possess the compensating power which he ascribed to them. The discrepancy existing among the mean values of the speed, is nothing more than what may be ascribed to casual variations in the moving power. This experiment also was made under very favorable circumstances, the day being quite calm. Without going into the details of the principle on which these remarkable results depend, it may be stated generally, that since the chief part of the resistance of a railway train depends on the atmosphere, and is proportional to the square of the velocity, a very small diminution in the velocity itself produces a considerable diminution in its square. A train, in ascending a gradient, may therefore relieve itself from as much atmospheric resistance as is equal to the gravitation of the plane by slackening of its speed."

This is a mere corroboration of de Pambour's mode of assertaining the total resistance to a train in motion. Now if, on a plane of 1-89, the entire force of gravity be absorbed in overcoming the resistance, as previously assumed by Dr. Lardner, whence is derived the power, which, by carrying the train up the next plane, so very nearly compensates for the power expended in the descent of the first?

As for the "chief part of the resistance of a railway train depending on the atmosphere," we have seen, that well known and well established modes of calculation explain all with sufficient accuracy; the experiments of de Pambour with locomotives, give us the value of the power, and his experiments with the wagons, give us the traction; we have, therefore, the power and the weight determined by different methods, and they correspond with nearly all the accuracy the case admits. Hence, if the entire resistance has been so much underrated, the power of the engine and the value of the adhesion have been underrated in the same proportion, and we must of course infer, that all who have hitherto written on this subject, including de Pambour, are entirely in error. That the latter gentleman differs widely from Dr. Lardner, is very true, but that he is in error, on that account, is not, in my opinion, a logical deduction.

A variation of speed from 20 to 40 miles per hour, is spoken of as the "whole amount of inconvenience." "Inconvenience" is a very mild term for the enormous difference in the dividends, which such differences in speed would make. The wear of engines, road, coaches, and the increased liability to accident must be from 6 to 10 times greater at a speed of 40 than of 20 miles per hour. By making the road consist of a series of cycloidal arcs, the "compensating power" will be retained, there will be, in addition to this, a saving in time, and, as no engineer ever did or ever will adopt this plan, it will form a "constant" on which to "enlarge." when alluding to the obstinacy of "practical men" in neglecting the advice of "men of science."

I shall make only one more extract.

"When the first experiments indicating these results became public, various objections were urged against them, by Mr. Brunel; and although it was not considered by Dr. Lardner, or by any of the other persons engaged in this inquiry, that such objections were entitled to any serious attention, yet it was thought advisable to make experiments which would show whether or not they had any foundation in truth."

On this I shall merely observe, that the credit to which Dr. Lardner is entitled for his very extensive course of experiments, will be somewhat lessened by his disparaging allusions to Mr. Brunel, as well as by his assertion, that the statements of "men reputed to possess information in practical science," the foremost being de Pambour "are utterly unfounded."

For the American Railroad Journal and Mechanics' Magazine.

Gentlemen:—I enclose you two circular letters on the subject of a Society of Civil Engineers, which a due respect for the Convention that met at Baltimore last spring, requires me to publish—in connection with the documents already printed in the Railroad Journal, (Vol. 2, New Series, pages 153, 193, and 225,) they complete the history of this abortive attempt to establish a society.

I have delayed the publication of these papers, under the impression that the Committee of seventeen might, perhaps, take further action on the subject. They have not done so, however, and I therefore am justified in considering the measure abandoned.

The members of the Baltimore Convention have a right to be officially informed of this fact, in order that they may be at liberty to adopt such further measures as they may deem necessary.

My position as a member of the Committee, and its Secretary, caused me to devote considerable attention to the subject; and I am fully satisfied that the appointment of a large Committee for this purpose, by the vote of a general Convention, (although certainly a very *democratic* mode of proceeding,) was by no means that likely to produce harmony in council, or the greatest benefit to the profession and science. When to this is superadded the facts, that most of the individuals composing the committee were ignorant of their appointment, and of course unable to promise attendance; that several of them were absolutely indifferent or hostile to the formation of any Institution, which could fulfil the objects proposed by the Convention; that many of them were personally unknown to each other; and that they were scattered over such an extent of territory, as to render a general meeting very difficult, and an epistolary discussion so tedious and troublesome as to be almost out of the question; there can hardly be a necessity of pointing out the local views, partialities and jealousies, which influenced in some measure the result.

I must confess that my own views on this subject have undergone considerable modification, and I am by no means satisfied that a grand National Society is at present either practicable or desirable. The members of the profession are so widely scattered, and have generally so little command of their own time, that even an annual session would be but thinly attended, and the advantages resulting from the collections of plans, models, reports, books, and manuscripts, (which appears to me among the main objects of the Association,) would be almost exclusively local.

The management, too, of a National Society must necessarily rest in a few hands, and those on account of convenience in consultation and action, should reside near the point where the Society's hall is located. This will cause jealousy and discontent.

Cannot the object aimed at be reached by the formation of four independent Societies, having their points of meeting in different portions of the Union, and their sessions at different seasons of the year?

A properly authenticated certificate of membership from any one of them might then by common consent, entitle the holder to a participation in the proceedings and privileges of the others, (with the exception of voting, etc.;) and thus, those whom leisure and inclination permitted, might attend a quarterly meeting of Engineers, instead of an annual one, and listen to the voice of experience from every quarter.

These societies would emulate each other in the advancement of scientific and practical knowledge; and although less imposing in their title and character, than one nominally combining the talents of the nation, in the aggregate they would be vastly more useful; for numbers of excellent Engineers would participate in their advantages, who would be debarred by the expense and time incidental to a long journey, from attending the annual meeting of a National Institute.

The following, would perhaps, be considered a convenient division of the Union.

1. New York and New England.
2. Pennsylvania, New Jersey, Maryland, Delaware and Virginia.
3. All the States south of Kentucky and Virginia.
4. Kentucky and the North Western States.

I shall be glad to see a full discussion of this important matter in your Journal. And am very respectfully,

EDWARD MILLER, *Civil Engineer.*

Philadelphia, January 15, 1840.

CIRCULAR NUMBER ONE. ADDRESSED TO EACH MEMBER OF THE COMMITTEE OF SEVENTEEN.

PHILADELPHIA, April 27, 1839.

Sir :—The same mail which will bring you this letter will also transmit you a printed copy of the proceedings of the Committee, appointed by the Baltimore Convention, for the purpose of organizing a Society of Civil Engineers, and adopting a constitution for its guidance.

It is to be regretted that so small a number of the committee attended the meeting in Philadelphia; though perhaps the six who met, (representing each a different State,) may be considered as affording a fair indication of the feelings and wishes of the profession throughout the Union.

The approval of a majority of the whole seventeen is required in order to adopt the constitution, and, therefore, in accordance with Section XV, I solicit you to peruse the document, and send me at your earliest convenience a notice of your approval or disapproval of the same.

I have to regret the occurrence of three errors in the printed copy, of some importance. The first is in Section II, Par. 5. Add at the end of this paragraph the following sentence, "*Consisting of seven members.*"

And in the list of names added to the original seventeen, Section XVI, for M. R. Stanley, read M. R. Stealey; and for T. M. Fessenden, read John M. Fessenden.

I am, very respectfully, your obedient servant,

EDWARD MILLER.

Secretary of Committee of Seventeen.

Residence No. 246 *Spruce St. Philadelphia.*

CIRCULAR NUMBER TWO, ADDRESSED TO EACH MEMBER OF THE COMMITTEE OF SEVENTEEN.

PHILADELPHIA, July 30th, 1839.

Dear Sir:—I have the honor to inform you that the form of constitution proposed for the Society of Civil Engineers by that portion of the Committee of seventeen which met in Philadelphia on the 10th of April last, has failed to receive the votes of a majority of the Committee, and must therefore be considered rejected.—

The votes are as follows, viz.:—

7 *Approving*,—Benjamin Wright, Wm. S. Campbell, Charles B. Fisk, Edward F. Gay, Edward Miller, Moncure Robinson, and J. Edgar Thomson.

6 *Disapproving*,—W. M. C. Fairfax, Walter Gwynn, John B. Jervis, Jonathan Knight, B. H. Latrobe, and W. G. McNeill.

C. Crozet declines his appointment as one of the Committee of seventeen, without expressing an opinion.

J. B. Jervis declines becoming a member of a society, formed on the principles of the proposed constitution.

Edward F. Gay declines becoming a member of any society of Civil Engineers.

Isaac Trimble, Sylvester Welch, and G. W. Whistler have made no reply to my circular.

I have been convinced, from the tenor of the letters received from different members of the Committee, that a *National Society*, on a broad and useful basis cannot be formed by gentlemen holding such discordant opinions, unless they will take the pains to meet together, and give the subject a fair discussion. The adjournment of the Committee in April was "sine die"; and those portions of sections 15 and 16, which fix a meeting in September next, and appoint a provisional Secretary until that time, fall to the ground with the body of the instrument.

Matters must consequently commence de novo, and additional correspondence will be necessary before a day of meeting can be selected.

I have hitherto cheerfully attended to the duties which the Baltimore Convention, and subsequently, the Committee imposed upon me, but as I now see no prospect of a beneficial result to the profession, and have no leisure for useless correspondence, I respectfully decline acting longer a the organ of the Committee, and will hand over the papers and correspondence in my hands to any one they may designate.

Very respectfully,

EDWARD MILLER.

LIEUT. LE COUNT, ON RAILWAYS.

The mean receipts for five years on the Liverpool and Manchester line give the following proportions:—Revenue 100, expenses 55, profits 45; and the expenses have been as high, or higher than 60. The average, however, gives the ratio of revenue to profit at 1 to .45. On the Dublin and Kingston railway the same ratio for 26½ months gives 1 to .4344. On the Brussels and Mechlin railway the ratio for 1 year is 1 to .488. On the Grand Junction railway, for 6 months it is 1 : 48. On the London and Birmingham, no data exists to form a judgment. There is a very singular coincidence in these ratios on lines so very differently circumstanced, and of lengths varying from 6 miles to more than 100; but we have not yet acquired any sufficient experience in railway statistics to enable us to speak with confidence on the subject. If every railway would publish yearly its experience, as was so handsomely done by the Liverpool and Manchester for several years, analyzing every source of expense, and reducing them to the ratio per passenger and per ton per mile, we should then soon acquire such a stock of knowledge as would enable all these points to be decided; indeed, of so much consequence are railways now becoming, that the legislature should take up the question, making it a law that returns should be sent yearly, according to a form arranged by sone person thoroughly conversant with the subject.

The following extract shows the difficulties of obtaining an act of incorporation from Parliament; we have not in this country found similar embarrassments.

That these matters require the greatest consideration, will be apparent from the difficulty, delay and expense of obtaining acts of parliament for railways. The cost of that for the Liverpool and Manchester line, for instance, thirty miles, was about 900*l.* per mile. That for the London and Birmingham, 112 miles, was 72,869*l.* or 650*l.* 12s. per mile; and it is well known that the expense has reached 1000*l.* per mile on long lines, and that latterly, in every new session of parliament, there have been fresh difficulties thrown in the way of obtaining the necessary acts, till it is now nearly impossible to succeed at all.

There are many very great hardships connected with obtaining an act of incorporation for a railway. Parliament requires that a plan and section of every part of the ground through which the intended line is to pass, shall be lodged with their clerk, and with the clerks of the peace in every county through which the railway goes. This is a very proper regulation in order that every landholder may be able, by travelling a convenient distance, to have a personal inspection of a duly authorised document, so as to examine the nature and extent of the benefit, or the inconvenience which it may occasion to his particular property; but parliament should at the same time have given the railway companies the power of complying with this wholesome regulation, in the same way as road surveys are made in Ireland, by an order from two magistrates to enter any requisite grounds. This, however, is not done, and therefore it follows, as a necessary consequence, that the projectors of these undertakings, no matter how beneficial or important soever to the community at large, are left entirely at the mercy of the landholders, whether they can make their survey or not. We have ourselves known, that when decided opposition has been evinced to the undertaking, the engineers and surveyors have been put to all possible shifts to obtain the necessary data for their plans and sections. Working by night with lanthorns has even been unavoidably resorted to; and in one case, where the proprietor was a clergyman, he was watched on Sunday until he went into his church, and a strong party immediately setting to work, just suceeded in finishing the business as he concluded his sermon.

The facilities of opposing a bill in parliament are so great, that every temptation is held out to do so, especially when the rich harvest to counsel, solicitors and witnesses, is considered; and as has been well observed by the Irish railway commissioners, discussions are mooted of the most discursive and discordant kinds, relating to all the abstract professional matter in the most distant manner connected with a railway. The principles of curves and gradients are entered into with mathematical precision, and the laws of friction and gravity are investigated; questions about which the counsel and the court are often equally ignorant, the one side seeking to swell the estimates and lower the profits, and the other pulling in the opposite direction, like the bulls and bears on the stock exchange, till at last, probably after the expenditure of thousands, the bill is thrown out, not on its own merits or demerits, but because, perhaps, a notice to the proprietor of five or six yards of a cabbage garden, was left next door by mistake.

The parliamentry rules are now as much too strict, as they were at first too loose. The time when the required plans and sections are to be deposited, is very inconvenient; two years at least being required between the deposits being paid and the act obtained. Thus at the present time, if any line is wished to be procured, the surveys must be made in the autumn of 1838, the plans must be lodged and the notices given in Mareh 1839, the petition for the bill presented to the Commons in February 1840, and supposing the act obtained the same session, little if any real work can be done until the spring of 1841.

It would seem that the same spirit, even in a greater degree, actuates landholders in England as in this country. The following plan of obtaining cessions may be useful to some of our readers.

While the engineer is employed in getting out the working drawings, &c., for the several contracts, the land-valuers will be using all their endeavors to get possession of the land in the order in which it is wanted. Public companies have been so grossly taken in on this head, and particularly railway companies, that it becomes imperative that something should be done at all hazards to protect their interests. We have ourselves seen the land for one of the principal railways just constructed, paid for at the enormous sum of 5,500*l.* per mile, and another at upwards of 330*l.* an acre or about 5600*l.* per mile, under all circumstances of fraud, delusion and downright robbery, that can any how be conceived. No means were left untried, no artifices unresorted to, and the most barefaced falsehoods unblushingly set forth in aid of one vast system of plunder from beginning to end, with hardly any exception. They understand these things better in America. Juries there have actually awarded that landholders should compensate railway companies for bringing the line through their lands; while in England, it is notorious that the consent of men of great influence has frequently been obtained as a matter of policy, by agreeing to pay them amounts totally out of proportion to the value of the land required; while others have purposely dissented, until they were bought off by a bribe. All these unnecessary extortions, as well as the enormous sums expended in order to obtain acts of incorporation, come in most cases, ultimately out of the pockets of the public in the shape of heavier fares.

The first step in order to prevent this in other cases, will be to ascertain the fair value of the land, and of the requisite compensation, and whoever asks more than 25 per cent. above that value, hand him over to a jury that minute. If this course be in the beginning avowedly and unhesitatingly adopted, there is no doubt the interests of the company will at any rate be protected from those gross cases of pillage which have lately taken place.

In order to render this complete, the agent, or the land valuer, should be engaged with on the following terms:—Suppose 900 acres are required, and that if some greater precaution than has hitherto been taken be not put in force, then this land will average 300*l.* an acre, or the whole will cost 270,000*l.* Now, if the remuneration to the land valuer be made upon a scale which increases, while the price of the land decreases, the amount may stand as follows:—

Land valuer's pay per cent.	When the price is, or above per acre.	Total land-valuer's pay.	Saving to the compy.
$\frac{1}{4}$	L.300	L.675	nothing.
$\frac{1}{2}$	275	1237$\frac{1}{2}$	22500
$\frac{3}{4}$	250	1687$\frac{1}{2}$	45000
1	225	2025	67500
1$\frac{1}{4}$	200	2500	90000
2	175	3150	112500
2$\frac{3}{4}$	150	3712$\frac{1}{2}$	135000
4	125	4500	157500

The above per centage must only be paid in this way. For example, if the land, when totalled, is found to be between 200*l.* and 225*l.* per acre, then 1$\frac{1}{4}$ per cent. is paid on a suppositious price, namely, 200*l.* per acre; when it is between 225*l.* and 250*l.* per acre, 1 per cent. is paid, rating it at 225*l.* per acre, and so in all other cases.

The scale of remuneration will require adaptation to peculiar circumstances; in fact, if the principle above laid down be adhered to, the details are immaterial; all that is necessary is by a bonus of 4000*l.* or 5000*l.* exciting the land valuer to the most rigid attention to economy, which, combined with a firm resistance to every attempt at extortion, will no doubt in most cases prevent the gross impositions which have been lately put in practice. The short-sighted land-holders, by their outrageous opposition, may have here and there driven a railway into a bad curve, but by causing so much discussion, they have mainly contributed to the rapid spread of the system.

The following extract in relation to excavation and embankment may be of interest to some of our readers.

There are several ways in which earth-work may be hastened, for instance, the use of locomotive and fixed engines to draw the earth along, both of which will be cheaper than horse-power; and as no very rapid speed is required for this work, a cheap description of locomotive engine might be constructed, fully able to take a train of earth wagons at the rate of eight or ten miles an hour, and not costing more than 700*l.* or 800*l.*—whereas a good passenger engine, made in the best manner, will cost 1500*l.* One large tube would be sufficient for all common purposes.

A common moveable steam-engine, working with a rope, will be cheaper than locomotive power, but not so convenient; if used, advantage should be taken in all cases of gravity. Loosening the ground with a plough, will be very advantageous where the soil will permit it, such as clay, marl, and sometimes shale; and as the quantity of work which can be done is limited by the tip, this must be paid every attention to. The usual mode, by running sidings out from the main line in the form of a fan, so to have as many tipping places as possible, requires modifying. At present the common practice is to take up and relay the rails as the embankment proceeds, which consumes a great deal of time, and gives a corresponding portion of trouble, instead of which, if longitudinal bearers are framed for each tipping place, these can be at once lifted up all in a piece, and carriad forward, and a rail put in behind them, in a very short space of time, and with one-fourth of the trouble which is found in the old way. When the embankment is not high, these frames may be supported from below on a railway, and be moved forward any length that may be required. A horse should be kept for tipping above, and he may take in three wagons at a time. By making the above frames to propel forward, and having a door in the bottom of the wagons, the quantity tipped may be very considerably increased.

Whenever the lead gets above $1\frac{1}{2}$ miles, and there is much to do, a locotive engine should be employed, the expense of which, including fuel, wages repairs, interest on capital, and provision for a renewal every five years, will not exceed 4*l.* per day; the engine will take 24 wagons per trip, at 10 miles per hour, while a horse taking 3 wagons will only go 15 or 16 miles per day. That a great saving will ensue is clear, and may be thus shown. Let the lead be two miles, and the contractor required to tip 1200 cubic yards per day; this would require 150 two-yard wagons, besides spare ones and as a horse with three wagons would make four trips per day, or 24 yards per day, $\frac{1200}{24}=50$ horses, besides spare ones and tipping horses.—Now these wagons are to be constantly travelling, and to keep these going there must be 24 always filling, and 24 tipping. This, with the requisite number of spare ones, will in the whole require about 220 wagons; whereas, with the engine, 24 travelling, 24 filling, 24 tipping, and 24 spare, total 96, is all that is required, say 100. Here then is a saving of 120 wagons at 20*l.* each, or 2400*l.*, which is considerably more than the cost of the engine, besides the 50 horses, which, with their harness, cannot be taken at less than 25*l.* each, or 1250*l.*

Again, take 50 horses' keep at 3s. per day, is 7*l.* 10s.; 50 boys at 1s. 6d., or 25 men going one to two trains, at 3s. is 3*l.* 15s., total 11*l.* 5s. per day, whereas the engine will not cost more than 4*l.* Under very unfavorable circumstances, a mean of 15,000 trips gave for a distance of 1969 yards, 15 wagons per train, carrying 25 cubic yards, with a consumption of coal of 245 lbs., costing 2s. 4d., wages, $11\frac{1}{4}$d., repairs and sundries, $6\frac{1}{2}$d., total 3s. $9\frac{3}{4}$d. per trip.

The old way of working at the face of an excavation, and bringing it out by lifts, is now known to be more tedious, and consequently unprofitable, than running a gullet through at once, in which as many wagons as the contractor likes can be put in and filled, both by throwing in the earth from above, or having a stage over the wagons to run barrows on. To get the greatest quantity of earth, besides ploughing it, which plough may be often worked by a steam engine, the method called "falling" may be resorted to, that is, digging underneath and then splitting it on the top with wedges, and with the help of long iron levers, bringing down a lump containing several cubic yards at once.

The contractor will find it best to provide wagons, engines and rails, and to sub-let his labor to small gangs of about a dozen men each and a ganger. The best sort of rails for a contractor's use is the T rail, inverted so that the lower flang nails down on the sleeper, and requires no chair. 30 lbs. per yard will be enough, but from 40 to 50 lbs. is better, as these will do for anything, and 30 lbs. would be too light for clayey soils.

In any place where time is an object, the tip end of the embankment ought to be made much wider and steeper than it is intended, so as to get in more roads at the tip; and as the work proceeds, this extra width is pared off and thrown down below to increase the slope, which should be left a little too narrow at the bottom on purpose.

There is another mode of increasing the tip, by which the time of forming a large embankment may be reduced one-half. This method is to form the embankment at twice in the following manner:—Carry out the earth to the required width, say 20 feet high, and then come on and complete this with a second set of tipping places, say for 30 feet more in height; the wagons must run from the 50 feet level down to the 20 feet by means of inclined planes on both sides of the upper embankment, and from the width of the lower one, a great many roads may be put in at the tip; the upper part of the embankment is brought on in the usual way, and by this means the quantity tipped may be doubled.

Under favorable circumstances, a contractor ought to move 1000 cubic yards of earth per day at each trip, and this by the above process may be doubled, in fact the limit is the tipping, for, by running a gullet into the hill getters and fillers may be placed as thick as will leave them room to work, the quantity of which depends greatly on the weather, the average number of working days being from 200 to 230, in which may be got, by having night shifts in summer, and 3, 6 and 9 hours' shifts in spring and autumn, about 3000 working hours. Under many peculiar circumstances, it will be very advantageous to lay in a line of rails, and place huts on it for the workmen on wheels; so that their place of abode always follows up, and is close to their work, in fact a moveable village. Much, of course, also depends on the nature of the soil, as to the work which will be done in this time; generally a filler will put into a wagon from 15 cubic yards per day in stiff clay, to 25 cubic yards per day in loose sand, and by falling the earth as before described, 1 getter will keep three fillers going, so that to keep up 1000 cubic yards per day, will take from 60 to 90 men according to the nature of the ground.

Where there is much rock the natural stratification of it should be closely examined and attended to in the blasting of it, as a horizontal blast would in many cases bring down ten times as much as a vertical one, and the force of the powder will be increased by mixing saw-dust with it. The strength and disposal of the blasts must entirely depend on the nature of the rock, and also in some measure, on whether it can be used in the bridges, or other erections along the line.

The contractor will find it his interest to look out sharp for clay, and either to make his own bricks, or let his clay to a respectable brickmaker to make them for him, unless he happens to be very favorably situated as to carriage; he should also do all his wagon repairs, erecting temporary carpenters' and smiths' shops in some position adjacent to his heaviest work, but being careful they are so situated that they can be let or sold at the termination of his contract; he should always work towards his greatest job, and of course so apportion his men as to bring in the whole at one time at the end.

It may sometimes happen, that from unavoidable causes, a contractor will find it impossible to continue his work, and occasionally this will be done intentionally. To guard against the last has been already adverted to, but to guard against the first is morally impossible; for there are so many cases in which a man, with the very best intentions, is yet borne down by the uncontrollable force of circumstances, that no human foresight can by any possibility prevent an unfavorable result. As a general rule, it will be best for the directors, in every prudent way, to assist and encourage a contractor, and by every means in their power to enable him to complete his work, provided it be seen that he really is desirous to get on. If prices have risen against him, or if he has made a miscalculation, it will be most decidedly the best thing for the company to increase the amount, to remit his retained money, or by any means to get him to finish his contract. If this be not done, the consequences will be very uncomfortable. His inability will have first become manifest by his employing too few workmen. If the checks which we have explained be put in force this is seen at once. He is served with a legal notice, that under the contract, the company will employ men if he does not, and charge their expenses against him. This will probably induce him to come forward and state what his difficulties are; then if the company do not assist him, he will tell them he must give up his contract; he is perhaps, a man of no capital, and his sureties are the same, so that the company have no resource but to take the work into their own hands. In the mean time, the work having fallen in arrear, there comes the tedious admeasurement of what has yet to be done, and two or three weeks' squabbling between his lawyer and the company's, as to the terms on which he is to give up the works, and perhaps references to umpires, each taking a week; then the company have to order wagons, engines, and tools of all kinds, and to find foremen, overseers, sub-contractors, and workmen, all at a vast expense, it being the fate of almost every public company to be charged higher than individuals. While all this is going on, the work is so much delayed that the line cannot be opened at the time which was intended, the proprietors loosing the whole proceeds. Then come the enormous expenses which are requisite to redeem the time as much as possible. Land has to be bought to make side-cuttings in order to form the embankments, and, in another place, to deposit the earth from the excavation, which is now to a great extent thrown into spoil; horse-runs are established at as many places as possible, to bring up the earth in barrows, and all this in addition to the regular work at the gullet and the tip; and when these things are taken into consideration, it will at once be seen, that the company ought never to agree to finish the work themselves, but as a dernier resort. There are on one of the railways in England, six contracts which were let for 600,000*l*., and which the company have had to take into their own hands at an expense of 1,200,000*l*. In one instance, the cost of the contract was more than trebled so that any means should be resorted to in order to assist the contractor through his job; and we again repeat, that it is decidedly bad policy to take the lowest tender in letting the contracts. A man of character alone should be selected, and ought to receive every encouragement in the execution of his work.

THEORY OF THE STEAM-ENGINE.

(Continued from page 32.)

In the calculations relative to locomotive engines we shall introduce three terms more: the first to express the resistance of the air against the train in motion, a force which, increasing in the ratio of the square of the velocity could not be neglected without error; the second to represent the resistance offered by the engine itself in the transport of its own weight on the rails;

and the third to take account of the force expended by the engine in animating its fire, according to the method in use in those engines. But as these divers circumstances do not in general occur in stationary engines, we will omit them at present, it being easy to reproduce them in the particular cases as it may become necessary.

From what has just been said, the resistance R may be replaced by

$$R=(1+\delta)\,r+p+f.$$

We shall then substitute this value in that of v, and at the same time make

$$\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}=k;$$

an expression, which in the case of $l'=l$, that is to say, for unexpansive engines, reduces itself simply to the ratio $\frac{l}{l+c}$. Then, the value of v will become

$$v=\frac{S}{a}\cdot\frac{k}{n\quad q\,R},$$

or

$$v=\frac{S}{a}\cdot\frac{k}{n+q\{(1+\delta)\,r+p+f\}}. \quad . \quad . \quad . \qquad (1)$$

It will be remarked that the quantity

$$\frac{S}{n+q\,R}$$

is nothing else but the *absolute* volume of the steam correspondent to S, in contact with the liquid at the pressure R. Therefore, to have the velocity v, we must calculate the volume of the steam which corresponds to the volume of water S, supposed immediately transformed into steam at a pressure equal to the resistance R, afterwards divide that volume by the area a of the piston, and lastly, multiply the quotient by the quantity k, of which we have a little before given the developed expression.

The formula (1) contains the general relation between all the data of the problem, and will serve us to solve successively the different questions we have proposed elucidating. It will, however, be observed that the homogeneity of the formula requires that the dimensions of the engine a, l and l' be expressed in the same unit as the volume of water evaporated S, and that the pressures per unit of surface P, r, and p, be also referred to the same unit as S. We mention this circumstance because these various quantities are usually referred to different units, according to what may be, in practice, the most convenient manner of expressing each.

Besides, from the mode of our reasoning itself, it is to be understood that the quantity S, in the equation, is the *effective* evaporation of the engine; that is, it represents the volume of water which really enters the cylinder in the state of steam, and there acts upon the piston. If then, from any mode of construction of the engine, it should occur that a portion of the steam generated in the boiler, escape without acting on the piston, that portion is not to be considered as included in the quantity S, and ought, therefore, to be deducted before all calculation.

The formula just obtained will give the velocity of the piston for any load r, when the dimensions and different data of the engine contained in the equation are known. This formula is general, and applies to every kind of rotative steam-engine. If the engine be expansive, it will suffice to replace l' by the length of the stroke traversed when the steam begins to be intercepted; if the engine be unexpansive, it will suffice to make $l'=l$. If there be condensation, p, must be replaced by the pressure of condensation; and if the engine be not a condensing one, p is to be replaced by the atmospheric pressure. However, before making these deductions relative to the different systems of engines, we shall continue to seek the general formulæ for all the problems we have undertaken to solve.

Let it only be observed, that the velocity of the piston in a given engine, is totally independent of the pressure at which the steam is formed in the boiler, and that, on the contrary, it depends essentially on the evaporation S of the boiler per unit of time, and on the total resistance $[(1+\delta)r+p+f]$ opposed to the motion of the piston.

Section III.—Of the load of the engine, for a given velocity.

The analogy we have just obtained will show reciprocally the reistance a known engine can set in motion at a determined velocity. In effect, it suffices to draw from it the value of r; or rather, as r is only the resistance per unit of surface of the piston, it will be preferable to have the whole resistance, by taking immediately the value of $a\times r$, that is,

$$ar=\frac{\mathrm{S}k}{(1+\delta)qv}-\frac{a}{1+\delta}\left(\frac{n}{q}+p+f\right) \quad . \quad . \quad . \quad . \quad (2).$$

From the form of this expression, it would appear at a first glance, that on making $v=0$, that is, on supposing the velocity null, the result would be an infinite load; but on examining the formula more attentively, we soon perceive that the result would by no means be such.

In effect, if $v=0$, it follows also that $\mathrm{S}=0$; for S is the quantity of steam which effectively traverses the cylinders in a unit of time; and no quantity of steam whatever can traverse the cylinders without moving the piston, and consequently creating some velocity in the engine. If, then, the velocity be supposed equal to zero, we must necessarily have at the same time $\mathrm{S}=0$. But, making at once $v=0$ and $\mathrm{S}=0$, we find

$$ar=\frac{0}{0},$$

and not $ar=\infty$, as it first appeared.

Thus, in this case, the formula reduces itself to the indeterminate form; but it is to be observed, that the present formulæ give the effects of the engine, only after the uniform motion has taken place. Now we shall presently see that, for a given evaporation S, the uniform velocity can never be less than

$$v'=\frac{m\mathrm{S}}{a}\cdot\frac{l}{l'+c};$$

since it is that which corresponds to the passage of the steam into the cylinders, at its state of greatest density, and that at any other density, that steam would form a larger volume, and consequently could not traverse the cylinders in the same time, without producing a greater velocity. All supposition of less velocity than this, is then inadmissable in this problem, as being incompatible with that state of uniformity of motion, for which alone the effects of machines are calculated.

Section IV.—Of the evaporation of the boiler, to produce wanted effects.

To find the evaporation of which an engine ought to be capable, in order to set in motion a certain resistance r at a known velocity v, the value of S must be drawn from the same equation,

$$\mathrm{S}=av\frac{n+q\{(1+\delta)r+p+f\}}{k} \quad . \quad . \quad (3)$$

This equation gives the quantity of water the engine ought to be capable of evaporating and transmitting to the cylinder per minute. It will then be easy, according to the mode of construction intended to be used for the boiler, and the practical data proper to estimate the quantity of water evaporated by such form of boiler, to know what extent of heating surface should be given to the boiler of the engine, in order to obtain the proposed effects.

As the quantity S represents here the effective evaporation disposable by the engine, it is understood that, if the usual construction of the engines under consideration give rise to a certain loss of steam, either by safety-valves or otherwise, account of this must be taken, with as close an approximation as possible, by first adding that loss to the quantity S deduced from the preceding equation, then by estimating the heating surface suitable to the production of the useful steam augmented by the lost steam.

Section V.—Of the different expressions of the useful effects of the engines.

1. The useful effect produced by the engine in the unit of time at the velocity v, is evidently $a\ r\ v$, since the velocity v is at the same time the space traversed by the piston in a unit of time. Consequently, by multiplying both members of equation (2) by v, we shall have the useful effect;

$$\text{u. E.} = a\ r\ v = \frac{Sk}{(1+\delta)q} - \frac{a\ v}{1+\delta}\left(\frac{n}{q}+p+f\right) \quad . \quad . \quad . \ (4)$$

This may be expressed in terms of the load, by multipying the two members of equation (1) by $a\ r$. We have then for the useful effect the engine may produce with a given load,

$$\text{u. E.} = arv = \frac{S\ r\ k}{n+q\,\{(1+\delta)\,r+p+f\}} \quad . \quad . \quad . \quad . \ (4\ \text{bis})$$

It will be remarked, that in a given engine this useful effect does not depend on the pressure at which the steam is generated in the boiler, since the quantity P does not appear in the above equations; but that it depends essentially on the evaporation S effected by the boiler in a unit of time.

2. If it be required to know the horse-power which represents the effect of the engine, when working at the velocity v, or when loaded with the resistance r, it suffices to observe that what is called one-horse-power represents an effect of 33,000 lbs. raised one foot per minute. All consists then in referring the useful effect produced by the engine in the unit of time, to the new measure just chosen, that is, to the power of one horse; and consequently it will suffice to divide the expression already obtained in equation (4) by 33,000.

Thus the horse-power of the engine, at the velocity v, or with the resistance r, will be

$$\text{u. HP.} = \frac{\text{u. E.}}{33000} \quad . \quad . \qquad (5)$$

We will here observe, that what is designated by *horse-power* would, with much more propriety, be termed *horse-effect*, since it is an effect and not a force. It should then be said, that an engine is of so many horse-effect, instead of saying that it is of so many horse-power.

3. In the two preceding questions, we have expressed the power of the engine from the total effect it is capable of developing, without regard to its consumption of fuel or water. We are now about to express the same, either from the effect it produces per unit of fuel or of water expended; or from its consumption while performing a given work.

The useful effect obtained in equation (4), is that which is produced by the volume S of water transformed into steam; and as that volume of water S is evaporated in a unit of a time, the result is, as has been said, the useful effect produced by the engine in a unit of time. But if it be supposed that during the unit of time, there be consumed N pounds of fuel, the useful effect produced by each pound of fuel will plainly be the Nth part of the above effect.

Hence the effect arising from the consumption of 1 lb. of fuel will be

$$\text{u. E. 1 lb. co.} = \frac{\text{u. E.}}{\text{N}} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

To apply this formula, it suffices to know the quantity of fuel consumed in the furnace per minute, that is to say, while the evaporation S is taking place. This datum may be determined by a direct experiment on the boiler itself, or by analogy with other boilers similarly disposed. And the datum once obtained, may be used for every other case, and for every supposition of velocity of the engine.

4. We have seen above, that the effect indicated by u. E. is that which is due to the volume of water S transformed into steam. If then it be required to know the useful effect arising from each cubic foot of water, or from each unit of the volume S, it will obviously suffice to divide the total effect u. E. by the number of units in S. Thus, for the useful effect due to the evaporation of one cubic foot of water in the engine, we have

$$\text{u. E. 1 ft. wa.} = \frac{\text{u. E.}}{\text{S}} \quad . \quad . \quad . \quad . \quad (7)$$

5. we have obtained above the useful effect produced by one pound of fuel. It consequently becomes easy to know the number of pounds of fuel which represent any given useful effect, as, for instance, one horse-power. A simple proportion is, in fact, enough, and we have for the quantity, in weight, of fuel requisite to produce one horse power,

$$\text{Q. co. for 1 hp.} = \frac{33000\ \text{N}}{\text{u. E.}} \quad . \quad . \quad . \quad . \quad (8)$$

6. By a simple proportion will also be found the quantity of water that must be evaporated, in order to produce one horse-power, viz.:

$$\text{Q. wa. for 1 hp.} = \frac{33000\ \text{S}}{\text{u. E.}} \quad . \quad . \quad . \quad . \quad (9)$$

7. It may yet be required to know what horse-power will be produced by a pound of coal; which will evidently be

$$\text{u. HP. for 1 lb. co.} = \frac{\text{u. E.}}{33000\ \text{N}} \quad . \quad . \quad . \quad . \quad (10)$$

8. Finally, the horse-power produced by the evaporation of 1 cubic foot of water will likewise be

$$\text{u. HP. for 1 ft. wa.} = \frac{\text{u. E.}}{33000\ \text{S}} \quad . \quad . \quad . \quad . \quad (11)$$

Substituting, then, in these several equations for u. E. its value determined by the formula, (4,) we immediately deduce the numerical solution of the proposed problems.

Sec. VI.— Table for the numericle solution of the formulæ (rotative engines.)

As the formulæ we have just obtained, and those which are about to follow, contain hyperbolic logarithms, the use of which is inconvenient, we here subjoin a table which gives, without calculation, the principal elements of the equations, and will greatly simplify the matter.

In this table we have supposed the clearance of the cylinder $c = \cdot 05\ l$, as is the case in rotative steam-engines, of which we are now treating. In single-acting engines the clearance of the cylinder, including the adjoining passages, amounts to ·1 of the stroke, because the motion of the piston not being limited by a crank, is it more liable to strike the bottom of the cylinder.

We have not inserted in the table a column to represent the fraction

$$\frac{l' + c}{l}$$

because it is evident that $\frac{l'}{l}$ being known by the first column, the fraction

$$\frac{l'+c}{l}$$

will be equal to the former augmented by $\frac{c}{l}$, that is, by ·05.

Table for the numerical solution of the formulæ (rotative engines.)

Portion of stroke performed before the expansion, or value of the fraction $\frac{l'}{l}$	Corresponding value of the fraction $\frac{l}{l'+c}$	Corresponding value of k, or of the expression $\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}$	Portion of stroke performed before the expansion, or value of the fraction $\frac{l'}{l}$	Corresponding value of the fraction $\frac{l'}{l'+c}$	Corresponding value of k, or of the expression $\frac{l'}{l'+c}+\log\frac{l+c}{l'+c}$
·10	6·667	2·613	·51	1·786	1·539
·11	6·250	2·569	·52	1·754	1·523
·12	5·882	2·526	·53	1·724	1·507
·13	5·556	2·485	·54	1·695	1·491
·14	5·263	2·446	·55	1·667	1·476
·15	5·000	2·408	·56	1·639	1·461
·16	4·762	2·371	·57	1·613	1·445
·17	4·546	2·336	·58	1·587	1·431
·18	4·348	2·301	·59	1·563	1·417
·19	4·167	2·268	·60	1·539	1·402
·20	4·000	2·235	·61	1·515	1·388
·21	3·846	2·203	·62	1·493	1·374
.22	3·704	2·173	·63	1·471	1·361
·23	3·571	2·142	·64	1·449	1·347
·24	3·448	2·114	·65	1·429	1·334
·25	3·333	2·085	·66	1·409	1·321
·26	3·226	2·059	·67	1·389	1·308
·27	3·125	2·032	·68	1·370	1·295
·28	3·030	2·006	·69	1·351	1·282
·29	2·941	1·980	·70	1·333	1·269
·30	2·857	1·955	·71	1·316	1·257
·31	2·778	1·931	·72	1·299	1·240
·32	2·703	1·908	·73	1·282	1·233
·33	2·632	1·884	·74	1·266	1·221
·34	2·564	1·862	·75	1·250	1·210
·35	2·500	1·840	·76	1·235	1·297
·36	2·439	1·818	·77	1·220	1·186
·37	2·381	1·797	·78	1·205	1·175
·38	2·326	1·776	·79	1·191	1·164
·39	2·273	1·755	·80	1·177	1·152
·40	2·222	1·736	·81	1·163	1·141
·41	2·174	1·716	·82	1·149	1·131
·42	2·128	1·697	·83	1·136	1·119
·43	2·083	1·678	·84	1·123	1·109
·44	2·041	1·660	·85	1·111	1·099
·45	2·000	1·642	·86	1·099	1·088
·46	1·961	1·624	·87	1·087	1·078
·47	1·923	1·606	·88	1·075	1·067
·48	1·887	1·589	·89	1·064	1·057
·49	1·852	1·572	·90	1·053	1·047
·50	1·818	1·555			

We limit ourselves to the preceding problems, because they are those which are most commonly wanted; but it is obvious that, by means of the same general analogies, any one of the quantities which appear in the problem may be determined, in case that quantity should be unknown, and that it were desired to determine it according to a given condition. Thus, for instance, might be determined the area of the piston, or the pressure in the boiler, or the pressure of condensation, &c, corresponding to given effects of the engine, as we have done for locomotive engines, in a preceding work (TREATISE ON LOCOMOTIVES.) But as these questions rarely occur, and as they offer no difficulty, we deem it sufficient to indicate here the manner of obtaining their solution.

ARTICLE II.

OF THE MAXIMUM OF USEFUL EFFECT WITH A GIVEN EXPANSION.

Section I.—Of the velocity of maximum useful effect.

The preceding problems have been solved in the most general way, tha is to say, supposing the engine to set in motion any load whatever at any velocity whatever, with the single condition that the load and velocity be compatible with the power of the engine. In constructing an engine for a determined object, or to move a certain load with a given velocity, it must not be planned in such manner as to require the greatest effort of which it is capable, to perform that task which is to be its regular work; for in that case, it would have no power in reserve, to meet whatever emergencies may occur in the service. On the other hand, since the maximum effort of the engine with a given expansion, corresponds, as we shall presently see, to its maximum useful effect, it follows that we are not to expect regularly from the engine its maximum of useful effect, nor can the engine be constructed with such pre-intention. It is necessary, however, when an engine is constructed, or to be constructed, to know what is the velocity at which it will produce its maximum useful effect, and what this maximum useful effect will be; for it is evidently that knowledge which must decide the regular working load of the engine, and mark the possible limits of its effects in case of emergency.

What is that velocity or that load, most advantageous for the work, and what are the divers effects which will then be produced by the engine? This is what now remains to determine, first, in supposing the expansion of the engine fixed *a priori*, that in making that expansion itself to vary, in order to obtain a further increase of effect.

To know the velocity corresponding to the greatest useful effect, it suffices to examine the expression of the useful effect produced by the engine under any velocity whatever, namely, (equa. 4):

$$\text{u. E.} = \frac{Sk}{(1+\delta)q} - \frac{av}{1+\delta}\left(\frac{n}{q}+p+f\right).$$

It is observable here, at the first glance, that since the velocity enters only into the negative terms, the less that velocity is, *for a given expansion*, the greater will be the useful effect of the engine. On the other hand, referring to the expression of the velocity of the engine under a given load, before having substituted for P′ its numerical value, viz. (equa. B):

$$v=\frac{S}{a(n+qP')}\cdot\frac{l}{l'+c},$$

we perceive that the velocity is the smallest possible, without loss of steam, when P′ is the greatest; and as P′, which is the pressure of the steam in the cylinder, can in no case exceed P, which is the pressure in the boiler, the condition of the minimum velocity, or of the maximum useful effect, will be given by the equation $P'=P$, or

$$v'=\frac{S}{a(n+qP)}\cdot\frac{l}{l'+c}\quad .\quad .\quad .\quad .\quad (12)$$

Expressing by m the volume of the steam under the pressure P, referred to the volume of the same weight of water, this formula may, from equation (a) take the form

$$v'=\frac{mS}{a}\cdot\frac{l}{l'+c}\quad .\quad .\quad .\quad .\quad (12\text{ bis})$$

In this manner the calculation of the term $(n+qP)$ is avoided, since the quantity m is given by the tables of Chapter II., and may thence be taken with greater accuracy than from its approximative value

$$m=\frac{1}{n+qP}.$$

This observation will equally apply to all the following formulæ, wherein the quantities n and q recur united under the form $(n+qP)$.

It is to be remarked, with respect to the preceding formula, that, mathematically speaking, the pressure P′ can never be quite equal to P. In fact, since there exist pipes between the boiler and cylinder, through which the steam must pass, and that the passages of those pipes form an obstacle to the free motion of the steam, there must necessarily be, on the side of the boiler, a small surplus of pressure equivalent to the resistance of the obstacle in question; otherwise the motion of the steam could not take place. This surplus of pressure, then, on the side of the boiler, prevents P′ from becoming mathematically equal to P, and thus the real volocity will always be rather greater than v'. The difference between P′ and P (we mean the difference merely arising from the obstacle just mentioned) will be by so much the less, as the area of the passages is larger and their way more direct; but as, with the dimensions of ordinary use in steam-engines, that difference is very trifling, we shall not notice it here. Seeking it, in fact, by known formulæ for the flowing of gasses, we find that it is hardly appreciable by the instruments used for measuring the pressure in the boiler; consequently, to introduce them into the calculation would only complicate the formulæ, without rendering them more exact.

To return to the inquiry before us, the maximum useful effect will be given by the condition $P'=P$, or

$$v'=\frac{S}{a(n+qP)}\cdot\frac{l}{l'+c}.$$

This is, then, the velocity at which the engine must work, in order to obtain the greatest effect possible; and the equation $P'=P$ shows reciprocally, that, when that velocity takes place, the steam enters the cylinder at full pressure, that is, nearly at the same pressure which it had when in the boiler.

(To be continued.)

AMERICAN
RAILROAD JOURNAL,
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ERRATA.—In our last number, page 78, thirtieth line from top, for "one pound more," read, one pound *less*.

In No. 2 of FULTON, p. 68, 4th line from bottom, for "locks," read *canal*. p. 69, 3d line from top, insert a period after the word canal.

The recent melancholy disaster, the burning of the Steamboat Lexington, has already been announced to our readers in all its distressing detail, through the columns of the daily press. As usual, public feeling has been much excited, and our papers have teemed with communications of every sort from the most bitter and injudicious invective against the captain and owners of the ill-fated vessel, down to the most elaborate apologies in their behalf. Although, in all this, there is undoubtedly much nonsense, yet good may eventually come from it, if the conductors of our daily press are careful to exclude such communications as bear marks of extreme ignorance or violent feeling.

It may be thought by some that there can be no use in discussing the matter at this late date, but we are of opinion that it is pre-eminently the duty of a Journal devoted to Internal Improvement to suffer no such accident to pass without a careful and candid notice.

On all occasions of this kind we find the majority of persons in the two extremes. One party rails against monopolies and chartered rights, etc., finding fault sometimes, where praise really is due, while the other blindly maintains the absolute infalibility of the company and all its employees.—In this vast discrepancy of feeling, it is hard to get at the real merits of the case—in the present instance, however, the proper view of the matter seems to be generally taken, and there is, therefore, less difficulty in arriving at the truth.

In making our remarks, we shall freely and unhesitatingly express our opinion, in hope that others may be led to investigate the matter. In the first place we are to consider whether the owners are culpable in employing an unfit vessel or one not under proper management. In the evidence before the Coronor's Jury much stress seems to have been laid upon the fact that the vessel was sea-worthy. This doubtless would have been an important question, if the Lexington had gone to pieces, but has little or no bearing upon the present accident. It seems that the vessel was one of ordinary strength with her boilers below. This is said to be much more dangerous than boilers on the guards, and the English steamers, in which the boilers are always below, are adduced as an example, accidents by fire it is said being in them by far the most numerous. We are not aware that this is a fact, on the contrary, we think that in English steamers there are fewer disasters occasioned by fire than by any other cause.* The specimens of this mode of building which we have had in the Sirius, British Queen, Great Western, ect., have convinced us that there is not a steam vessel in our waters so well guarded against fire. In fact there is no combustible in the vicinity of the boilers or engine with is not covered by metal.

So far it seems that instead of resembling the English steamers, the Lexington was unlike them in every thing save the position of the boilers.—That she was well guarded against fire could not be the fact, since it is stated on the best authority that fires frequently occurred, and sometimes threatened the destruction of the boat. This is attempted to be glossed over by the testimony of some one that it is *a common thing for steamboats to take fire.* If this is so, it is an alarming fact that hundreds of persons are daily endangering their lives without the slightest consciousness of their peril. It may be that the company owning this boat was not aware of her unsafeness in this particular, but we fear that it will require more white washing than they can accomplish to free themselves from all blame. From the manner in which the boat came into their possession, it cannot be supposed that they could have had much regard to her safety, even as far as concerned their own interests, and from the occurrences of the past year, it does not seem that they have valued public convenience so much as their own aggrandisement and the *extinction of all opposition.* We are to remember that during the last year an accident of unusual character occurred on one of their boats—at which time it was stated, and without contradiction, that the same difficulty had occurred before, though not with such a dangerous termination.

Again, is there any thing in the management of the boat or disposition of the freight so faulty as to throw blame upon the owners or their agents. It is said that cotton is too dangerous to be carried in steam-boats. This is certainly a very sweeping assertion, and one calculated to impose unnecessary restrictions upon steam-boat traffic. But was this cotton stowed in such a manner as to become a hazardous freight? This is quite another matter, and we fear will prove culpability on the part of the agents or persons employed in this part of the business. It does seem that a large quantity of cotton was stowed where, from the frequent fires on board, there was a great risk of setting fire to it and the vessel. If, as asserted,

* Since the above was in type, we find that the number of disasters in British steamers in 10 years is 92. Of these, 40 were such as might happen to all vessels at sea, 23 from explosion, 12 from collision and 17 from fire—the majority of the latter being caused by carelessness.

fires are common in steam-boats, such matters as cotton should certainly be placed as far from their place of occurrence as possible.

It is plain that the owners furnished the vessel in the proper manner with boats, (one of them a life boat too,) that they provided, as far as they could judge, an excellent captain, a sufficient crew and a fire engine, as well as iron rods for steering, as directed by law—but that they employed a vessel, known to be dangerous as to fire, not properly guarded in this respect, and that a large quantity of cotton was stowed in a dangerous place. They of course cannot be charged with wantonly sacrificing the lives of many persons—but they cannot wipe off the stigma of having by this culpable carelessness, encountered risks which finally ended in an auful disaster as serious to them, as far as pecuniary loss is concerned, as to any one else.

The next matter of inquiry, is one of more delicate nature, since it concerns one of the sufferers, we mean the captain. His conduct has always been gentlemanly, and as far as respect goes, that of an able commander. From the record of the awful occurrence, as given by the few survivers, it is thought by some that probably from constitutional inability, the energies of the captain were not equal to the dreadful immergency, while others are of opinion that he did all that could be done under the existing circumstances.

But whatever blame attaches to others, as having caused the accident, its fatal termination was brought about by the absolute madness of the *passengers.* The most horrible disorder must have attended the tumultuous efforts to escape in the boats. No one doubts, that on board a man-of-war every thing would have taken a different course, and that all would have been saved. But in the unorganized crowd of passengers, no one is found to command and no one to obey.

From the astonishing coolness and presence of mind, together with uncommon powers of endurance, manifested by Capt. Hilliard, it is presumed that the knowledge of his presence would have inspired confidence, and a right direction might have been given to the united labors of the passengers. A bold and unflinching demeanor, assumed by the proper person, might have restrained the unnatural disorder that prevailed. It is said by some that this fearful abandonment of reason in the extreme of danger is human nature.. It is not—the assertion is a foul libel upon the human race, and a doubt of the goodness of our Maker. Who has not seen the timid, the sickly, even of the gentler sex, roused in the extreme of danger to uncommon exertion of mind and body. The very case before us furnishes four instances of human exertion and endurance of almost miraculous extent. In the case of the Pulaski, out of a smaller number of passengers, at a far greater distance from land, *fifty-four* were saved, and among them women and children. It is true that the present case was so far worse that it was in the winter season, and that many perhaps perished merely from cold.

To what then are we to attribute the extraordinary fright which in this case, as in previous ones, has produced such fatal consequences? We conceive it to be almost a national peculiarity to manifest an utter recklessness and want of providence against danger and as utter a want of self control, and presence of mind in the crisis. The intense selfishness which is a prevailing trait at the present day—not only here but else where—prompts each one to take care of himself, to the exclusion of all others. It is morally and physically impossible for more than one hundred persons, situated as the passengers of the Lexington were, to attempt to provide each the means of individual safety, without endangering that of all.

It is not recollected that passengers as well as owners and captains, have responsibilities which are as binding and necessary to safety as those more frequently considered and commented upon. There is too much dependance upon the ordinary imperfect provision against accident, and no trust in a over ruling Providence, and when danger comes, and the reed we lean upon is broken, having no thought of a higher power, despair soon drives reason from her throne. We must say that in time of danger, we have often heard of conduct befitting a savage rather than a christian people. In an unbounded reliance upon our mechanical perfection, we seldom reflect, that moral causes have much bearing.

One word more before we leave this melancholy subject. There are peculiarities in the construction of English marine engine well worth our imitation. The whole machinery is firmly bolted and fastened into one mass of iron, without any dependance upon wooden support, except on the very bottom of the vessel. The most serious accidents may happen to the boat without deranging the machinery, or impairing its perfect action. A fire might destroy the whole upper works without stopping the engine. Although in the case under consideration, the better course might have been to stop the boat, there is no reason why we should not have machinery that could be trusted in such an emergency.

The use of a small deck fire engine, has sometimes proved of the greatest service when from the smoke and flame the large one below had become useless. At a trifling expense this additional means of safety could always be procured.

Having expressed our opinions as freely as we have considered our duty to require, we leave the subject with the hope that we shall never again be called upon to notice a similar disaster.

TABLE OF CUBICAL QUANTITIES, FOR DETERMINING THE AMOUNT OF EXCAVATION AND EMBANKMENT, IN THE CONSTRUCTION OF RAILROADS AND CANALS, WITH ILLUSTRATIONS.

TABLE OF QUANTITIES, EOR TRACING RAILROAD CURVES, WITH ILLUSTRATIONS.—BY EDWIN F. JOHNSON, CIVIL ENGINEER.

The first of the above tables differs from any of the numerous tables for a similar purpose, which have fallen under our observation. The ordinary tables give the cubic contents from the centre cutting, supposing the ground to be *level* transversely of the line; or, from the outside stakes, supposing the ground to be *even* between these two points. It is obvious that these tables must be calculated anew for every different slope and breadth of roadway, besides which they are only sufficiently accurate in very even ground. It is said by Lieut. Lecount, (p. 33,) "The average height, however, can, in almost every case, be taken perfectly near enough for every practical purpose." Such is not the general opinion or practice in this country, and except in very even ground, at least two cross levels are taken on each side of the centre stake. Two are, however, in the great majority of cases, quite sufficient to ensure all desirable accuracy, and Mr. Johnson's tables are peculiarly applicable to this mode of calculation, though by no means limited to it, being also adapted to the measurement of masonry in piers, culverts, walls, etc.

The linear measures are supposed to be taken in feet, and the solid contents are given in the table in cubic yards, all calculated for a length, or distance, of 10 feet, so that it is only necessary to remove the decimal point one place to the right to obtain the contents, per chain of 100 feet, or, to multiply by a single digit, for lengths of 30, 40, 50, etc., feet.

The table embraces 4 different slopes, ½, 1, 1½, and 2 horizontal to 1 vertical, and gives the solid contents of pyramids, frustrums of pyramids and triangular prisims, for these slopes, besides a column for rectangular prisms into which all trapezoidal areas may be reduced. The latter column is calculated for a breadth of 10 feet, and, as the contents are directly as the breadth, it is easily applied to any breadth whatever.—This is evidently not the case with the pyramids and triangular prisms, which vary with the slope as well as with the depth. These latter values being given and the length remaining constant, (10 ft.,) the cubic contents are at once obtained by multiplying the areas by one-third the length for the pyramids and by the whole length for the prisms. These solids require, therefore, only one column for each of the 4 slopes.

The contents of the frustrums, however, are not so easily obtained, depending on the ratio of their basis. They form, moreover, the majority of cases in practice, and occupy two-thirds of the table, being calculated, not only for different slopes, but for different ratios of basis. The illustrations are particularly full on this point, and we shall conclude by the following quotation from the "Introductory Remarks," which says more for the usefulness of the table than any opinion of ours:

"As an evidence of the utility of the table, it may be stated that a few manuscript copies were taken in its original form, which, although less general in its application than the one here presented, have been for some time in use on several public works, and have been found to answer well the purpose designed."

The table for curves gives the offsets from the tangent to the curve for every 25 ft. from the point of tangency to the distance of 200 feet, and, as the same offsets apply equally well to the continuation of the tangent on the other side of the point of tangency, the table is calculated for stations of 400 feet and for radii of from 379 feet to 137,500 feet. The offsets are those parts of the secants between the tangent and the circumference, or the secant less the radius, and are measured towards the centre of the circle. It is therefore necessary to know their inclination to the tangent, and the columns of angles and offsets are placed in juxta position in the table.

These tables are adapted to approximate locations, final locations, to laying the rails on the main line or in turnouts.

It is stated by Mr. Simms in the Civil Engineers' and Architects Journal for July, 1839, that he hopes shortly to publish a table of ordinates for setting out railway curves from tangents, which he has himself used for some years in England, and a table less complete than the one now offered to the public by Mr. Johnson, has been used on different public works in this State.

The usual mode has been to run out as many chords, of one chain each as could be seen from the origin of the curve; then to remove the goniometer to the station last determined, and proceed as at the origin. By the method of ordinates to long tangents much time is saved, and the number of angles to be measured is reduced, on ordinary ground, to about one-fourth of the number required by the usual mode. The table gives also the lengths of arcs to tangents of 200, 150, and 100 feet for the different radii.

The latter table will enable the young engineer to lay out any curve required in practice, with all possible accuracy, and, by means of the former, he will readily ascertain whether the curves so run will satisfy the other conditions of excavation and embankment, and if some modification be required, the table of ordinants will aid him in determining on the different degree of curvature required to place the line on the best ground. We have here, within the compass of a few pages, all that an assistant, familiar with the instruments, requires to enable him to locate a line and determine the quantities of excavation and embankment, and, as there are no similar tables published in this country, we have no doubt that these manuals will soon come into very general use.

The following abstract of a report made by "the Committee of Science and the Arts" of the Franklin Institute, Philadelphia, has been furnished us for publication.

PRESERVATION OF TIMBER.

"Hall of the Franklin Institute,
Philadelphia, Dec. 12, 1839.

"The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination Dr. Edward Earle's method of preserving timber, "Report."

[The "Report" being long, and a considerable portion of it, although a necessary part of the whole, irrelvant to the main purpose; an abstract of it may suffice to show the proceedings of the Committee, and the conclusions to which their investigations, experiments, and reasonings have conducted them as to the nature and qualities of the means employed, and the probable advantages and value of the "process."

Composed of many of the most distinguished members of the Institute—such as President A. D. Bache, Messrs Boothe, Peale, Frazer, Merrick, and others—the above Committee may be considered as constituting, in matters of science, the highest tribunal in our country, and the sanction of its approbation must go far to establish the character of those inventions and improvements on which it is conferred.

Having adverted to the form of the process, the materials used, and the mode of applying them, together with the different kinds of decay to which timber is liable, and which they agree with others in attributing to the gasseous, alluminous, and glutinous substances inherent in it;—they give a short history of the attempts which have been made in different countries to prevent or cure this costly evil. They proceed then to detail their own experiments made to determine the relative effects produced on the putrefactive constituents of timber by the sulphates of iron and copper and by corrosive sublimate, which salts they find to act *similarly and equally*, and are considered by them as the materials most powerful in their preservative agency; and also their experiments to ascertain the introduction of the sulphates by the proposed "process," into the body of different kinds of wood. In the course of the experiments made for these several purposes, the Committee satisfy themselves of the following results, most affecting the subject, which we give in the language of the "report" itself.]

"1st. That if these salts—the sulphates of iron and copper—penetrate the wood thoroughly, according to the process adopted by Dr. Earle, we have an economical substitute for the mercurial compound—the corrosive sublimate."

"2d. That the solutions *are* carried through the pores of the wood is conclusively shown by the experiments (detailed) on pieces taken from the interior of large pieces of timber which had been boiled with the solutions. The pieces were further split in half and the experiments made on the inner surface."

"3d. That heated solutions of various salts, such as corrosive sublimate and the sulphates of iron and copper, operate by expelling the gasseous matter and rendering the albumen and gelatine inert in all the parts of the wood which they penetrate."

"4th. That they—the sulphates—penetrate different woods in different degrees, *ash* being more thoroughly impregnated; *hemlock* nearly the same; *hickory* less so; and *oak* still less."

"5th. That the sulphates of iron and copper produce the precipitation of albumen equally well with the perchloride of mercury—corrosive sublimate—and that of gluten in a nearly equal degree; and that they are therefore to be considered as an excellent and economical substitute for that compound."

"6th. That therefore the penetration of wood by these salts—the sulphates of iron and copper—renders it less subject to decay and the attacks of insects."

"7th. That although theory and experiment thus go to show the diminished destructability of the wood, experiments on a large scale should be instituted in order to ascertain the correctness of these views of the committee, without which they are of little value; but that the subject is one of sufficient importance, and the probability of success sufficiently strong to warrant the performance of such experiments with great care, and with less regard to the primary expense."

"8th. That lime penetrates wood in a similar manner"—[but the opinion of the committee as to the effect of lime on the wood being less favorable, their experiments and reasonings are not thought important to be communicated.

The process is conducted by means of boilers and wooden tanks, which, in size and cost, may be accommodated to any purpose—whether it be to prepare posts for fencing, or the largest ship timber; and is capable of reducing timber, in a few hours, from a perfectly green, to a perfectly seasoned state—a short time being allowed after the operation for drying. The efficiency of this method, it is believed, will prove at least equal to any that has ever been tried; while the facility with which it may be practised, and the trifling cost of it, give it powerful claims to general acceptance. The materials employed being inexhaustible, too, and not liable to fluctuation in price, can never occasion an augmentation in the cost.]

EDWARD EARLE, *Patentee.*

Philadelphia, January, 10, 1840.

Applications for the use of his patent &c., may be addressed to "Dr. Edward Earle, to the care of John C. Montgomery, Esq., President of the Little Schuylkill and Susquehanna Railroad Company," or "Wm. Rawle, Esq., Counsellor at Law, Philadelphia."

For the American Railroad Journal and Mechanics' Magazine.

INTERNAL IMPROVEMENTS OF NEW YORK. NO. 3.

In the two preceding numbers it was shown, and it is believed conclusively, that the enlargement of the Erie canal on the plan and to the dimensions proposed, is not now required, to accommodate the business upon it, and will not be for many years to come. Want of capacity, however, is not the only ground on which the enlargement of the canal has been advocated. It has been urged as indispensable to a reduction of the cost of transportation, and it is asserted that the saving, when the canal is enlarged to the dimensions as adopted, will be full 50 per cent., or one half the present prices. Should the inquiry be made from what data this inference is drawn, no better answer could probably be given than the very unsatisfactory one of its being the *opinion* of gentlemen who were selected to examine and report upon the subject.

It will scarcely be credited that a measure of so much importance as that of the enlargement of the Erie canal, involving an expenditure of more than thirty millions of dollars, should have been undertaken without instituting the most rigid examination into the merits of the project, and particularly whether so vast an expenditure was essential to effect the leading object proposed to be attained, viz. a reduction in the cost of transportation so as to render the expense as nearly as possible a minimum. Such, however, appears to be the fact.

The great importance of determining in the very outset of such an investigation by suitable experiments, the dimensions of the canal and boats, adapted to the most economical use of motive power, is too obvious to need illustration, yet we are not aware that a single experiment was made by those whose duty it was to conduct such an inquiry, with a view to this object.

The information which it is natural to suppose would have been first sought for as essential to arriving at just conclusions on so important a subject was not obtained, except in a very vague manner and hence was not of a character to entitle it to any very great degree of confidence.

The only experiments to which any allusion is made in the reports are those of the Chevalier Du Buat. These experiments were made upon a very limited scale, "in a canal varying from $2\frac{3}{8}$ to $6\frac{1}{4}$ feet in width, and from $1\frac{1}{4}$ to $2\frac{1}{4}$ feet in depth. The boats used were prismatic in form, with *square ends*, the immersed part varying from 1 to $1\frac{2}{3}$ feet in depth, and from 1 to 2 feet in width." The velocity at which the boats moved was not given. It was from such data, principally, that conclusions were drawn in respect to the most suitable dimensions for the enlarged canal.

It will not be surprising if from such crude data, the authors of the several reports arrived at very different results. Two, at least, of their number advocated an enlargement to the size of 80 feet width of surface by 8 feet depth, with locks 16 feet in width and 115 feet in length—while others were somewhat more rational in their views, but still erring and differing greatly in their conclusions.

In one report it was stated, that the burthen of a boat best adapted to a canal 60 feet wide and 6 feet deep, with locks 15 feet wide and 105 feet long, was 103 tons, in another it was put at 79 tons. In the estimated cost of transportation there was also considerable discrepancy.

We cannot avoid again expressing our surprise that these different opinions, based as they were in a great measure on mere conjecture, were considered sufficient for establishing the dimensions of one of the most stupendous works of the age—a work which was to cost millions, more especially as it was so easy a matter to have tested by proper experiments on the canals already in operation, the actual practical loss or gain of any change in dimensions which might have been proposed. Experiments of this description were not made, nor were they recommended, although the expense would have been inconsiderable.

The dimensions established for the enlargement were those of 70 feet width of surface and 7 feet in depth. This result seems to have been reached, not by any systematic course of reasoning or logical deduction from well established data, but by the very singular process of taking the *average*, or *splitting the difference* of the several opinions advanced in the reports.

It is not unworthy of remark, as indicating the enlightened view taken of the subject in the reports alluded to, that in the several dimensions proposed, the ratio of the width of surface of the canal to its depth was assumed invariably the same, viz. as ten to one, corresponding with the present proportions of the Erie canal, which was undoubtedly taken as the standard. Upon this principle, a canal ten feet wide should be only *one* foot in depth, and a river one mile in width, to afford the most perfect navigation should be 528 feet in depth !

In the ratio proper to be adopted between the width of the locks and the canal, similar erroneous views were entertained and advanced in the report, and but for the representations of a third person, *incidentally* elicited, whose reasonings upon the subject could not be controverted, we should, in all probability, have witnessed the singular inconsistency of a canal 70 feet wide with locks only 16 feet in width ! or what would perhaps have caused still greater surprise, we should have witnessed the entire destruction of all the locks on the present canal, which are now 15 feet wide, and built of masonry, for the purpose of obtaining only *one foot* additional width !

Assuming that the ratios of the boat and canal which afford the least resistance as deduced from the experiments of Du Buat are correct upon the scale of the magnitude contemplated in the enlargement, it does not follow that an increase in the dimensions of the canal from its present size of 40 feet wide and 4 feet deep, to 70 feet wide and 7 feet deep, is essential to effect the desired saving in the cost of transportation. To render the resistance a minimum, or the same that it would be on an indefinite expanse of water, it is requisite according to the rule given by Du Buat, that the width of surface of the canal should be $4\frac{1}{2}$ times the width of the boat, and the transverse section of the canal 6.46 times that of the immersed part of the boat. These proportions, it should be distinctly borne in mind, *are independent of the absolute size of either the canal or the boat*, and hence are as applicable to *small* as to *large* canals. This fact has evidently been wholly overlooked by the advocates of the enlargement. One of the principal sources, therefore, to which we are to look for a reduction in the expense of transportation is not dependent upon the magnitude of the canal, but is quite as attainable on a small canal as a large one.

The width of the Erie canal is 40 feet, the locks 15 feet, and the boats about 14 feet. If the latter are proportioned to the width of the canal, according to the rule, they should be a little less than nine feet. The navigators on the Erie canal have not discovered it to be for their interest to make their boats of this width, but have invariably made them of the full width allowed by the locks, giving to the ratios above mentioned, a value not exceeding one half the amount prescribed by Du Buat. Du Buat's rule is therefore not applicable in practice, or there are other circumstances entering into the question of the expense of transportation, other than that of the resistance to motion or amount of motive power. A careful analysis of Du Buat's experiments shows that the resistance is not very sensibly increased if the ratio of the width is reduced from 4½ to 4, and hence the gain by increasing to 4½ is not commensurate with the expense of attaining that ratio, and the same may, we believe, be said with propriety of a ratio even less than 4. The only particular advantage resulting from a greater ratio, is that of being able to navigate boats with equal safety with a little less care and attention, and to diminish the resistance in passing.

For boats 14 feet wide, such as are now used on the Erie canal, a width of water surface of 4 times that amount, or 56 feet, is undoubtedly all that it is expedient to obtain. How very absurd, therefore, was it to propose, as was done in the reports we are discussing, a width of canal of 80 feet, for locks of 16, or boats of 15 feet in width!

Remarks, similar to the above, are applicable to the sectional ratio, which, it appears from the experiments, may be reduced from 6.46 to 5½, without materially increasing the resistance. There is another reason, aside from the expense of obtaining it, why the maximum ratio in this case is not desirable. The *down* tonnage upon the canal, is from 4 to 5 times that conveyed in the opposite direction. Boats ascending, have consequently, on the average, much less draught than those descending—plainly indicating the inexpediency of adapting in practice, the canal and boats to the maximum ratio. But whether expedient or not, this is a consideration, as already stated, which relates more particularly to the *relative* and not to the *absolute* dimensions of the canal and boats. We are therefore to look for the benefits of the enlargement in its effect in cheapening transportation, *solely* to the advantages possessed by the use of boats *larger* than those now employed. The assertion has been frequently made, that the saving would be 50 per cent. or one half the present rates. The public have been deluded with the idea that the enlargement to the size proposed, was indispensable to, and would effect this reduction.

It is believed that nearly one-third of the expense of transportation is made up in the cost of animal power. Since, from what is shown above, this power can produce an useful effect as great, or nearly as great, on a small canal, properly proportioned, as upon a large one, it follows, that little or no saving can be anticipated from this source. *As to steam power, the advocates of the enlargement having scouted the idea of its profitable use on either a small or a large canal, we are relieved from making any remarks, in the present place, respecting it.* There may, and probably will be, a saving in the cost of boats of larger dimensions, and also in their furniture and equipments, and in the number and wages of the crew, but this saving must of necessity fall far short of one half the whole cost of transportation, and, as we shall show, even this saving, which cannot reasonably be rated higher than 15 or 20 per cent., will be somewhat reduced by circumstances to which we have not as yet alluded, and not only so, but may in all probability be fully realised without resorting to an improvement to the *extent* of the proposed enlargement.

The question of the most economical size of boat for towing with animal power is one of great importance. Various opinions are advanced in the reports on this subject. The present boats, particularly those designed almost exclusively for freight, (and such, for reasons assigned in our last number, will, in all probability, be the character of the boats traversing the canal,) are towed with difficulty, when fully freighted, by two horses, at an average rate not exceeding two miles per hour, being probably the greatest speed at which power of that description can be advantageously employed. From information derived from those having experience in canal navigation, it is by no means certain that more than two, or at most, three horses, can be usefully employed in towing the same boat.

There is no evidence, therefore, that any important advantage is to accrue from the use of boats *very greatly* exceeding in capacity those now in use upon the canal—certainly none which can justify a belief in the statement, that the cost of transportation will be reduced 50 per cent., or render it proper to suppose that it will approach any where near that amount.

By an improvement in the locks, such as was suggested in the last number, that is, adding to their length, and wherever the pressure of business required, increasing their number, the capacity of the canal would be more than doubled. If to this improvement, be added that of widening and deepening the channel of the canal to the extent which may be easily and safely done, viz., by excavating from the berm side about 13 feet in width and using the material thus obtained for raising and enlarging the bank on the side of the towing path, an additional depth of water of from 1 to 1½ feet may be obtained, which will give to the boats a tonnage more than double that which they now possess, and enable the canal to accommodate more than quadruple the trade now conveyed upon it. Such an improvement, it is believed, will give to the boats a size about as well suited to economy in transportation as any other where animal power is used. It will give to the surface a width of 56 feet, being, as above explained, all that is expedient for a diminution in the resistance.

It will prevent the great destruction of property, resulting from the breaking up of the present mechanical structures on the canal, including locks, culverts, aqueducts, and bridges, etc., most of which are built in a very substantial manner. It will prevent the great injury to lands adjacent to the canal, resulting from an interference with the drainage consequent upon depressing the bottom of the canal to obtain the additional three feet in depth. It may be accomplished without interfering with the navigation, or in any way deranging the business of the canal, in the short period of six years without resort to loans, using only for the purpose the surplus revenue of the canal; and last, though not least, it will save to the people of the State in the original outlay, full *twenty-five millions of dollars*, together with the interest to be piled on that amount of principal, and which it is justly to be feared, the nett revenue of the canal for a series of years, after the enlargement shall be completed, will not be able to liquidate.

This subject will be continued in the next number.

FULTON.

RAILROADS IN CITIES.—As the right of *city authorities*, or of legislative bodies, to permit railroad companies to lay *rail tracks* through public streets of cities and villages, is doubted by many, though we have never been of the number, nor do we doubt the sincerity of those who have doubts on this subject, we avail ourselves of the politeness of a friend, to lay befere our readers the following decision of the *Court of Appeals* of Kentucky, at the spring term of 1839.

We give the letter, omitting the name of the gentleman who furnished us with the copy, and agree with him fully, as to the importance of the case, and therefore give place in the Journal, asking for it the attention of our readers.

For the American Railroad Journal and Mechanics' Magazine.

I have the pleasure to send you, herewith a manuscript copy of the report of the case of "the Lexington and Ohio railroad company, against Applegate and others," as given by the court of Appeals of the State of Kentucky.

In this case, the first legal tallent of the State was employed on each side, and the great importance of the case, involving the vital principle of the *existence* of railroads; for if the defendants had prevailed, it would have been a fatal blow to the future progress of railroads in that State at least; and if adopted by other States, final in its effects throughout the country. Its importance, therefore, I should think such, as to justify you in publishing it in the Railroad Journal.

The cases reported in this volume, were selected by the Judges, under an act of assembly, which directs that they shall permit the publication (under State patronage,) of such cases only, as, in their opinion, "establish some new, or settle some doubtful point, or be otherwise by them deemed important to be reported."

The Court of Appeals of Kentucky, at the spring term, 1839, when the following cases were decided.

Judges on the bench—the Hon. George Robertson, Chief Justice of Kentucky. The Hon. Ephraim Ewing. The Hon. Thomas A. Marshall, Judges.

COURT OF APPEALS, KENTUCKY.

The Lexington and Ohio Railroad Company

vs.

Applegate and others.

[Mr. Guthrie and Mr. J. T. Morehead for the appellants. Mr. Crittenden and Mr. Pirtle for the appellees.]

From the Louisville Chancery Court. June 19, 1839.

Chief Justice Robertson delivered the opinion of the Court.

This appeal brings up for revision, a decree of the Chancellor of the city of Louisville, perpetually enjoining the Lexington and Ohio Railroad Company "from running, using, or employing their cars and carriages, by steam or otherwise, upon their railroad along Main street, between Thirteenth street and Sixth street," in the said city.

By an act of the Kentucky Legislature approved in 1830, "the Lexington and Ohio Railroad Company" was incorporated, with authority to construct a railroad from Lexington, to "some one or more points on the Ohio river;" and to use any land and materials, necessary for that purpose, by obtaining the consent of the owner, or by paying the value thereof, to be assessed upon a writ of *ad quod damnum;* and "to place on the road, when constructed, all machines, wagons, vehicles or carriages which they may deem necessary and proper for the purpose of transportation," and also to exact a prescribed toll for transportation of persons and property on the railroad. Having determined to make a point on the Ohio river, at or near the city of Louisville, the terminus, the company located its railroad from Lexington to Louisville, constructed it as far as Frankfort; and partially graded it between Louisville and Frankfort, and desiring to extend the road through Louisville, to the Ohio river, below "the falls," it obtained a supplemental act, in 1833, authorizing such extension.

Under the authority of these enactments the company, with the concurrence of the Mayor and council of Louisville, extended the location of its road, within that city to a designated point in Jefferson st.; and having afterwards obtained the consent of the Mayor and council to the construction of the road from Portland below "the falls" to Thirteenth street; thence along Main street, to Sixth cross-st., and thence to the wharf; with permission "run its cars *by steam,* at the rate of not more than six miles an hour between Sixth and Thirteenth sts.," it constructed the road accordingly, from Portland to the intersection of Main st., and Sixth cross st., in Louisville; and from the 29th of April 1838, until arrested by the Chancellor, on the 26th of October 1838, it had used the railroad between those points, chiefly by transporting daily about five hundred and fifty passengers in cars propelled generally by steam, though sometimes drawn by horses, at the price of twelve and a half cents for each passenger. instead of the accustomed hack charges, which have generally been from twenty-five cents to one dollar.

The injunction was granted on a bill filed by Elisha Applegate and forty-three others, most of whom were either owners or occupants of property on Main st., between Sixth and Thirteenth cross st., forty of whom were citizens of Louisville, and all of whom alledged that the railroad through the city, was a *nuisance purpresture* and unlawful encroachment on their private rights of property.

The railroad company, in its answer denied most of the principal allegations of the bill, and insisted that the road had not operated as a nuisance, or an encroachment on private right.

Between the granting of the injunction and the final decree, twenty-six depositions were taken and filed—ten for the complainants, and sixteen for the defendant. And, on the final hearing of the case on the bill, answer and depositions the Chancellor perpetuated the injunction as originally granted, upon the following grounds, stated in the conclusion of a very copious and learned opinion delivered when the first decretal order was made:—"It seems to me that the jurisdiction of the court to interfere by way of injunction, is clear according to established principles and precedents; that the case shows a common nuisance by which the plaintiffs have special damage; a purpresture amounting to a nuisance; a disturbance of easements annexed by grant to private estates and of privileges dedicated and secured by a public law of the general assembly of Virginia, in the streets and town of Louisville; of a corporation abusing the powers arising out of the act of incorporation, thereby working serious injuries to the complainants; and finally of a disregard of private rights, of a character continuous, vexatious, and degenerating into a species of irrepairable nuisance."

In addition to those already suggested, the following facts clearly appear: first, that in 1781 Louisville with its main street and cross sts., from first to twelfth, as now and ever since existing, was established by an act of the Legislature of Virginia, vesting the legal title in trustees, and declaring that purchasers of lots should "have and enjoy all the rights, privileges and immunities which the freeholders and inhabitants of other towns in this State not incorporated by charter, have, hold and enjoy." Second, that the lots owned or occupied by the appellees on main street, between sixth and thirteenth cross streets, had been purchased from the trustees, many years ago, and have been held by the purchasers and their alienees ever since.

Third—that most of the wholesale and heavy business in Louisville, is, and ever has been, done on Main street, between Sixth and Second cross streets, that the population between Sixth and Thirteenth streets is comparatively thin, and that the business houses on that portion of Main street, are chiefly retail shops, groceries and coffee houses. Fourth—that the title and authority of the trustees of the town passed by the act of incorporation to the Mayor and Council of the city of Louisville, subject to all then subsisting trusts, private rights and public obligations; and fifth—that Main street is ninety feet wide; the railroad in the centre, with a single track; and the entire street, since the construction of this track, has been used as a pass way for all persons and vehicles, without objection by the railroad company, and without any assertion by it of an exclusive right to use that portion of the centre of it which is covered by, and included within, its *flat* iron rails.

But, as to the effect of the railroad, and of the use made of it by the company, there is much diversity in the opinions of the witnesses, who testified in behalf of the appellees, and of those who deposed on the side of the appellant.

Some of the ten witnesses for the appellees expressed the opinion, that the rails of the railroad obstructed the free and convenient public use of Main street; some of them testified to facts conducing to show that the use made of the road by the company, and especially by the frequent transportation of passengers in a long train of cars, propelled by steam, alarmed horses, and endangered the security of persons passing on foot, on horses, and in hacks and private carriages; and all of them averred, that in their opinions the railroad, as constructed and used, had the effect of diminishing the value of real estate on Main street, between Sixth and Thirteenth, and of injuring the commercial and manufacturing business of those who resided there; and that, therefore, it was a public nuisance, and an injurious encroachment on the private rights of the appellees and of many others.

On the other side—most of the sixteen witnesses for the appellant, (and all of them who testified as to this point,) expressed the opinion, that the railroad itself was no obstruction whatever to the safe, free and convenient public use of the entire street by all who might choose to use any portion of it; and they stated facts strongly conducing to that conclusion. *All* of them expressed the opinion, that the prosperity of Louisville, and the public interest had been promoted by the use that had been made of the railroad from Portland to Sixth cross street in the city, and would be still more advanced by the completion and use of the continuous line of railroad communication, according to the charter and the avowed purposes of the company.

No one of them considered the use as made of the road even with steam power as being a *nuisance*, or as injuriously affecting the value of property the productiveness of business, or security of persons on Main street, between Sixth and Thirteenth, or elsewhere. Most of them were of the opinion, that as steam when well regulated as a motive agent, may be more easily and promptly controlled than horse power cars propelled by steam with a velocity not exceeding six miles an hour, were more safe to the public than cars drawn by horses, and were not more perilous or inconvenient than hacks, stages and omnibusses.

Some of them proved that cars are run by steam through some of the towns and cities in Europe, and through Orleans, Lancaster, Philadelphia, Richmond, Frederick, and several other town and cities in the United States, without having been considered *nuisances*, so far as they had heard or believed; and that some of the streets, through which long trains of cars moved by steam, are frequently running, are narrower, more populous and much more thronged than Main street in Louisville, between Sixth and Thirteenth cross streets. Some of these witnesses, also, indicate by their testimony, more than an ordinary acquaintance with railroads and steam power—and all of them state facts conducing persuasively to sustain all the opinions they have expressed.

It neither appears, nor has been suggested, that the speed of the cars, when propelled by steam on Main street, in Louisville, had ever exceeded the prescribed rate of six miles an hour; and it does appear clearly that the travelling and commercial public would be benefitted by the continued use of the railroad, as constructed and hitherto used, from Portland to the heart of Louisville; and the more especially, during that season of the year when the boats cannot pass over the falls of the Ohio river.

Upon these facts, the Chancellor's decree is to be revised, and either affirmed or reversed. The streets of Louisville were designated, not only for subserving the public purposes for which the town was established by law; but also, for the especial convenience and enjoyment of such persons as should purchase and hold lots contiguous to them. The title to such lots carries with it, as essential incidents, certain services and easements, not only valuable and almost indispensable, but as inviolable as the property in the lots themselves. And, therefore, the owners and occupants of houses and lots on Main street, between Sixth and Thirteenth, have a peculiar interest in that street, which neither the local nor general public can pretend to claim—a private right of the nature of an incorporeal hereditament, legally attached to their contiguous ground—and incidental title to certain facilities and franchises assured to them by contract and by law, without which their property would be comparatively of but little value, and would never have been bought by them.

Although, therefore, an ordinary public way may be discontinued or applied to some other public purpose than that for which it was first established, without any legal liability for pecuniary compensation to the local public, or to any owner of adjoining land—because neither such public or proprietor had any right of property in the way or any other legal interest in it than that which was common to all the people, and though, also, the Mayor and Council holding the legal title to the streets of Louisville, in trust chiefly for public purposes, might regrade and improve those streets, or authorize the public use of them, in any mode consistent with the objects to which they were first dedicated, without obtaining the consent of the owners of the lots thereon, and without making any compensation to them—nevertheless, there may be no constitutional authority for closing or discontinuing any one of the streets, or even for applying it to any public or private use, incompatable with any one of the ends for which such street was established, without first obtaining the consent of the owners of lots thereon, or without making just compensation to them for any damage which may result to their property, corporeal and incorporeal, from such exclusion, discontinuance or new application of the street.

The commonwealth, with all her sovereign right of eminent domain cannot take away private property, even for the most imperious or important public use, without either the owner's consent, or the payment to him of a just equivalent in money.

But, we cannot concur with the Chancellor in the opinion, that the commonwealth could not constitutionally exert her eminent authority, to take private property for public use, through the instrumentality of the railroad company. Public roads of all sorts, may be constructed wherever the sovereign shall be pleased to have them; and if the public choose to avail itself of the capital and liberal spirit of select persons for insuring the construction of an important highway, the persons who may agree thus to appropriate their own funds, may surely be permitted to enjoy, as some equivalent for the expenditure, the profits of tolls prescribed by law, for using the road, and may be authorized to construct and preserve it by all the means which the commonwealth could constitutionally employ. The sovereign will can be effectuated only by the instrumentality of agents. And in the case just supposed, the private association should be deemed the agent of the public, although as to its conventional privileges and profits, it may be only a private corporation; and the road also should be considered, in the popular sense, a public highway.

In 4 East, (2nd ed.,) p. 21, it was adjudged, that though the lord of the fee was entitled to the profit arising from the use of an established road, yet it was a public highway—"le haut chemin le Roy." When the legislature incorporates an association of private persons for the purpose of making a turnpike road or a railroad, the public welfare should be presumed to be the legislative object of the enactment; and though the interest of the corporators be private and exclusive, yet the construction of the road should be deemed to have been authorized for the public good, as the chief and primary object; and the act of incorporation, and the priviledges granted to the corporators should be considered only as a means for effecting the public end, and as secondary and incidental only.

And to accomplish such an end by such means; the sovereign power may, undoubtedly, as we think, exert through such an instrumentality, all the constitutionally authority which it might employ, for the effectuation of a similar object by any other agency, or in any other mode. The railroad is applied to "public use," though the profits are appropriated to private use.

And the legislative authority to take private property implied, that when so taken it would be appropriated to the use of the public. The right of eminent domain has long been exercised in similar modes here and elsewhere, without question, and in instances almost innumerable. In this manner nearly all the turnpike roads have been made, and all the railroads; and thus, too, are mills established; by the condemnation of private property on the application of persons who desire to make profits by the tolls:—and the cities of Lexington and Louisville, and other incorporated cities, thus only exercise the power of opening new streets, by taking private property, upon the payment of the assessed value of it, to the owner or owners.

This proposition was considered so indisputable, that this court, in the case of O'Hara vs. the Lexington and Ohio railroad company, (1 Dana, 232,) decided that an appeal by O'Hara, from a judgment on an assessment of damages upon a writ of ad quod damnum, should be affirmed without argument as a delay case—the only ground for prosecuting the appeal being the assumption that the legislature had no constitutional power to authorize the company to take his land without his consent, even upon paying the assessed value of it. Judge Underwood did not, as the Chancellor seemed to have imagined, dissent from the opinion that there was no plausible ground for seeking a reversal of the judgment. In that opinion he fully concurred; but, as the report of the case itself will show, he thought the submission was premature, only because the appellant had not filed the record, and the case was submitted by the appellee, upon a record filed, without the appellant's concurrence, only a few days after the appeal had been taken.

In such a case, the court did not consider it necessary to write an elaborate opinion, but was contented with a suggestion of the general reasons which it deemed satisfactory—believing, as it did, that, upon such a point as that then involved, such a brief and comprehensive opinion was better than much amplication.

The brevity of the opinion ought not, therefore, to have been assumed, as it has been by the Chancellor, as proof that the judgment of the court was hasty and inconsiderate. A similar judgment has been virtually rendered in many other cases in this court and in many other courts; and the Chancellor's decree exhibits the only opposing judicial opinion we have seen or heard of; "Aliquando bonus dormitat Homerus."

But there was no writ of ad quod damnum in the city of Louisville.

Nor was such a proceeding necessary unless the railroad or the use of it should be deemed to have been a purpresture or a nuisance operating to the damage of private property or the injury of some private right.

The purchasers of property on Main street, as on every other street, took their respective lots of ground subject to all the contingencies that might arise to it and to the use of it, from all the uses which might ever be made of the street as a publie way, consistently with the objects of its original dedication.

If the construction of the railroad and the use made of it were not inconsistent with those public objects, nor with private rights, the Mayor and council of the city of Louisville had an unquestionable right to authorize such construction and use of it, without any ad quod damnum. Unless the railroad on Main street be, per se or otherwise, a nuisance, either public or private, then, as all persons have an equal right to use the street, with carriages for transportation, consistently with the objects of its dedication, we cannot doubt that the railroad company, under the sanction of its charter and with the permission of the local municipality, had a right to lay its own iron rails in the streets, for the purpose of facilitating the use it might rightfully make of it, in cars adapted to the improved mode of transportation on railways. And unless the railroad, either in itself, or in the use made of it, should be considered a purpresture or other nuisance injuriously affecting private rights, and which even the Legislature could not constitutionally authorize, there could have been no necessity for an ad quod damnum to assess damages which no person would have been entitle to claim.

The supreme law requires such an inquisition only, when private property is taken and applied to public use; and private property, could not be considered as being thus taken or applied when there is neither any injury to or deprivation of any private right. Any injury to private right by either the construction or the use of the railroad, would be a private nuisance.

And if the road, or the use made of it, did not thus operate, there was no necessity for an inquisition concerning damages. And therefore, in the language of Justice Holroyd, in Rex vs. Russell et al (13 Eng. Com. Law Rep. 254,) we are clearly of the opinion that, unless the railroad, or the use made of it, should be considered, "upon the facts and merits, a nuisance, the neglect to make them the subject of an ad quod damnum, will not make them so."

Nor, if their be no such nuisance, could there have been any breach of the compact with Virginia, or an impairment of the obligation of any contract implied in the purchase of lots by the appellees and other citizens of Louisville.

If either purpresture, or other nuisance, injurious to the private rights of the appellees be clearly established, the Chancellor may have had jurisdiction to enjoin such wrong.

But both public policy and a long series of adjudged cases, require that a public improvement, so benificent in its general operations and results, and more especially when, as in this case, sanctioned by the Legislature of the local public, should not be destroyed or suspended by the injunction of a Chancellor unless strong reasons for doing it be conclusively manifested. The only decisive or pertinent question to be judicially considered in this case, is, therefore, whether a purpresture or other nuisance injurious to private rights, has been satisfactorially established by the appellees.

A purpresture being the appropriation to exclusive private use or the enclosure for such use, of that which belongs to the public—it seems to us, that the facts exhibited in this record, will not authorize the conclusion that the railroad itself, abstracted from the use made of it in the city of Louisville, was ever such a nuisance or wrong as is technically denominated purpresture.

The opinions and the facts presented in the record preponderate decidedly against any such deduction. And if, as should be presumed, in the absence of proof to the contrary, the road has been constructed as was required by the corporate authorities of Louisville, and as it certainly might have been constructed, it may not obstruct the public use of the whole street by any person who may wish to use any portion of it in any accustomed mode. And it is evident that the entire street, railroad and all, has been used by the public as a common highway for wagons, carriages, horses, and footmen, without objection by the railroad company, or even the assertion of a right in the company to any exclusive use of that part of it covered by and contained within its rails. It appear to us, therefore, that there has been neither an enclosure of any part of the street by the company for its exclusive private use, nor any appropriation of any portion of it to such exclusive use, in merely construcing the railway. If such exclusive use should ever be monopolized, or attempted, then it will be time enough to denounce the railroad as a purpresture. It is premature to utter such a denunciation now, merely because the charter vainly purports to confer the empty and unavailing right to such use.

Nor for the same reasons, can the railroad, in itself alone, according to the evidence and all proper deductions and presumptions, be deemed a nuisance in any effectual and injurious sense.

This is virtually conceded by the Chancellor's final decree; for if he had considered the mere rails in the street as being a nuisance, he would as we presume have not left the nuisance remaining as he has done, by only enjoining the running of cars upon the rails; but would have also required the removal of them, and a restoration of the street from their noxious effects.

Did the use which was made of the railroad on Main street operate as a nuisance, injurious to private rights? This is the only remaining question we deem worthy of grave consideration. As already intimated, we cannot concur with the opinion expressed by the Chancellor, that the possibility that the company may at some future day, arrogate to itself the exclusive use of the railroad track along Main street, shows, or tends in any degree to show, that either the road itself or any use hitherto made of it, should be deemed a nuisance. Nor can we doubt that the fact, that the appellants may have lost something of interest merely, such as a reduction in the profits of their business, or in the value of rents of houses, is insufficient to show a nuisance, or authorize an injunction. There must have been an invasion or deprivation of some right, before they could be entitled to any relief in a court of equity.

We have admitted that neither the constituted authorities of Louisville nor the legislature of the State, could either license a private nuisance, or could take or encroach on private property, without the owner's consent, or the payment to him of adequate damages, or could appropriate any street in Louisville to any use to which it was not originally dedicated, unless the consent of all those immediately interested in such street should be given, or just compensation should be first made to them.

But, even though some persons owning property on the railroad street, may be subjected to some inconvenience, and even loss, by the construction and use of the road, yet if the use made of the road be consistent with the just right of all, such persons have no right either to damages, or to an injunction; because they purchased their property and must hold it, as all others purchase and must hold town lots, subject to any consequences that may result, whether advantageously or disadvantageously, from any public and authorized use of the streets, in any mode promotive of, and consistent with, the purposes of establishing them as common highways in town, and compatible with the reasonable enjoyment of them by all others entitled thereto.

As the Legislature and the local authorities of Louisville authorized the construction of the railroad through that city, and also authorized the company to employ upon it cars and steam power; and the more especially as such improvements in the means of transportation must be useful to the travelling and commercial public, and in many respects, obviously advantageous to the local public of the city itself; it does seem to us that, *prima facie*, the ordinary and careful use of the road, as thus authorized and prescribed, should not be deemed a nuisance, public or private.

This deduction is fortified by the fact already suggested, that railroad cars, drawn by horses, and propelled also by steam, are permitted to pass through other cities in both Europe and America, and have not in any instance been adjudged nuisances; and the facts proved in this case corroborate the same conclusion.

Main street in Louisville was established as a common highway for the universal public; and as said in Rex vs. Russell, "the right of the public is not confined to the purposes of passage; trade and commerce are the chief objects, and the right of passage is chiefly subservient to these ends."

It must be an extreme and anomalous case, in which an improved mode of transportation, which not only facilitates passage, but promotes trade and commerce in and through the city of Louisville, could be nevertheless a nuisance. It should never be so considered, unless in its operations it unreasonably circumscribes or excludes the rightful use or enjoyment of Main st., by others, who have an epual right to the use and enjoyment of it.

Russell and others, indicted in England for a common nuisance, by the erection of Staiths in the river Tyne, for facilitating the coal trade, were acquitted on the ground that, though the erection abridged the common use of the river as a navigable stream, yet it was for a public purpose, was in a reasonable situation, left a reasonable space for the passage of vessels, and was beneficial to England, by producing areduction in the price and an improvement in the condition of coal.

And the Court of King's Bench, consisting of Lord Tenterden, Chief Justice, and Bailey and Holroyd, Justices, refused a new trial—the two latter concuring, and the former dissenting only on the ground that he was inclined to think that it was not, as the jury had been instructed, the fact of benefit to England, but the fact of an improvement in the business of the Tyne, which should be considered as decisive against the charge of nuisance.

In the case of the King vs. Edward Pense and others, (24 Eng. Com. Law, Rep. 17,) the Court of King's Bench rather approved the decision in Rex vs. Russell and others, and seemed to recognise the principle that an injury to one mode of transportation and travel, by the rival use of another mode more beneficial to the public, was not a public nuisance. Under the authority of an act of Parliament, a railroad with the stationary privilege of using steam power, had been constructed parallel with, and almost contiguous to, a previously established and then existing public turnpike, from Stockton to Yarm, in the county of Durham—and Pease and others were indicted for using on the railroad, ten locomotive engines propelled by steam, to the great alarm of horses, and the annoyance and peril of persons travelling on the turnpike; but, though the facts were proved, the accused were acquitted, and the Court of King's Bench approved the verdict chiefly on the ground just suggested.

But, in the subsequent case of the King vs. Ward, (31 Ib. 91,) the same Court in an opinion delivered by Chief Justice Denman, seemed to concur with Lord Tenterden, in the distinction intimated in his dissent in Rex vs. Russell, et al. And we should be inclined to concur in this last view, as the more reasonable and authorative.

The cases which we have just noticed, chiefly involved the question of public nuisance; but they recognize a plain principle applicable to this case; and that is when applied to this case, just this—that, even if the use of the railway in Louisville may in some degree have occasionally operated as an enclosure of a small part of Main street, along the centre of it, or diminished or rendered less convenient or free, other uses of it, by persons equally entitled to use it in other modes, still, though a compensatory benefit to the general public, might not be sufficient to show that it was nevertheless, not therefore a nuisance, yet such a benefit to the business of the street as a highway for passage, transportation and commerce, resulting from such a use of the street, by the railroad company, as did not unreasonably disturb others in the rightful use of it, could not be considered wrongful. And this principle is evidently just and undeniable.

Unless, therefore, it clearly appears in this case, that, in the use made of the railroad by the running of cars upon it, other accustomed uses of it were excluded or unreasonably obstructed or abridged, or private rights invaded, the Chancellor's injunction cannot be maintained.

And this inquiry is devisable into two branches:—First, was the running of a car on the railroad a nuisance? Second, did the length of the train of cars which were used upon it, or the frequency of the transits, constitute a nuisance?

First. As it appears clearly, from the testimony, that a single car drawn by horses was not more inconvenient or perilous than a wagon, stage coach or a hack, we are bound to infer judicially that, so far as the use of the railroad may be concerned, the prudent running of one such car upon it cannot be deemed to have been a nuisance in any respect. Nor do we feel authorized, by the facts now before us, to decide judicially that the discreet running of any single car propelled by steam, was any nuisance.

We will not presume that the ordinary operations of a well regulated steam engine must necessarily be a nuisance in a city or town; and especially when, as in this case, we have facts and opinions of observant men, conducing strongly to the conclusion that a steam car in motion on the street of the city, is not, merely as such, a nuisance, public or private.

A steam mill or manufactory has never, so far as we know, been adjudged a nuisance, merely in consequence of the peculiar character of the moving agent; nor has a steamboat or ship, merely as such, been ever considered a nuisance any where. Railroads frequently cross other highways are sometimes parallel with them, and always pass, at some point, through a dense and travelling population.

And of course, wherever they may be, if steam engines be used upon them, persons travelling in stages, private carriages, on horse, or on foot, are often subjected to some annoyance, inconvenience and hazard. Steamboats, also, are necessarily prejudicial to other boats.

But a steam car on a railroad, or a steamboat on a river, is not, therefore, *per se* a public or private nuisance, they have both become eminently useful as means of commercial and social intercommunication; and their prevalence and success only demonstrate their great utility and general popularity.—They may curtail the profits of carts, drays, arks and wagons; but they do this only because they are preferred, and the interests of society require the use of them.

They may also do, as but too often they have done, private injury and personal damage. But such occasional consequences must be expected from other agents of transportation in a populous and prospering country.

Therefore, according to the testimony in this case, we cannot decide that either a horse car, or a steam car, running cautiously on Main street in Louisville at the rate of only six miles an hour, should be deemed to be a nuisance to the public, or to the appellees, or any of them.

We are, therefore, of the opinion, that the Chancellor ought not to have enjoined the use of the railway altogether by the running of any car upon it. Second. Nor do we feel authorized, by the facts as now presented to us in this record, to decide that either the train of cars, as used on the railway, or the frequency of their transits, operated as a nuisance in judgment of law. Though the train may have been generally from sixty to ninety feet long, and though also, it may have passed frequently every day, yet it has not been satisfactorily shown that, either the crossing of the street has been unreasonably obstructed, or that the open space on each side of the railway were not always sufficient for the passage of wagons, carriages, horsemen and foot passengers, without unreasonable inconvenience, unless the apprehension and surprise occasionally produced by the novelty of the spectacle, the noise of the cars, and the puffing of the steam pipes, should be deemed unreasonable.

But these alone we are not authorized so to consider, as we have already suggested. The proofs incline to the opposite conclusion. It would be unreasonable to use a longer train than the ordinary purposes of a safe and useful transportation should require. It would be unreasonable to make more transits than the same objects should demand.

It would be unreasonable to detain the cars on the street any longer than a faithful and vigilant superintendent should find necessary for effecting those objects, prudently and as safely and conveniently to the rights of others as possible. It might be unreasonable to run a long train of cars in quick succession, and at uncertain periods and irregular intervals, so as to take the public by surprise. And it might, perhaps, be also unreasonable to use a train as long as ninety feet, or to make successive transits so frequently on Main street, as was done when the cars were used upon it by the company. But the facts appearing in the record do not enable us to determine, certainly or satisfactorily, that, in any of these particulars, the company had habitually, or even in any instance, transcended reasonable limits.

Nor are we convinced, by the facts now appearing, that any public right of passage upon, or other use of Main street, or any franchise, or personal security, has been unreasonably abridged by the railway, or by the use which has been made of it. The evidence when carefully compared and weighed inclined to the opposite conclusion.

And, considering the sparseness of the population on Main street, between Sixth and Thirteenth, and the character of the business chiefly done in that portion of the city, it may not be unreasonable to infer, from preponderating opinions in the record, that the use hitherto made of the railroad by the company in the running of its train of cars, may not have been unreasonably prejudicial or inconvenient to the appellees, or to any portion of the public. If there has been, as alleged, some diminution in the profits of a few persons engaged in business, between Sixth and Thirteenth, the facts authorize the inference, that this has resulted chiefly, if not altogether, from the translation of that business, by the cars to other portions of the city, or from the conversion of it into some other and more useful business, in consequence of the facilities afforded by the railroad.

This is no ground of just complaint. It is but a common case in commercial cities; and will always occur in a greater or less degree, from all improvements in the arts, and all public improvements for facilitating travel and commerce.

And it is evident, that the use of the railway, as made by the company, produced to the city of Louisville and to the public generally, much more of good than of evil.

In such a case, we cannot decide that the use which had been made of the railway in the city, had been so excessive or injurious, or unreasonable, as to authorize this court to require any prescribed curtailment or modification of that mode and kind of use. No facts appear which would enable us to determine the precise manner and extent of limitation upon the use, even if, as may not be altogether improbable, there had ever been, in any respect, any use unreasonably or unjustly inconsistent with private rights. As a guarantee against abuse, the municipality reserved the power of revocation, if the running of the cars, or the construction of the railway itself, should ever become an obstruction to the free and common use of the street by the entire public, or should unreasonably endanger personal security.

The fact that the public authorities of Louisville have not interposed or complained, tends rather to repel the inference that the running of the cars has been unreasonable or injurious. And the deduction from this circumstance is, in some degree, corroborated by the fact, that only ten persons have deposed in favor of the appellees. As, therefore, it does not satisfactorily appear from the record that the railroad has been used in such a manner as to authorize restriction or modification by the order of this court; and, as the evidence would not enable us to prescribe any precise curtailment or modification of the use of it by steam power and cars—we do not feel authorized to perpetuate the Chancellor's injunction to any extent, or in any respect.

If, hereafter it shall ever be ascertained satisfactorily, that an injurious abuse of its privileges is committed by the company, those privileges may be revoked by the official guardians of the interest of the citizens of Louisville, or the company may be restrained within reasonable limits by the Chancellor upon ascertaining such facts as may enable him to prescribe proper and exact regulations for controlling the use of the road in the city. Were we to undertake such a task now, we should act without sufficient authority from the record before us, and should make a leap in the dark, whereby we might unjustly prejudice private rights and important public interests.

In such a case, involving such interests, no injunction should ever be decreed, without clear proof of a nuisance, injurious to the private rights of the applicants. If there has not been an unreasonable use of the railroad in Louisville, injurious to the rights of the appellees, we cannot sustain their injunction merely on the ground (if it had been even satisfactorily established) that they may be subjected to some inconvenience, and even loss, in consequence of the novelty of this mode of transportation in their city, or the extent of its success in a fair competition reasonably conducted.

If a train of cars, occasionally obstructed, in some slight degree, a perfectly free and convenient passage of a private carriage, or wagon, or horse, and produced some apprehension and even danger, successive hacks, or stages, or omnibusses, with the same number of passengers, might perhaps have caused the like obstruction, apprehension and damage. Such inconveniences, whenever they may have occurred, might have been, and we cannot say they were not, the ordinary consequence of the free and common use of a public street in a commercial and prosperous city. And when they occur without negligence or wantonness or unreasonable purpresture, they should be considered by the citizens, as evidences of the appreciation, rather than the depreciation of their property. For that very business and bustle which must inevitably produce some such occasional inconveniences, and collisions, and prrsonal losses, Louisville was established, and its main street made as it is. And as that growing city shall continue to grow and prosper, similar accidents will more frequently occur, and be more sensibly felt. And, if there shall never be another steam car or horse car upon its streets, hacks and omnibusses, perhaps as pestilent and not so suitable will crowd the way, and supply their places, possibly to the disadvantage of the city and the whole community; and when too, the houses on the street between Sixth and Thirteenth, will not as now, be "few and far between," nor be occupied as now, chiefly by retail shopkeepers and retailers of liquors.

The onward spirit of the age must, to a reasonable extent, have its way. The law is made for the times, and will be made or modified by them.

The expanded and still expanding genius of the common law should adapt it here, as elsewhere, to the improved and improving condition of our country and countrymen. And therefore railroads and locomotive steam cars the offsprings, as they will also be the parent of progressive improvement, should not, in themselves, be considered nuisances, although in ages that are gone, they might have been so held, because they would have been comparatively useless, and therefore more mischievous.

We know that a zealous and inconsiderate spirit of innovation and improvement requires the vigilance and restraint of both reason and law. We are fully aware, also, of the fact that, when such a spirit is abroad, private rights are in peculiar danger, unless sternly guarded by the judiciary; and we are not sure that such guardianship is not most needed in a government where whatever is popular is apt to prevail at first, and often at last, only because it is the *vox populi.*

This case has been, therefore, carefully and anxiously considered, under a full sense of its magnitude, and of all the responsibilities of an authorative decision of it by the court. After thus considering it, upon all the facts presented, we are unanimously of the opinion that no cause has been sufficiently established for enjoining the use of the railroad in Louisville, as the Chancellor did, altogether, or for enjoining even such use as has been made of it by the railroad company.

We do not wish to be understood as deciding, that we are satisfied that the use of the railway, as hitherto made in Louisville, was not in any respect a nuisance. All we have decided, or intended to decide, is that the facts upon which alone we have had to adjudicate in this case, do not authorize the judicial deduction that a nuisance has been sufficiently proved. If it shall ever hereafter satisfactorily appear, upon other proof, that such use as that complained of by the appellees, encroaches on any private right or obstructs the reasonable use and enjoyment of the street, by any person who has an equal right to the use of it, we shall be ready to enjoin all such wrongful appropriation of the highway. The railroad company having made its answer a cross bill, and prayed for damages sustained by it, in consequence of the injunction, the Chancellor, in his final decree, dismissed the cross bill absolutely; and the appellant complains, also, of that decree.

The Chancellor granted the injunction without requiring any bond or other security.

Whether this was proper or not, we need not now determine. But in this state of the case, if, as may be presumed in the absence of proof to the contrary, the appellees filed their bill, obtained the injunction, and prosecuted the suit in good faith, believing that the railway, or the use made of it by the company, was a nuisance operating to their private injury, it is our opinion that they are not, according to any adjudged case, or established principle of equity or law, responsible for damages.

As they have never undertaken to pay any damages in the event of an ultimate dissolution of their injunction, it seems to us, that they could now be made liable only for a malicious prosecution. And not only is there no satisfactory proof of any such vexatious or wanton motive, but we are inclined to think that if there had been, a court of equity was not the appropriate forum for assessing the damages, to which the appellant would in that event be entitled. Whether, therefore, the Chancellor had jurisdiction over the matter of the cross bill, or whether he had not, his decree dismissing the prayer in that bill for damages, was, in our opinion, proper. Wherefore, it is decreed by this court that the decree of the Chancellor dismissing the cross bill be affirmed; and that the decree perpetuating the injunction against the running of cars on the railway on Main street, between Sixth and Thirteenth cross streets, in the city of Louisville by the Lexington and Ohio railroad company, be, and the same is hereby reversed: and that the cause be remanded, with instructions to dissolve the said injunction, and dismiss the original bill, with costs.

We have before this had occasion to commend the very able treatise of Mr. Charles Ellet on the "Laws of Trade," and we now have the pleasure of presenting to our readers an exposition of some of these principles in a popular form. Mr. E. is of the opinion, that no effort should be spared in bringing this most important subject into general notice, and while in his former work, he has aimed at the foundation of the Laws of Trade, upon strict mathematical reasoning, for the satisfaction of the professional reader, he has in this one now before us, translated his mathematical, into popular phraseology, thus opening the subject to all classes of the community. There is no time more fitting than the present, for the discussion of this subject, and convinced as we are, of its momentous bearing, we recommend the paper of Mr. Ellet to the attentive perusal and earnest consideration of our readers.

A POPULAR EXPOSITION OF THE INCORRECTNESS OF THE TARIFFS OF TOLL IN USE ON THE PUBLIC IMPROVEMENTS OF THE UNITED STATES. BY CHARLES ELLET, JR., CIVIL ENGINEER.

The object of this paper is to point out, in a brief and popular view, the consequences of some of the errors which are committed in the charges assessed on the public works of this country.

The writer has recently published a work* in which he has attempted to expose the true principles of trade, and to show the only correct mode of determining the tolls proper to be levied on our great lines of canals and railroads. But it has been suggested to him by some intelligent readers of that work, that the method of analysing the subject which he has been compelled to adopt in it, is not the best adapted to the pursuits of the class of readers most likely to be interested in the subject; and that some advantage might be derived from exhibiting, in a popular form, a few of the results which were there obtained by a different process. This paper is intended to subserve that purpose; and to show that the principles on which all the tariffs in the country are based, are unsound, and lead, in their application, to oppressive injustice to a portion of the community, and to great loss of trade and revenue to the improvements.

Section I.—*Of the importance of the subject.*

1. There are no questions of public policy which are thought to concern so intimately the general and particular interests of the people of this country, as those which relate to their internal improvements. The consideration of this subject constitutes the greatest part of the legislation of nearly all the States in the Union, and the employment of the privileges sanctioned by the law, constitutes a prominent portion of the efforts of individual enterprize. There are now completed and in use in the country more than three thousand miles of railroads, and not less than three thousand miles of canals, the construction of which has occasioned an actual expenditure of probably $150,000,000, and for which loans have been incurred by the State governments or incorporated companies, to nearly an equal amount.

*An Essay on the Laws of Trade in reference to the works of Public Improvement in the United States.

This enormous investment of capital is by some viewed as alarming; and might indeed, appear so, when it is considered that a draft of some $8,000,000 will be annually made on the country for the payment of the interest on this sum, and that the principal itself, in the brief space of twenty years, may possibly have to be refunded. On the other hand, there are sanguine advocates of improvements, who look to the revenue to be derived from the works themselves, consequent on the rapid growth and progressively increasing productiveness of the country, as offering an ample guarantee for the prompt payment of the interest, and the due liquidation of the principal, of the debt.

It is not the intention now to discuss this momentous question, or to endeavor to ascertain which of these hypotheses approaches nearest the truth. Both are but surmises, advanced as the result of a hasty glance at the facts, or possibly based on no safer evidence than the prepossessions, or mere conjectures, of the parties. They are wanting in that detail, that exhibition of statistical information, without which it is impossible to generalize with security.

Doubtless many of the works of the country will possess abundant means to sustain their credit; and among so many enterprises, it is equally probable that some have been undertaken which will fall very far short of the expectations of their patrons.

2. But, whatever may be the general ability of these immense lines of improvements, it is certain that the success and profitableness of those which are now progressing under the fairest auspices, are not so well established but that it ought to be an object of deep solicitude with their proprietors to find the means of increasing their productiveness. To every state that has embarked in a career of internal improvement, and to every individual who has invested his property in such stock, it is an interesting question to ascertain the most efficient means of equalizing the charges on the trade, and increasing the revenue and tonnage of the line.

The public improvements of Pennsylvania are sinking that commonwealth in debt about a *million and a half per annum*—or, in other words, the interest on the loans incurred for their construction, added to the annual charges for repairs and superintendence, exceeds the gross revenue of the works from one or two millions of dollars per annum.

Those of Ohio, and many of those constructed by great incorporated joint stock companies, exhibit balances scarcely less unsatisfactory; and although these unpropitious results cannot be fairly adduced as evidences of the impolicy of the undertakings, they are facts which may be legitimately used in evidence of the necessity of inquiring into the correctness of the principles of their management. Many of them are now regarded as partial failures, and have involved the community in great pecuniary difficulty. Possibly a careful investigation of the principles on which their tariffs have been established, may lead to the conviction that there is some radical error of administration which may be advantageously corrected.

No more fitting season can be selected for such an investigation than the present. The system of public improvement is now prostrated throughout the country for want of the means necessary for the extension of the works. Those who have been engaged in their execution, may therefore take time to consider by what mode the tax with which they load their constructiors may be lightened, or the revenue they pay may be augmented.

3. It is not less important that the charges adopted on the works should be those which would render them most productive to the stockholders, or to the commonwealth as a proprietor, than that they should be reconcilable

with principles of justice. In levying a tax for purposes of revenue on any portion of the property of the public, it has been an object of legislation in all times, to make the nearest possible approach to equity in its distribution. The tolls charged on the works of the commonwealth are intended for revenue, and they should be so adjusted, if such an adjustment be practicable, as to produce the greatest possible revenue with the least inequality in the taxation.

At the same time it is essential to have due regard to the cultivation of the trade, which is the primary object of the improvements—a condition which must be reconciled with those above stated—of drawing the greatest possible revenue from the transportation of the produce of the country, and an adherence to principles of equity in the distribution of the tax.

This may appear to be a complicated problem, the solution of which, however desirable in itself, can scarcely be regarded as attainable in practice.

I shall endeavor, however, to show by a few evident propositions, both that the principles by which these charges are now assessed on all our great lines, are such as operate unjustly upon a large portion of the country; are such as in a great measure defeat this primary object of the improvement, that of inviting the distant trade to a market—and such as reduce the revenue far below the limit belonging to a more just and more judicious tariff; and, at the same time, that an attention to the true laws of trade will render the avoidance of these errors exceedingly easy.

Section II.—*Of the incorrectness of the principles on which tolls are at present assessed.*

4. To be able to appreciate the necessity of a departure from the principles on which the present charges for the use of our public works are established, it is essential to examine into the effective operation of the scale now in use. To render the view which I design to take as little complicated as possible, it may be confined for the present to one of the principal divisions of the trade of the country. For, in treating of the laws of trade it is found convenient to divide the commerce of the line into two principal classes; in the first of which is included all those commodities which will bear but a limited charge for their transportation, and which, if taxed beyond that limit, will be excluded from the line and from market. This division usually consists of stone, coal, lumber, ore, lime, and many agricultural productions. Indeed it embraces all articles which will seek a market along the line in question, and no other; and in this respect is to be distinguished from that division of the trade which consists of more valuable commodities, and which, if not accommodated on one line, will find a passage by the route of a rival work.

Our present investigation will be confined to the first of these divisions.

5. The charges which are levied on this trade consist of what are usually termed *freight* and *toll*. If the work be a canal, by freight is understood the charge of the carrier, and by toll that of the state or corporation owning the work. In the management of railroads, it is usual for the company to act as carrier on their own line; and to make but one charge, which is called *toll*, for both objects. In this pamphlet I shall make a somewhat different application of these terms, and designate by *freight*, in either case, every expense actually incurred in the carriage of the commodity, and by *toll*, the clear profit on its transportation. So that if the carrier, or transporting company, charge seven mills per mile for the carriage of one ton of any article, and the cost of repairs and superintendence of the line due to the passage of that ton is three mills per mile, I call the *freight*

on the article one cent per ton per mile; and any charge, exceeding this three mills, which is assessed by the state or company, is what I denominate their *toll.*

6. In nearly every tariff of toll adopted in this country, the charge on every article is proportional to the distance it is transported on the line.—The *toll* is some fixed amount per ton per mile. This scale of taxation, I contend, is improper and unjust.

To examine the question, let us suppose the article to be lumber, of which the market value, at the point to which it is sent, is $10 per ton. Let us also assume that the cost of producing this article, or preparing it for shipping on the canal, is $6 per ton. It is then most obvious that if the charge for transportation on this commodity exceed $4 per ton it will be wholly excluded from the line; for then the cost of carriage added to the cost of production would exceed the market value of the article, and there could be no profit to remunerate the producer. But if the charge be less than $4 there will be a certain profit, and the article will be found to seek the market.

If now, this lumber is carried a space of *one hundred miles* to its mart, and the charge for *freight* is one cent per ton per mile, the freight for that distance will obviously be $1, and there will remain a balance of $3 for the extreme limit which the article will bear to be charged for toll. The toll levied by the state, at one cent per ton per mile, will be $1, or one-third the amount, which the article could in this case sustain.

Let us next suppose that similar lumber comes upon the line at a distance of *three hundred miles* from the same mart. The charge for *freight* would now be $3, and there would consequently be a residue of only $1 on which the state might levy for toll. The commodity could bear no more than $1 —since that sum added to the $3 freight would be $4, or the difference between the cost of producing the lumber and its price in market. But, by the principle of taxation usually adopted, the toll assessed at one cent per ton per mile, would here be $3, or three times as much as the article would bear. In other words, *at the distance of one hundred miles from the mart, in the usual tariffs, a commodity is charged one dollar where it might bear a charge of three, and at three hundred miles it is charged three dollars where it could bear but one.*

7. Does it need any argument to prove that a scale producing such results is neither compatible with principles of equity or good economy? Is it not manifestly unjust to charge the man who is situated three hundred miles from market three times as much as he can afford to pay, while the man at one hundred miles can afford to pay three times as much as he is charged? Is it not any thing but good economy to tax all the trade in this article beyond two hundred miles so heavily that it is totally driven from the line, when, if the tolls were differently assessed, it might be invited, and made to pay a respectable revenue to the state? And is not the primary object of the work defeated by the adoption of a tariff that excludes those commodities from it which it was especially intended to draw to market—an effect which is accompanied by a direct sacrifice of trade, revenue and even justice?

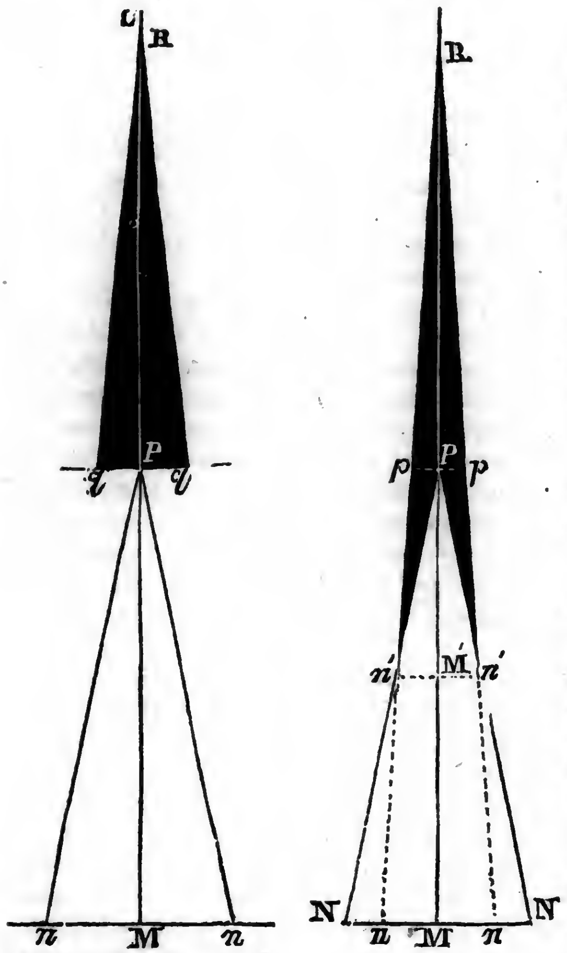
8. I think it can scarcely need more than this plain exposition to make clear to any reflecting mind that some of the charges on the public works of this country need revision: that they are based on principles which are unsound, and at once do injury to the proprietors of the work, and injustice to a large portion of the public. The commonwealth, as the constructor and owner of the improvement, is a sufferer in the loss of the trade that is excluded, and the revenue that might be derived from it; the citizens of

the emporium which is the mart of the line, suffer from the contraction of their business in consequence of the exclusion of the articles in which they traffic; and the country traversed by the improvement, and taxed, perhaps, for its construction, suffers from its inability to share the benefits which the work was designed to confer.

SECTION III.—*Further evidence of the loss of trade consequent on uniform charges.*

9. To render more palpable the fact that a charge for toll proportioned directly to the distance will cause the exclusion of a certain amount of tonnage, without conferring any compensating advantage, we will consider the subject with the aid of a diagram.

Fig. 1. *Fig.* 2.



Let M in the figure be the position of the mart, and M L the line of the improvement: and let us assume, as before, that the commodity will be capable of sustaining a charge of $4 per ton for its transportation; that the *toll* is one cent per ton per mile, the *freight* likewise one cent, and the cost of carriage on the lateral roads by which the tonnage is brought to the work, is ten cents per ton per mile.

The distance M*n* from which this commodity can be brought to the mart at M on the lateral roads *n*M, *n*M, will then be 40 miles; and the distance M P which we can afford to carry it along the improvement, at an aggregate charge of two cents per ton per mile, will of course be two hundred miles. The area of country, therefore, which will supyly trade to the line, will be represented by the triangle *n*P*n*, having a base *nn* of 80 miles, and a height MP of two hundred miles.

10. Now, it is apparent that the line will receive no tonnage of this article, from beyond the point P; and therefore, that if the trade were permitted to come free of toll from beyond that point, there would result a certain increase of tonnage, which would be accompanied by no diminution of revenue.

Under such an arrangement of the tarriff, the charge for freight from P to M, for produce coming from the country beyond P, would be only $2, and there would consequently be left a ballance at P of $2 out of the limit of $4 which the article could sustain, to bear the cost of its carriage along the lateral roads to the improvement, and down the improvement to the mart.

This balance will be sufficient to pay the cost of transportation on the lateral road from q to P, a distance of twenty miles, at ten cents per ton per mile; and the charge for freight along the improvement, from R to P, a distance of two hundred miles, at one cent per ton per mile. It would, therefore, be within the ability of the state or company, in this example, to extend the benefits of the improvement four hundred miles into the interior, instead of two hundred, and increase the tonnage of the line, with all the incidental advantages, 50 *per cent.*, without sustaining any loss of revenue.

11. It is far from my intention here to advocate a tariff arranged with a view to this effect: but merely to show what is lost by those which are commonly adopted. Instead of draining only the country contained in the triangle nPn, which will supply the trade where the charge for toll is one cent, and freight one cent, by charging toll from M to P, and permitting all articles brought from beyond the angle P to pass free of toll, the shaded triangle qRq in the figure, will be added to the area using the work and supplying its tonnage. The value of the improvement to the country will be increased one half; the trade of the city at M will likewise be increased one half, and the value of the property of the commonwealth, as far as it is dependent on the activity of the work, will be proportionally augmented.

But such an arrangement would effect injustice, and could not therefore receive the sanction of a government administered in a due regard to the first principles of its existence—the equal protection of the citizens, and an equitable distribution of the benefits which its constitution was intended to confer.

Such a tariff would augment the tonnage of the line—but it would produce that result by taxing the citizen immediately at P $4, and excluding him from the work; and the neighbor immediately beyond P but $2, and inviting him at the expense of a premium.

Besides these objections to this arrangement, there exists the additional and important one, that it would not fulfil another imperative condition—that of obtaining the greatest revenue from the trade.

(To be continued.)

RAILROADS.

The following letter from Judge Wright, who was the Chief Engineer of the Erie Canal, and who is now in the service of the State of Virginia, to Col. Dexter, the Engineer of the Selma and Tennessee Railroad, treats of matters of the deepest interest to the State of Tennesse. It will be seen that Judge Wright is of opinion that a line of railroad from the Atlantic cities on the Eastern slope of the Alleghanies, in a South Westerly direction through the Virginia Valley and the Valley of the Tennessee to Gunter's landing, could never have a competing route, for all travel from the Atlantic cities to the cities of Mobile and New Orleans.

JUDGE WRIGHT'S LETTER.

Scott's Ferry, Albemarle Co. Va.
December 2d, 1839.

My Dear Sir :—I received your favor of the 20th ult. together with the Reports of the Selma and Tennessee Railroad Company. I have examined them carefully, and looked at the map of the United States, to see the full bearing of your great project. I confess to you that when I look at the importance of a line of Railroad from the Atlantic cities, on the eastern slope of the Alleghanies, in a southwesterly direction, through the Virginia Valley, and at the favorable character of the country, as elicited by the various surveys which have been made from Lynchburg and Buchanan, on James River, to the Tennessee line, near the Boat Yard, showing that a route can be had without stationary power, and with grades not exceeding fifty or sixty feet to the mile, (and presuming, that by following the Valley of the Tennessee, favorable grades may be had to Gunter's Landing,) I think I see a location for a Railroad which can never have a competing route, for all travel from the Atlantic cities to the cities of Mobile and New Orleans.

The two last years have satisfied most people that the Ohio cannot be relied upon for four or five month, and leaves too much uncertainty to induce travellers that way.

The fact which you mentioned in your report of the Legislature of Pennsylvania, having taken action on the plan of getting to the Mississippi, by a railroad through three States, rather than rely upon the Ohio River, is strong evidence of the importance of something being done to remedy the evils in business, occasioned by severe droughts in the Western Rivers.

Our rivers on the Eastern slope are not subject to the same fluctuations of those west of the mountains, and the canal I am now forming along James River, will never want water. The town of Buchanan, (Virginia Valley) is 200 miles above Richmond. To this point the canal will soon be done; it being now under contract to within 20 miles of that place. From Buchanan there will soon be a Railroad, which uniting at a point 30 miles distant, with a railroad from Lynchburg, will pass on South to the Tennessee line, a distance of 150 miles.

The State of Tennessee has always been ready to meet Virginia, and carry it down by Knoxville, and so on to the line of Alabama.

If, therefore, the State of Alabama brings up her line to the Tennessee river, at Gunter's landing, it is certain that the States of Tennessee and Virginia will not be backward in carrying it on through, to connect with the lines now done, and in great progress towards completion. This must and will be the case, and when once done, a look at the map of the United States, will satisfy any one that no route can be projected which can compete with this, in directness of course and easy grades, taken as a whole.

I have examined your estimates of cost of grading and bridging. If you are correct in these, it shows a remarkably feasible route, and one not equalled in any country I have ever examined.

You appear to have some difficulties on the first section, from Tennessee river, and think an inclined plane, with stationary power, may be required. I had rather have grades of 90 feet per mile, than stationary power;—and should prefer to increase the distance, rather than have a change of power, in any way, either by horses or steam.

I wish you success in your application to Congress. I shall be very glad to see you when you come North, and to renew and brighten the chain of friendship, which has so long existed. Although now an old man, hard upon 70, still I am wandering about doing all the good I can, and shall continue to do so, while a kind and merciful Providence blesses me with health and the use of my faculties.

In a few weeks we shall have an annual report of the James river and Kanawha company, and I will send you a copy.

With much esteem, I am, dear Sir,

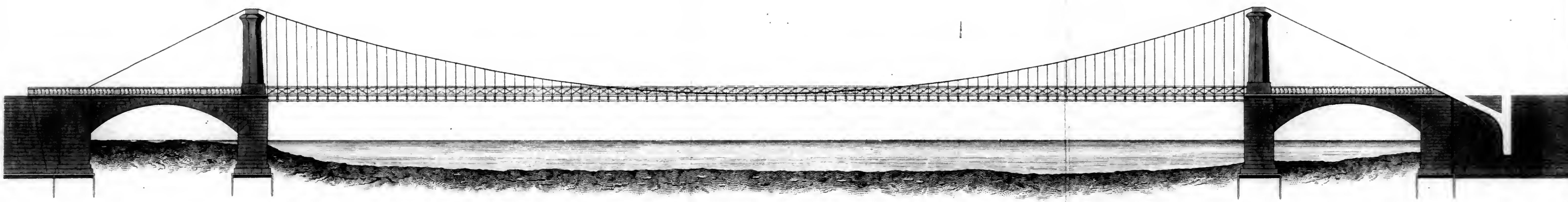
Very truly yours. BENJ. WRIGHT, *Civil Engineer.*

A. A. DEXTER, Esq., *Civil Engineer.*

☞ On examining the article in our last number, on Dr. Lardner's experiments, it appears that the writer has fallen into an error, which vitiates much of his reasoning. The article was prepared in haste, and the writer is not at present in the city, but will doubtless make the necessary correction. For the present, we request a suspension of any criticism upon it.

Elevation of the Wire Suspension Bridge across the Schuylkill at Philadelphia

By Charles Ellet Jr. Civil Engineer.



AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 5, Vol. IV. New Series. | MARCH 1, 1840. | Whole No. 353. Vol. X.

In placing before our readers Mr. Ellet's plan for a suspension bridge, for the Schuylkill, at Philadelphia, we beg to congratulate them upon the prospect of a re-introduction of this mode of bridge building. We have frequently commented upon the importance of this subject, and it may be remembered, that when introducing Mr. Ellet's pamphlet, on Wire Bridges, that we suggested the adoption of this form of structure for the Croton Acqueduct at Harlem river. Mr. Ellet, long since proposed a suspension bridge, but as no definite plan has yet been agreed upon, we think it not too late to take him up. We repeat what we then said, that a failure of the high bridge in even a small portion would cost more than a complete Wire Bridge which would answer in every particular. In these days of economy and retrenchment, it becomes our Water Commissioners to look well before they leap.

SUSPENSION BRIDGES.—PLAN OF THE WIRE SUSPENSION BRIDGE ABOUT TO BE CONSTRUCTED ACROSS THE SCHUYLKILL, AT PHILADELPHIA. *By Charles Ellet, Jr.*, Civil Engineer.

The wire suspension bridge represented in the annexed engraving, was designed in compliance with an invitation of the Commissioners of the city and county of Philadelphia; and is intended to succeed the Fairmount bridge, which was destroyed by fire in the summer of 1838. The plan was approved by the Board, who have since advertised for proposals for the erection of the work; and it is understood to be their intention to urge its immediate completion.

Without adverting to the merits of this plan, as a particular application of the principle of suspension; the fact that such a bridge is about to be constructed, cannot but be a matter of interest to the profession, as an auspice of the introduction into this country of an improvement which has deserved and acquired the most abundant success abroad.

Suspension bridges present many claims for public attention, which have been fully recognized wherever they have been fairly submitted to the test of experience. Nearly all the principal rivers of the cultivated portions of Europe flow through densely populated districts, in which the importance of an unembarrassed communication with the opposite shores, has been long appreciated; and bridges were consequently established at an early period, wherever the interest was sufficient to justify the expense of their erection. But nevertheless, as soon as one or two suspension bridges had been successfully accomplished, it was found that there were numerous places where similar works were greatly needed, and where the abilities of the inhabitants had yet proved to be unequal to the charge required for their erection and maintenance, by the application of any system of construction previously devised, which might thenceforth participate in the advantages held out by the new method. In the course of very few years, great numbers were accordingly erected; and it soon became manifest that the anticipated objections to the recent innovation were either entirely fanciful, or such as could be readily removed.

Popular opinion had foreseen inconvenience from the supposed instability of the platform; but experience taught, that when properly built, the motion in an arch of 300 feet opening, or more, did not exceed that which has place in ordinary wooden bridges; and theory at the same time demonstrated that the oscillations produced by an equal disturbing force diminish as the length of the span is augmented.

The apprehension of a rupture of the cables, was dissipated before the proofs which were furnished by science and experiment;—proofs which show that of all the applications of building materials to architectural purposes, none admitted of greater certainty than that of iron, and especially of iron wire, to the support of bridges; that the tension to which the metal was exposed, is susceptible of the most rigorous determination, and its strength, of the most accurate preparatory trials.

At the same time that these positive objections were relieved, the comparative value of the system was made equally apparent. The unrivalled beauty, and even gracefulness, of those examples which had been constructed, gave them a preference for positions where ornament was essential and elegance a merit. Their susceptibility of being applied to rivers where the width of span must necessarily be very great, rendered them peculiarly appropriate for situations in which it was requisite, for the preservation of the navigation, or other object, to avoid obstructing the water way by the establishment of too many piers in the channel.* They possessed, withall, the merit of durability, to an extent which will render them monumental; and to these advantages was superadded a claim not unfre-

* The span of the Freibourg bridge, built by M. Chaley, is 889 English feet, and its flooring is 167 feet above the surface of the Sarine. Another bridge in Switzerland, by the same officer, over the valley of Gottron, has a span of 152 metres (499 feet,) and is elevated 340 feet above the bottom of the valley. Ships pass under the flooring of the Menai bridge under full sail.

quently esteemed as still more important: viz. that the first outlay necessary for their construction, will generally be less than that for any other description of bridges. There are exceptions to this assertion, but where they obtain, the stream must be very inconsiderable, and such as will permit the adoption of the wooden bridge requiring the simplest possible combination of the materials.

With these claims—which in fact cover the whole ground on which a preference could be founded—the system of suspension prevailed throughout Europe; and was immediately applied to the most important streams, in the heart of populous cities, and on various lines of railroads. Arches were commenced and successfully accomplished, from two to three times as wide as had ever before been attempted; and the practice of constructing bridges of any other description, was nearly superseded by the favor yielded to a system which appeared to combine every possible advantage, with a susceptibility for universal application, and which could scarcely be opposed by one solid objection.

The rivers of the United States, and especially those west of the Alleghany, present a broad field for the introduction and development of this improvement. In general, these streams are remarkably wide, and subject to freshets of great height and power; they are navigable for steam boats during a certain portion of the year, and sustain a commerce of the highest value to the country; considerations which may be regarded as so many objections to the obstructing of their channels by piers, independently of the expense which the erection of such works, in these circumstances necessarily involves. Besides, the sparseness of the population in most of the States, and the deficiency of funds incident to that condition of things, renders it important to fix on plans which will at the same time require the smallest annual charge for maintenance, and the smallest capital for original construction.

These conditions are best satisfied by the pendant principle; and its introduction into this country must therefore be regarded as a valuable contribution to the means of perfecting our great and numerous lines of intercommunication.

The engraving of the bridge intended to be constructed across the Schuylkill offers a very faint idea of the appearance presented by such a structure, when tastefully designed and viewed in place. It will, however, serve to convey an impression of the general appearance of suspension bridges, to those who have not possessed the opportunity of witnessing some of the fine specimens of the art which have of late years been erected in Europe.

This bridge consists of one principal opening 400 feet wide, and two lateral stone arches of 65 feet. Upon the piers which sustain the thrust of these lateral arches are to be erected 4 isolated columns for the support of the wire cables which uphold the platform. There are four of these cables, each of which is about 600 feet in length, from 4 to 5 inches in diameter, and composed of about 900 strands of iron wire. The wire is the $\frac{1}{10}$ of a foot in diameter; and each strand is covered with a coat of durable varnish before it is put in the cable.

The cables pass over the summits of the granite columns, where they bear on a moveable saddle, resting on rollers of cast iron, which are placed between the saddle and the upper surface of the capital. These rollers have a slight play, and the object of introducing them is to prevent the columns from being disturbed by movements of the cables, whether caused by the dilatation of the wire consequent on atmospherical changes of temperature, or the small oscillations and vibratory movements of the platform.

The ends of the cables descend through appertures in the masonry, and are securely anchored in the abutments of the littoral arches; passages are formed for the easy access of the superintendant to these fastenings, in order to admit, if necessary, of the removal of a cable, or the application of fresh paint or varnish to the iron as often as it may be judged expedient.

The width of the flooring of the bridge is 26 feet; of which space 18 feet in the centre, is intended for a carriage way, and 4 feet on each side, next to the parapets, for foot ways. The foot ways are raised 10 inches above the level of the carriage way.

The dimensions of the cables are assigned with a view to the support of the bridge when the whole area of the platform is occupied by people; and it is assumed, in the calculation, that the number who can conveniently stand upon it is equal to 3500 men of ordinary stature. The weight of this number of people, estimated at 150 pounds per man, is 234 tons. The weight of the bridge, or of that portion of it which is suspended between the columns, is computed at 214 tons; and consequently the whole weight on the cables, where the platform supports a load of this amount, will be 448 tons; from which will result a tension at the points of support—the summits of the columns—of 720 tons. The ultimate tenacity of the wire which will be used, may be safely estimated at three fifths of a ton for each strand; so that the aggregate strength of all the wires in the four cables—which contain 3600 strand—will be 2160 tons; or three times the tension to which they will be exposed when the flooring is occupied by 3500 men.

The bridge is to be sustained by 4 granite columns standing on bases 9 feet square; which are obviously too light to be depended on for the support of any material part of the tension; and it is consequently essential that the direction of [the cables, on the opposite sides of the columns should be such, that the resultant may fall as nearly as possible in the centre of their bases. By this arrangement the horizontal components of the tension neutralize each other, and each column is subjected only to a pressure in the direction of its axis, of about 225 tons, or half the weight of the bridge and its load. The stability of the columns is consequently greatly increased by the weight which they sustain; and it would be much more difficult to overthrow them when crossed by the cables and receiving the pressure due to the load which they support, than when isolated.

The platform is one foot higher in the centre than at the abutments; and it is guarded on the sides by parapets, which fulfil the double office of protecting the passengers and reducing the oscillations to which the structure is liable.

The preceeding remarks apply to the plan of the bridge as it was presented and approved; but since its adoption by the commissioners a change of the location has caused certain modifications to be made to adapt it to the new site.

For the American Railroad Journal and Mechanics' Magazine.

INTERNAL IMPROVEMENTS OF NEW YORK. NO. 4.

We have shown in the preceeding numbers that, by lengthening the locks of the Erie canal, and constructing duplicate ones at certain points, its capacity for the transportation of freight will be doubled, and by an improvement in its channel, in raising the surface 1 to 1½ feet, and adding to the width 16 feet, its capacity will be fully quadruple what it now is, and such proportions obtained in respect to the size of the boats and the canal, as will render the cost of transportation with animal power a minimum.

All this may be accomplished at an expense not exceeding six millions of dollars, or about the one seventh part of the cost of the enlargement on the plan contemplated. The State will save by this plan nearly $30,000,000—the canal will be abundantly large enough to accommodate any prospective increase in the trade upon it for years to come, and the great desideratum of cheap transportation, effected to a degree as perfect, when all the attendant circumstances are considered, as can be attained by the proposed enlargement.

Although the arguments advanced, are believed to be quite sufficient to justify the conclusions to which we have arrived, we will give some further reasons in confirmation of their correctness.

Supposing the Erie canal to be enlarged the whole distance from Albany to Buffalo, it is easy to perceive that a similar improvement of the Oswego canal will speedily follow. The limited extent of the Oswego canal only 38 miles, half of which is natural navigation, and being, as it is, the channel of communication with lake Ontario, its importance is such as leaves no reason to doubt that its enlargement will follow that of the Erie canal, as certainly as its construction followed that of the Erie canal in the first instance.

The Cayuga and Seneca canal connecting with the Cayuga and Seneca lakes, and communicating with a fertile and populous portion of the State will also present claims for an enlargement which will be irresistable, and hence we may reasonably expect that if the plan of the enlargement is persevered in, the State in order to perfect the system will be forced into the expenditure of some seven or eight millions more than has been estimated. The advocates of the Erie Canal enlargement, although they must have seen the necessity of adding also to the size of these canals, have been silent on the subject. They have advocated the enlargement on the ground that the large boats would be better adapted to the navigation of the Hudson river and the lakes mentioned in the interior of the State, but have been silent as to the whole expense necessary to be incurred in carrying this plan into effect.

As to the other canals to which the *enlightened* internal improvement policy of the State has given birth, viz. the Chemung, Crooked Lake, Chenango, and the two less hopeful ones yet in embryo, the Black river and the Genessee valley, there is no danger of their acquiring an importance sufficient to render their enlargement in the least degree probable. These canals, however, in connection with the two first named, until such time as they shall be enlarged, must labor under the very serious inconvenience of a transhipment of freight to and from the boats of the Erie canal at the several points of junction, owing to the different dimensions of the boats and character of the navigation upon each.

The delay, expense and embarrassment of this transhipment has not been fully realised.

It has been shown from published reports, that of the 640,000 tons which came to tide water on the Erie canal in the year 1838, two-thirds was lumber or the product of the forest. It is well known that most of this is brought to the Erie canal from the lateral canals and is transported the most of it in boats. Flour, also, and other articles, are furnished in large quantities from the lateral canals, particularly the Oswego and Cayuga and Seneca.

The expense of transhipment must of course depend very much upon the nature of the lading, and will embrace the following items.

1. The interest on the cost, and depreciation of the boats during the time occupied in making the transfer.
2. Wages of boat hands for the same time.
3. Interest upon the cost, depreciation and feed of horses.
4. Dock rents and fixtures, and occasional warehousing expenses.
5. Such additional hands as may be necessary.

By giving to these several items their proper value, it will be found, we believe, that the average cost of transhipment, independent of the embarrassment consequent upon the delay, and the injury upon the articles transhiped, will be not much less than fifty cents per ton, or equal to the present average *cost* of transportation of down freight, independent of tolls on *fifty* miles of the canal.

Supposing, therefore, as is asserted, that the saving in the cost of transportation on the enlarged canal will be 50 per cent of the present rates, freight from the branch canals must be carried 100 miles on the Erie canal to make the expense what it now is. Putting the saving at 25 per cent instead of 50, which is undoubtedly nearer the truth, and the distance at which the expense will be the same as at present, is 200 miles. That is, if the distance at which freight from the lateral canals is carried in the Erie canal, is less than 200 miles, the total cost of transportation will be *greater* than it now is. This certainly does not show any *very great advantage* to be derived by the sections of country in the vicinity of the branch canals from the enlargement, unless the circumstance of paying as *high* or *higher* than they now do for transportation, and bearing, at the same time, their portion of the burden of the debt to be contracted, can be esteemed an advantage.

Again, those who are conversant with the mode in which the transportation is conducted on the Erie canal, are aware that the business is almost wholly in the hands of companies acting in concert and wielding an immense capital, and hence are able to defy all ordinary competition, monopolising the business, and becoming carriers at their own prices.

The power and extent of this combination, although its influence was then but partially developed, were manifested when in 1833 the Canal Board reduced the tolls to near the constitutional limit, with a view of bringing in the trade of the country west of Buffalo. Instead of producing the effect anticipated, the forwarding companies immediately raised their charges, thus converting a measure of great public benefit into a source of private emolument.

If the Erie canal is improved so as to admit of any material reduction in the cost of transportation, what guarantee have the public that the same scenes will not be re-enacted, and that instead of deriving any benefit themselves from so great an expenditure they are not putting money into the coffers of a monopoly which has already rendered itself odious by its unreasonable exactions? Certain it is, that however great is the evil of this monopoly at the present time, it will be much augmented should the project of the enlargement be accomplished. This follows from the fact of the business being conducted on a larger scale, the boats being larger and more expensive to build and to navigate will prevent many from engaging in the business of transportation, and drive therefrom also many who are now engaged, but whose capital and means although adequate to prevent exigencies are too limited for the purchase and navigation of boats upon the large canal.

There are still other reasons why the cost of transportation will not probably be reduced to the degree anticipated. The line of railway alluded to in a previous number, extending from Albany to Buffalo, will soon be completed. The restrictions imposed by the State upon the railway, as it regards the conveyance of freight, opposed, as it is, to the enlightened principles of political economy, and the true interests of the people of the State, will ere long be removed, and when so removed, the railway will carry a very large proportion of the merchandize, which now pays, for both tolls and transportation, more than double the charges upon other descriptions of freight. This change will not only make considerable inroads upon the tolls from the canal, but the forwarders loosing, as they will, their very great profits on merchandize will be compelled to charge higher on other freight. This, although it may not cause any increase in charges over *present* prices, will prevent their being reduced as low as they otherwise would be.

That the railway will carry merchandize to a very considerable extent, when the restrictions alluded to are removed, is obvious from the experience on the lakes, where the steamboats take most of the freight of this description at much higher rates than sail vessels, principally on account of the saving in time by that mode of conveyance.

Rapidity and certainty of conveyance are very important to the merchant located in the distant interior. It gives him a more speedy return on capital invested, and with the convenience which a winter conveyance upon a railway will afford, he will not be obliged to purchase so largely when procuring his fall supplies, and thus derive a double advantage in the constant receipt of fresh supplies, according as his necessities may require, and in the less amount of capital needful for the transaction of his business.

That the transportation of merchandize upon the railway will take place, to a very great extent is obvious for another reason. If but a single merchant in a village or city in the interior should obtain his supplies by the more speedy conveyance of the railway, others will be compelled to do the same, and that such will be the natural course which business will take, appears to us to be too obvious to need further comment.

As to the effect of a reduction in the charges of transportation upon the canal in drawing to it a greater amount of business by pushing further to the south and west the dividing line which separates the portions of the valley of the St. Lawrence and upper Mississippi doing business respectively with New York and the cities south, we cannot but believe the anticipations of the friends of the enlargement have been too sanguine. The tide of emigration to the States and Territories west, is yet strong and will undoubtedly so continue for many years to come, the consequence of which is a consumption within their own borders, of their surplus products, leaving comparatively little for the Atlantic marts.

That the influence of a reduction of tolls in inviting business to the canal from the sections of country mentioned, must for some time be limited, appears probable from the fact that the business of the canal thus far has been mainly from within the limits of N. York, notwithstanding in the last six or seven years there has been a general reduction of 25 per ct. upon the tolls and a further reduction of full 30 per ct., arrising out of the extraordinary advance in prices, which for the last five years has taken place under the *benign* influence of the *credit* system. The country having began to realize the bitter fruits of making that which is a mere *evidence of debt* a *standard of value*, or in other words, of giving to paper which possesses no intrinsic value, the properties of coin, there is every reason to believe that prices will recede until they shall reach a point at which they can be permanently maintained. The tolls of the canal being based not upon the value but upon the weight or dimensions of the several commodities, this *reduction* in prices is practically equivalent to an *increase* in tolls.

The business of the canal must, to a considerable extent, experience the injurious effect of this change in prices, or relative increase in tolls, the remedy, supposing it expedient to apply any, which is doubtful, being beyond the reach of the State authorities, since the tolls are now down to the limit fixed by the constitution.

There is another view of the subject of the probable effect of the enlargement in reducing the charges for transportation which merits the most serious attention.

In the report of the comptroller for the year 1838, from which we quote, not having the last report at hand to refer to, the nett revenue of the the State canals is thus given.

Surplus of the revenues of the canals from tolls over and above the cost of their maintenance,	$841,888,09
If the *interest* paid for the year on the debt of the lateral canals *which are finished*, be deducted,	170,000,00
It leaves a surplus of	$671,888,09

The revenue from the Erie and Champlain canals, being the only canals which more than pay expenses, has not varied much for the last seven years. During the whole of this time it has ranged between $1,300,000 and $1,400,000. This being the fact, there is no good reason to believe that the increase will be very rapid for several years to come. If it remains the same, the only available means of the State, derived from the canals, for paying off the debt of the enlargement, is the surplus above stated of $671,888,09. This it must be remarked, is the surplus after paying *interest*, without *reducing* the principal of the debt of the lateral canals *which are finished.* It does not therefore include the two last of the *pauper* progeny of the State, viz., the Black River and the Genessee Valley. The interest on these being deducted, amounting to $600,000, it being doubtful whether they will ever pay the cost of maintenance, and there remains but a precious small sum for defraying the interest on the cost of the enlargement, amounting, at 6 per cent., to $2,400,000 per annum.

That the revenue of the Erie canal will continue to increase, we firmly believe—but the expenses also will increase; and it should be borne in mind that the most liberal estimate of the revenue for many years, will not be sufficient to keep down the interest, if the plan of the enlargement is persevered in, and a resort to taxation will become necessary to preserve the faith of the State, and obtain means for defraying the current expenses of the government.

If the enlargement of the Erie canal is accomplished on the scale proposed its probable cost for reasons given in our first number will amount to	$40,000,000
Debt of the lateral canals in operation, about	2,500,000
Cost of the Genessee Valley canal,	6,000,000
" Black river "	4,000,000

Expense to be incurred in enlarging the Cayuga and Seneca and Oswego canals, say	7,000,000
" rebuilding locks on Chemung canal of stone, they being now of wood and almost useless,	700,000
" rebuilding also the locks on Chenango canal which are of stone and wood,	1,300,000
	$61,500,000

The State of New York, without entering into any *new* projects, is already in for about $60,000,000 *on account of her canals alone* without even a reasonable prospect of being able without resort to taxation, to pay the interest on that amount. Is it not time to pause in this career of extravagance. *Of all the visionary projects into which the State has been drawn by the influence of unwise counsels, the enlargement of the Erie canal is the most visionary, and the sooner she makes haste to retrace her steps the better.*

FULTON.

For the American Railroad Journal and Mechanics' Magazine.

ATMOSPHERIC RESISTANCE TO LOCOMOTION ON RAILROADS--DR. LARDNER'S EXPERIMENTS, ETC. BY WM. M'CLELLAND CUSHMAN, CIVIL ENGINEER.

I avail myself of a favorable occasion to notice some alledged discoveries in respect to the quantity of resistance the atmosphere makes to the progress of a train of cars when tracked by locomotive engines. The strictures upon this subject published in the third number of your Journal, abundantly evince the character of Dr. Lardner's claims, and his total failure to *establish any thing*, either original or secondary. I, however feel myself called upon to give some further attention to the subject, in my own behalf, inasmuch as I had long since investigated its effects, and published a formula expressing them, in July last year, as part of a "new expression of the powers, velocity, etc., of locomotive engines." I intend, however, while noticing Dr. Lardner's pretensions, to restrict myself chiefly to the more full development of the *rationale* of atmospheric resistance, than I then had occasion to do—a *practical indication of its value* being all I, at that time, aimed to effect. It may be remarked that the views in question first enlightened our horizon the present month, and were published in England in October last. This statement would be abundantly sufficient in point of priority, even assuming them to be *true* or *tenable;* but I may here be allowed to repeat that (as stated in my paper of July) my expression was investigated, *in extenso*, "on perusal of Chev. de Pambour's work"—which was in the fall of the year of its publication. So that the effect of the atmosphere upon locomotion on railroads, had been established with precision in this country, some three years since and more; and published some eight months before we were informed (and it may be very true indeed) that "no details exist, nor have any experiments ever been made, by which the resistance (to wit, such as Dr. Lardner has discovered) of the air to a train of railway carriages could be obtained by any calculation whatever; nor was the amount of *such* resistance ever suspected, even by the persons who have ventured to utter such statements, as have (has?) *here* (to wit, by himself) *been proved to exist.*" I for one (and most engineers will join me) must confess that I never did entertain a suspicion of *such* resistance, etc., as is set forth in this famous course of experiments.

I may perhaps be indulged in a reflection. It is not an unusual occurrence for unprofessional men to fall into egregious errors, when they pass from the popular and merely descriptive knowledge of a subject, to the development and application of complicate laws and principles to practical purposes--which is properly the province of the engineer. This I take to be the case in the present instance. As a popular lecturer upon the steam engine, Dr. L. has justly a high repute—that his fame rests here alone has been illustrated in more than one instance. Let his admirers recur to his extremely absurd estimates of the capabilities of the superb steam palaces now flying between the shores of the ancient and modern hemispheres—secure and uniform, maugre all presages—as if plying between the banks which sustain two opposite marts on the Hudson.

In illustrating the *rationale* of atmospheric action upon a train of railway carriages, it will be best, in the first instance, to pre-establish, by specific statements, an idea of the proportion of motive power actually annulled by such action, when performing *regularly the duty required in practice*—other trials, upon trains allowed to generate their own speed, can in few, if any instances, be of service in researches made with the view of determining the *actual amount of resistance*, though they may serve for illustrating a point; and such consequently do not present the data required in forming conclusive opinions. This distinction will be carefully observed; for erratic opinions upon this subject, are very generally, if not exclusively, to be referred to indiscriminate reliance upon this class of trials *as practical results.* (*Note.*)

I have shown (R. R. Journal, vol. 9, No. 2.) that, upon several lines of railroad of the same width of track, even with engines of very dissimilar constructions, the atmospheric resistance to the progress of the engine and train, was, *in general*, very nearly expressed by the formula $\cdot 4\ v^2$, the velocity of the motion being v miles per hour. At 30 miles per hour (a velocity exceeding the average rate of motion upon any railroad extant) the resistance is then 360 lbs. Now, the maximum effective power or force of steam, of the most puissant engines of the Liverpool railroad, is 2112 lbs. when working with their usual pressure in the boiler—to wit, 70 lbs. The proportion of power annulled then, will not exceed $\frac{1}{6}$ of the maximum effective pressure of steam exerted, when the velocity is *greater than the actual rate of running* upon any railway in this or the other hemisphere.

At 20 *miles per hour*, its value is 160 lbs. or $\frac{1}{13}$ the effective force of steam, as this is about equal to the friction of the engine, unloaded, it will furnish a very good notion of the amount of opposition experienced, as well as of its relative consequence as part of the total tractive force the engine is capable of exerting. This velocity is the *actual rate of the passenger trains* upon the Liverpool, and upon some of the best roads in this country. *Freight trains* usually travel at more moderate rates—the average rate being 12·5 miles per hour. The resistance for these is then 62 lbs. or $\frac{1}{34}$ part of the effective force the engine is capable of exerting. It is certain therefore, that, allowing the obstruction to be considerable, and always large enough to form a *necessary element* in reckoning the total resisting forces to be encountered, those other elements of the total resisting force must still always greatly predominate over that of the air—in the practical operation of railroads.

For further illustration in this respect, the following table is submitted, it is computed according to formula previously exhibited, viz: $\cdot 4\, v^2$.

Velocity of the Engine in miles per hour.		Actual resistance of the air upon the train at those velocities in lbs. avoirdupoise.		Proportion the loss of effect bears to the maximum power of the engine.	
	5.		10.		1 in 211.2
	10.		40.		1 " 52.8
	15.		90.		1 " 23.5
	20.		160.		1 " 13.2
	25.		250.		1 " 8.45
	30.		360.		1 " 8.87
	35.		490.		1 " 4.31

The amount of atmospheric resistance *does not depend*, in any sensible degree, upon the *length* or *volume* of the train.

The Atlas, the engine instanced above, with a train of 40 cars, does not show any greater proportionate resistance, at the same speed, than with a train of but 12 cars. In the first instance its train was about 475. feet long, in the second only 160. feet or but one-third the volume of the former. The same conclusion follows from each approved result of that course of experiments; wherein it has already been stated, the quantity of resistance is generally expressed by the formula of $\cdot 4v^2$; that is, to use ordinary language, *the resistance is always constant with the same velocity.* I have found very precisely the same result upon other roads wherever an opportunity has offered to test it by well conducted experiment, even with trains of much greater length than the longest of those specified. Dr. Lardner, therefore, asserts the precise *contrary* of the results of extended *experience upon engines, while doing their usual requirements*, when he says that the *resistance from the air is measured only by the volume* of the train. Experience drawn from the *objects themselves* being repugnant to this opinion, I beg leave to inquire if it has any *indirect support from analogy.* Now nothing has been more fully settled by a series of excellent experiments, than this. Take a body constituted of two cones placed base to base (the height of each=diam. of base,) and impel it through a fluid in the direction of its axis, and a certain force will be required: but on interpolating a short cylinder between the cones, the force required to move the lengthened body with the same velocity, will not be nearly so great—if the fluid be water, for instance, the *reduction of resistance will be in the ratio* 380 *to* 1000. Again, a blunt cylinder, impelled with any velocity, through the air, requires less force than a cone or hemisphere with the flat side presented—*the reduction* being expressed in the relation of the Nos. 288 to 291 and 288. Passing to instances upon a practical scale, observation instructs us that upon canals, boats of length require *less force* to track them, than short boats of equal transverse section: another instance in point is that the speed of steamers has, in many instances, been increased without changing their machinery—simply by sawing and interpolating a-midships—that is, the resistance has been *reduced by the addition in length.* Could the precise section of frontage of a train be obtained with certainty, by direct means, there is no reason to doubt but that a rigid plane surface of equal extent, tracked by an engine, would require much *more force to impel,* at equal speed, *than the train* of which it is the section, would. The rationale of this is perfectly understood—with the cylinder, long hulks, &c., the fluid *does* more readily and perfectly follow and replace the vacuity left behind them as they advance, than with the other objects of equal section—and although a certain increase of resistance in the article of friction, does attend increment of length, it has evidently little significance in comparison with the force required to overcome the mere *unbalanced pressure of fluid always superadded to its resistance proper,* in proportion as the figure favors the formation of a void in rear of the object. Analogies strictly in point, *do not,* then, *give any support to such views* as have been advanced by Dr. Lardner; but quite the reverse, they bid us rather to apprehend that the quantity of atmospheric resistance is at least *as great,* when an engine and tender move off *without any useful load,* as when it has a train in convoy.

The general expression of the resistance which has been established may be translated into language in these terms, viz.

The resistance of the air upon trains tracked by locomotive engines is as if made upon an *invariable section of frontage,* and *varies in amount* only with the velocity of motion—upon any given line of road. These results, which have been deduced from regular performances, are besides perfectly agreeable to analogy; and it is also evident that none other than these are consistent with the established laws of pneumatics. But that *no part* even of the resistance (in the way of increase at least) has any dependence upon the volume of the train, may be more clearly perceived on evolving the resisting section *implied by the formula* and bringing it into contrast *with measures taken upon the engines themselves.* For this purpose, put S for the unknown section of frontage implied by the formula, agreeably to the principle of pneumatics, and p for the resistance of a square foot of surface, at any observed velocity represented by v' miles per hour. We have then for the total resistance of the air upon a train $pS\frac{v^2}{v'^2}$ lbs., or more exactly still, by the law of Borda, $p\left(S^{\frac{1}{2}}\right)^{2 \cdot 2}\frac{v^2}{v'^2}$ lbs. at any time when the engine is running with a speed of v miles per hour. Now if *the frontage alone determines the resistance*, this last expression will be equal to $\cdot 4v^2$ the value deduced from the observed performance of engines—that is, we will have $p\left(S^{\frac{1}{2}}\right)^{2\cdot 2}\ \frac{v^2}{v'^2}=\cdot 4v^2$ and ultimately $S=\left(\frac{\cdot 4v^2}{p}\right)^{\frac{1}{1\cdot 1}}$ for the area of frontage which *must have been present*, according to established principles in the series of performances. And this deduced area and that made up from measures upon the engines, cannot be allowed to differ sensibly from each other, on our hypothesis. Now at 20 miles per hour the force upon a square foot of surface is 1.968 lbs., and consequently $S=\left(\cdot 4\,\frac{400}{1.968}\right)^{\frac{1}{1\cdot 1}}=54.6$ ft expresses accurately the *aggregate frontage presented by every member of the train* reduced to *plane* surface. Again, it is certain that, looking to facts, there is an unbroken frontage (measuring usually about $6\times 9=54$ sq. ft.) included between the sides of the tender or cars one way, and between the roofing of the tender and base of the furnace, the other, superadding for extra effect upon the small members, the area by direct measures, proves to be nearly, if not exactly, identical with our first result as evolved from the formula $\cdot 4v^2$. Now if this formula depended in any sensible degree upon the volume of the train, the near approach of the two results, would have been impossible. On the contrary, in that case, there must have been an *excess against the direct measures*—which excess, if the newfangled views had any basis to support them, must have been *indefinitely great.* The facts, as seen, are diametrically the reverse—for the excess is decidedly *in favor* of the direct measures, but so slightly as to give assurance that it can never, after accounting in the result all minutia, be made to exceed the other by an hundredth part of the total section.

It is plain then, that in practice the resistance, if any thing, is rather less than the actual frontage would give; but also that the difference is inappreciable. We are authorised, therefore, to assert that the atmospheric resistance is not only *as if made upon an invariable section of frontage*, but that it *depends, exclusively, upon that section, for its amount.* Dr. Lardner's opinions have consequently no foundation in fact and he is welcome to all the credit of their discovery.

Albany, February, 1840.

NOTE.—The resistance of the air can only be truly deduced from trials similar to the usual performances of engines—there must be *uniform* velocity, etc. And it cannot be obtained during such trials if any other element limiting the speed or power, remains undetermined. This was the case until the law of vaporization, as dependent upon velocity, had been established. Having done this, the amount of atmospheric resistance was deduced as represented in the paper containing my new expression of the powers, velocities, etc. De Pambour in his work made no attempt to determine either of these elements, however his measures of the friction of engines and of carriages exclude the atmospheric influence entirely—most of his trials with engines being made without velocity, and the others at so slow a rate of motion, that its influence was insensible. By excluding the leading car, he also freed the friction of carriages from its influence. The value of this last, with the cars there used, is accurately 8 lbs. per ton, or $\frac{1}{280}$ of the gross weight. Having instituted frequent comparisons of computed, with the running rates, upon several roads, I find no reason to disparage that result, in any degree, at least with similar cars. Let it however be observed that light cars have less friction per ton than laden cars. The rationale of this is in the compound nature of friction—in the former the resistance is made chiefly at the periphery, where the wheel bears upon the rail—in the other, at the axle—this last, in cars of the usual dimensions, greatly predominating. This may be mentioned among the anomalies of de Pambour's course.

SAMUEL ADAMS' COMBINED RIFLE AND SHOT GUN.

We have had presented to our notice the above named ingeniously contrived improvement in fire arms. It possesses the grand requisite of all useful improvements in such things—perfect simplicity.

The piece when used as a rifle, resembles ordinary arms of that description, and may be loaded as usual, or at the breech by a metallic cartridge. A small piece is unscrewed at the muzzle which loosens the inner or rifle barrel. This is kept in its place by means of an enlargement at the breech in that portion of the barrel in which the metallic cartridge is fitted. The space thus left when the inner barrel is removed, leaves room for a larger metallic cartridge for the shot gun, which may likewise be loaded in both ways.

The rifle sight turns on a pivot, and may be put out of the way when the smooth bore is used. The perfect adaptation of all the parts, renders the united barrels quite as firm as if in one entire piece—and as a rifle it is not heavier—or as a shot gun, lighter than common arms of those kinds.

We consider it as completely supplying the place of two distinct pieces, and combining economy of space and and money. For travellers such a gun would prove invaluable—while the hunter is thus enabled to command game of all descriptions by a single gun. The change may be made in half a minute, from a rifle to a fowling piece.

We understand that a small portion of the right is offered for sale, and we conceive it to be a fine investment—being free from the common objection to improvements in fire arms—complication of parts.

We are indebted to Mr. Roebling for a communication on the "Theory of the Crank," which came however, too late for this number. It will appear in the next number.

Benefits of Railroads.—We copy the following statement of the performance of a locomotive steam engine on a Pennsylvania railroad. Facts like these are convincing proofs of the superiority of railroads over canals. To this statement we annex some remarks from the Journal of Commerce, elicited by certain articles which have recently appeared in the Railroad Journal on the enlargement of the Erie canal. We profess not to be fully acquainted with this subject, but if the large sum of money necessary to complete this enlargement can be turned to the construction of railroads, we are of opinion a much greater good will be accomplished.

Ed. N. Y. Times.

UNEXAMPLED PERFORMANCE IN THIS COUNTRY OR EUROPE.—The engine "Gowan & Marx," built by Messrs. Eastwick & Harrison, for the Philadelphia and Reading railroad company, weighing eleven tons, drew yesterday, over the railway from Reading to the Columbia railroad bridge, Peters' Island, one hundred and one loaded cars.

Gross weight of train, 423 tons of 2240 lbs.
Nett " " 268½ " "

Running time, 5 hours 23 minutes—distance 54½ miles, being at an average speed of about 10 miles per hour.

The coal consumed by the engine in drawing this load was 5600 lbs. or rather less than two and a half tons.

The quantity of oil consumed by the whole train of cars was 5½ quarts, being about half a gill for each car.

The freight was as follows:

2002 barrels of flour, weighing	190½	tons
459 kegs of nails,	22	"
52 barrels of whiskey,	11¾	"
20 hogsheads of corn meal,	13¾	"
5 " whiskey,	3¼	"
7 " linseed oil,	7½	"
Lot of band iron, etc.,	19¾	"
Total nett freight,	268½	"

Philadelphia Gazette.

The following is a statement of the *receipt* and *expense* of transporting 423 tons of 2240 lbs., over the Philadelphia and Reading railway. The nett load of 2000 lbs. to the ton was 307 tons or 101 cars.

The freight received by bills of parcels was $835 19 for the down trip—or $2 78 per ton of 2000 lbs. carried 54½ miles in five hours and twenty-three minutes.

The *daily* expense of running the locomotive to carry a train one trip, is stated at	$16 67
To this add wear and tear of 101 cars, at the very liberal allowance of 30 cents each per diem, (this rate will renew them every three years,)	30 30
Add four hands at the brakes,	4
Five and a half quarts of oil,	2
	$52 97

The above does not include the incidental expenses of warehouse and unloading. On the supposition that the cars return empty, it will cost $105 94—it will cost at this rate 35 cents to transport one ton of coal, in a train of cars with 300 tons, 54½ miles, between 6 and 7 mills per ton per mile.

The company calculate to pass daily 2250 tons of coal in fifteen trains with half the above load. This will give them a gross income at $2 per ton on only 708,770 tons, per 315 days, of $1,417,540.

The facilities of this road, from its favorable grades, to transport coal, far exceeds the Schuylkill canal along side of which it is located.

The capacity of the canal is limited to the number of lockages, during the season of transportation. This period will not usually, on an average, (excluding Sundays, left out on the railroad estimate,) exceed 200 days. If a lockage is allowed every ten minutes, day and night, for the whole season, with the supposition that each boat carries to tide water, on an average, from the mines, 30 tons of coal, we have 744,000 tons, the capacity of the canals.

As regards the railway, a train with 200 tons could pass every half hour, say for 315 days, equal to 2,994,000 tons. On a well regulated railway, there would be no difficulty in starting a train every 15 minutes—a railroad with a double track, is nearly equal to travelling in a circle.

A POPULAR EXPOSITION OF THE INCORRECTNESS OF THE TARIFFS OF TOLL IN USE ON THE PUBLIC IMPROVEMENTS OF THE UNITED STATES. BY CHARLES ELLET, JR., CIVIL ENGINEER.

SECTION 4.—*On the most judicious charge on articles of heavy burden and small value.*

12. I conceive that it is essential to the fulfilment of the condition, that the tax levied on the trade of the line shall be reconcilable with principles of equity, that the charge at each point shall be proportional to the ability of the article to sustain. And, it fortunately happens, that when the charges are regulated in the mode that will produce the maximum revenue, this condition will be fully satisfied.

We are to understand by the ability of a commodity to sustain a charge for carriage, the difference between the cost of production and the market value of the object. If the article be worth $10 in market, and it cost $6 to produce and prepare it for market, it will sustain any charge for transportation, including both freight and toll, not exceeding $4. But its ability to sustain a charge *for toll only*, depends on the position in which it reaches the line of the improvement. For, after deducting the cost of production from the market value, the residue may go to bear the whole cost of carriage; but we must still deduct from this residue the charge for freight, to obtain the sum which it will bear to be charged for toll.

If, for example, the above article reach the line at one hundred miles from the mart, and the freight be one cent per ton per mile, the charge for freight will be $1, and this residue will be $3. If it reach the line at two hundred miles, the charge for freight will be $2, and this residue will be $2. If it come on the work at three hundred miles, the charge will be $3, and the residue will be $1; and if it reaches it at four hundred miles, the freight will be $4, and the residue will be nothing. I say, therefore, that to make the tax for toll proportional to the ability of the commodity, the charge levied by the State for its passage along

100 miles should be proportional to $3,
200 miles should be proportional to $2,
300 miles should be proportional to $1,

and along four hundred miles it should be allowed to pass free. From which it appears, that *the greater the distance the commodity is carried,* *the less should be the toll levied upon it.* In short, I propose that the tax should be proportional to the ability of the trade to sustain the charge; and by such a tariff, to supersede those now in use—by which the tax is *increased* in proportion as the ability of the trade to bear the tax is *diminished.*

13. Now, it may be demonstrated, that when the toll is assessed on this principle, both the tonnage and the revenue will be greater than if the most profitable uniform charge per mile that it is possible to levy were adopted.

But the method of determining this most productive charge, cannot be conveniently pointed out, with a demonstration of its correctness, in a mere popular discussion. I have, however, elsewhere considered the subject in some detail, and have shown that the toll on this division of the trade which will yield the greatest possible revenue, is about *three-eighths* of the charge which would exclude the article from market; or three-eighths the limit of the tax which it would bear.

In the above example, therefore, the charge at

100 miles, should be three-eighths of $3, or	$1	12½
200 miles, should be three-eighths of $2, or		75
300 miles, should be three-eighths of $1, or		37½
400 miles,	0	00

The difference between these sums and those above given constitutes the profits of the proprietors.

It cannot be objected to this scale of charges, that it deprives the citizen on the line, near the mart, of any of the advantages of his position. The work, on the contrary, furnishes him with the means of transporting the products of his estate to a market for one-fourth or one-fifth the sum he was compelled to expend before its construction. This is a positive advantage for which he is indebted to the commonwealth; and he has no right to complain, if the same commonwealth extend the benefits of the enterprse to more distant citizens. The avowed object of the improvement is to bring to market productions which could not otherwise reach it, and, generally, to reduce the tax on transportation. And if the objection, that the mode of charging here recommended may seem to disturb the relative advantages of position of the near and distant denizen, be a valid one, it is *a fortiori* a conclusive argument against *all* improvement. A consequence of the construction of any canal or railroad, is to increase the value of estates to which it affords new facilities, and of course disturb the relation between the advantages possessed by such property and other estates in the commonwealth, on which it has no effect.

But such an objection, even if a legitimate one, cannot be applied to the scale here advised. It is not proposed to tax the distant man less for the transportation of his effects than the nearer one; on the contrary, he is charged more.* The method merely proposes to make that portion of the tax which is to be considered as the profit of the State—that portion which is levied for revenue—proportional to the ability of the trade to pay it. And this is justice.

*In the example given in art. 12, as we have seen above, the *toll*

For 100 miles	would be		$1 12½
200	"	"	75
300	"	"	37½
400	"	"	00

But the *whole charge*, or freight and toll together,

For 100 miles	would be		$2 12½
200	"	"	2 75
300	"	"	3 37½
400	"	"	4 00

or, actually *increasing in proportion to the distance*, and at the rate of six and a quarter mills per ton per mile.

14. If, now, we represent by a proper scale, as in *Fig.* 2, the area of the country which, with the data of this example, would furnish the tonnage, in the hypothesis of an uniform charge of one cent for freight and one cent for toll, we shall have, as before stated, a triangular figure NPN, with a base, NN, of eighty miles, and height, MP, of two hundred miles.

But if the charges were adjusted with a view to the obtaining of the maximum revenue, the triangle would have a base, *nn*, of fifty miles, and a height, MR, of four hundred miles. In the one case the area of the country would be represented by the triangle NPN, and in the other by the triangle *n*R*n*.

15. But, instead of aiming to obtain the maximum revenue on all the trade which would reach the improvement from R to M, we may, by the system which it is intended to recommend, adopt in both instances an uniform charge for toll, as one cent per ton per mile, from M to M′—the point which corresponds with the intersection *n′* of the sides of the superior and inferior triangles—and confine the arrangement made with a view to the maximum revenue, to that portion of the country situated between M′ and R.

The consequence of this arrangement would be to obtain the same tonnage and revenue from the country traversed by the portion MM′ of the line, in both cases, since the tariff would in that distance be common; and at the same time to increase the area of the country trading on the improvement, a quantity equal to whatever would be due to this additional trade and the charge upon it, determined in accordance with the principles here laid down.

16. It will be perceived that the increase of tonnage and revenue which, in the preceding article, is shown to have place, will be obtained without any increase of toll on any part whatever of the trade. We have only to take the present tariff of New York or Pennsylvania, or any other state or company, and obtain these results *by a reduction of the charges.*

For, at the point P, which is supposed to be two hundred miles from M, we have seen that a toll of one cent per ton per mile would entirely exclude the trade. But if instead of a charge of one cent per ton per mile, at that point, or \$2 for the entire toll from P to M, the article were taxed but seventy-five cents per ton, as is stated (in article 13) to be the proper toll under the circumstances, there would remain out of the two \$2, which is the limit of the charge for toll it would bear at that position, a balance of \$1 25 to pay the expense of its transportation from *p* to P—a distance of twelve and a half miles on each side of the line. So that, by simply reducing the charge resulting from a tariff proportioned to the distance, we shall here obtain, instead of nothing, a revenue due to the tonnage that would be furnished by a district *pp*, twenty-five miles in breadth, at a charge of seventy-five cents per ton.

It is true that a much more important increase of revenue might be experienced by a modification of the uniform charge supposed to be levied from M to M′, and a reduction from the new tariff beyond M′. For, even where we adopt the principle of fixing on the determinate toll per ton per mile for a certain distance, we should bear in mind that there is a certain uniform charge which will yield a higher result than any other. But, without any reference to this, or any of the other advantages which would be derived from a thorough and strict regard to the laws of trade in the establishment of the tariff, I have only sought to render clear the fact, that by *simple reductions of the charges on a portion of the trade on all our public works, the revenue and tonnage may be simultaneously increased, and the tax on the public may be rendered more equitable.*

17. The preceding conclusions are applicable only to the trade in heavy

articles of small value. Equally salutary results might however be obtained by modifications of the charges on the other principal division of the commerce of the country—that which is rendered by its value an object for the competition of rival works. But the examination of the subject with reference to the latter division would, from its complication, be much less susceptible of receiving a popular form. This and other views of the subject, which have always to be considered in any attempt to establish a correct tariff, are examined in considerable detail in my "Essay on the Laws of Trade," where the methods to be adopted to obtain the greatest revenue which the work can possibly extract from the commerce of the country is fully exposed. It is not possible to repeat here, in the narrow space which we can now appropriate to the subject, even the most important of the principles to be regarded in the administration of our public works, which I have there attempted to develope. The glance which is here directed to the question is necessarily confined to a very few prominent points.

To establish a tariff of toll for all articles, on sound principles, requires a certain intimacy with the statistics of the line, and a proper acquaintance with the laws by which the tonnage and revenue are governed. This knowledge cannot be obtained intuitively; and a correct tariff cannot be devised, as those on all our improvements are, by the mere conjectures of the parties to whose discretion such subjects are usually referred.

Section V.—*General Laws of Trade.*

18. There are some facts of a general character relating to this subject which are susceptible of a most rigorous demonstration, that may be here profitably repeated. It has already been shown that a great loss of trade and revenue is sustained in the management of public works by the adoption of a uniform rate of assessment. In the examples adduced, this results from over charges, which, under such regulations, invariably have place in some part of the line. It may be shown by a legitimate course of argument, that however we depart from the charge which will yield the greatest revenue there will be an increase or diminution of tonnage, and, of course, always a decrease of revenue. If the departure be an overcharge, *the tonnage will be reduced a quantity directly proportional to the value of the overcharge, and the revenue proportional to the square of that departure.*

Nothing can prove more conclusively the danger of submitting so important a subject as the preparation of a tariff, to the uncertain guide of conjecture. For, if we err ten mills in the charge which we establish for any article, the loss will be one hundred times greater than if we err but one mill.

19. It is usual to assume that the charge for toll should be proportional to the distance the article is carried—that it should be greater for a great distance than a short one. But we have already seen that, on the contrary in most cases, *the greater the distance the article is carried the less should be the aggregate toll upon it.* (*Art.* 13.)

20. It is common to suppose either that the tariff of toll is independent of the cost of freight, or that the higher the expenses of carriage the greater should be the charge for toll. But, on the contrary, the fact is susceptible of general and easy proof, that *the higher the charge for freight on the line, the lower must be the toll;* and also that *any increase of the cost of freight will at the same time diminish the toll or profit on the article, and increase the whole tax for its transportation.*

21. The charge for toll is also assumed, in the ordinary establishment of tariffs, to be independent of the mode by which the trade approaches the line; and, for many articles, this is true; but, for others, it is an ascertained

fact, susceptbile of easy demonstration, *that if they are brought to the work by a common turnpike a higher toll should be charged for their passage on the improvement than if the same articles reach the work by a railroad, and, a fortiori, than if brought by a canal.*

22. Where the object is to obtain the greatest possible revenue, it is a general law, susceptible of satisfactory proof, that *the charge for toll should not exceed half that charge which would exclude the trade from the line.* It may be shown, however, that, although a higher charge than this can never be advantageously adopted, it may frequently be reduced to *three-eights* of the sum which would cause the exclusion of the trade, with a very beneficial effect on the tonnage, and without leading to any sacrifice on the score of revenne.

23. Another fact, which may be derived immediately from the preceding is, that *where the most judicious charge is levied, the tonnage of the line will be one-half of the tonnage which would be obtained if no toll at all were exacted.*

24. The charge for toll has already been shown to depend in part on the price of freight; and it is an established law that if the cost of freight be increased or diminished by any modifications of the work, or the system of transportation adopted on it, *the toll must be increased just half as much as the freight is diminished, or diminished just half as much as the freight is increased.* And it is further susceptible of demonstration, that the increase of revenue which will follow a general reduction of the charge for freight *will at least be equal to the arithmetical mean between the values of the tonnage before and after the reduction, multiplied by the amount that the freight is reduced.* In other words, if the trade of the line be one hundred thousand tons, and the freight be from any cause reduced $1 per ton, and the tonnage thereby increased ten thousand tons, the revenue of the work will be increased more than $105,000; and this result will have place simultaneously with a reduction of the whole tax on the trade to the amount of $50,000, and the corresponding augmentation of the tonnage.

25. The fact is not usually recognised, that the toll, and tonnage, and revenue, are all more or less dependent on the length of the line of the improvement. It may, nevertheless, be easily proved by a general demonstration, that *the tonnage, the charge which may be levied per ton per mile, and consequently the revenue will all receive an increase by a reduction of the length of the line of transportation.* So that if the toll be judiciously established on any given line, and any material change of location afterward be made, by which the distance, or cost of freight is diminished, there must be a certain increase of the charge for toll, from which an augmentation of revenue will necessarily result. The value of *this inerease of revenue is equal to the whole annual tonnage of the line, multiplied by the actual cost of freight through the distance saved*—and, considering only the value of the trade, it is therefore worth, to reduce the length of the line, the capital of which the interest is equal to that sum.

26. In the arrangement of the charges in a tarriff, there is no subject of greater importance, for some articles, than the positive, and for others, than the relative, value of the mart. From the positive value of the article, is determined the tax which one division of the trade can sustain; and from the relative value is in part deduced the proper toll on all commodities for which other works are competitors.

A permanent change of the relative standing of the mart, ought, therefore, to superinduce a modification of the toll. And it may be easily shown that if the relative value of the market—by which is intended its value compared with that of the rival mart—be increased any given sum, we shall find the corresponding increase of toll per mile proper to be made, *by dividing that increase by twice the length of the improvement in miles.* If, for instance, the value of Philadelphia as a mart for tobacco, compared with the value of New Orleans in reference to the same article, be, from any cause, increased $4 per hogshead, and the distance from Philadelphia to Pittsburg be four hundred miles, then, I say, the toll on tobacco on the whole central line of the Pennsylvania improvement, should be increased a half-cent per ton per mile.

It is also easy to demonstrate that, at the same time, *the revenue will be augmented by any increase of the relative value of the market, an amount obtained by multiplying the original tonnage added to half the increase of tonnage consequent on an improvement of the market, by the increased value of the tonnage at the market.*

It is shown, in fact, that whatever circumstance occurs to increase the value of the property sent along an improvement, to the holder of the property, will cause a certain increase of tonnage, of which the measure can be obtained, and a simultaneous augmentation of revenue equal to the whole increase of its value; and that *whatever unnecessary tax is levied on the trade, is at least so much deducted from the revenue of the improvement.* If, for instance, the engineer in making the location permit his line to be one mile longer than is essential, he will thereby cause to the State or company an annual tax, or equivalent loss of dividend, equal to the whole annual expense of transporting the whole trade of the country through that mile. He incurs, at the same time, the responsibility of reducing the tonnage of the work, and of injuring, to a certain extent, both the country that supplies the trade, and the emporium which receives it.

If he embarrass the line by an unnecessary grade, or any other impediment which involves a similar increase of the charge for freight, he is responsible for the same result; and, before adopting such a measure, is bound to compare the value of the difficulties to be avoided, with that of these inevitable consequences to the future trade.

28. It is an error, and a very frequent one, to suppose that the toll is in any manner dependent on the cost of the work; or ought, under any circumstances, to be directly proportional to the value of the article. It is, however, not uncommon to assume, that it ought to bear some relation to the cost of construction; and there are tariffs of toll in the data for the calculation of which the value of the commodity is in principal, if not the only element. It is not a little singular that, after encountering an expense of hundreds of millions for our public works, the tariffs by which they are to be sustained should be entirely ruled by considerations which, however plausible in a superficial view, have no legitimate relation to the question.

For one division of the trade, it is not the positive value of the commodity, but the difference between the market value and the cost of production; and for the other, the difference between the value of the article at the mart of the improvement and at that of its rival, by which the toll is influenced. And this influence is only partial. The value of the article, taken in any sense, is only a part of the data by which the true charge must be determined.

29. It is by no means the intention here to attempt a general analysis of this most important subject. My object, as already announced, has been to show that, under certain circumstances, a marked increase of trade and revenue may be obtained on all our public works, by simply reducing the charges; and that such modifications of the tax levied on the community is rendered imperative by the first principles of equity. If I have succeeded in making this truth perfectly apparent, the design of these pages will be fully accomplished.

I scarce hope to have satisfied the reader in a discussion so brief and popular, that to enable a company to take the full advantage of its position, and obtain the highest degree of success of which their enterprise is susceptible, demands a careful and close investigation of the laws of trade in reference to every branch of the subject. To appreciate the importance of this course, requires that the mind should have investigated such questions sufficiently to estimate the consequences of its neglect. To know the value of establishing the most correct tariff, we need to know what we are likely to lose by the adoption of a conjeetural or empirical one.

This subject, though usually taken under other auspices, is peculiarly a professional study. An intimate acquaintance with the principles which govern the trade of an improvement, is a department of knowledge which is essential to the engineer in the location of his line, and the establishment of many of the plans of his work. His first duties, when properly discharged, compel him to become the most intimately acquainted with the productions and statistics of the country, and the information acquired in the accomplishment of these labors, ought to be turned to account in directing the future administration of the line.

The preparation of the tariff is, or ought to be, the peculiar province of the engineer. For, though there may be many considerations of policy, which should have a certain weight with those whose final action is requisite to carry his recommendation into effect—and which may frequently render it advisable to modify the charges which an *a priori* investigation may indicate to be proper, where the questions of trade and revenue only are under consideration,—still, it is not less important that the tariff should first be correct in itself, that some estimate may be made of the effect that will be felt when such political modifications come to be admitted. And, withal, it is difficult to conceive what motives of policy should induce any material departure from those limits which the administration of justice, the promotion of trade, and the augmentation of the revenue simultaneously recommend.

LE COUNT ON RAILWAYS.

"Uniformity in the width of track" finds as little favor on the other, as on this side of the water.

When the contracts along the line are fairly at work, one of the first knotty points which the directors will have to decide on, is, the width of the rails, their shape, the length of their bearing, and the form of their chair. The width between the rails has only lately become a subject of dispute, nearly all the railways prior to the Great Western, having been laid down 4 feet 8½ inches apart. Mr. Brunel has extended it to seven feet, the Irish railway commission recommend six feet two inches, several of the Scottish railways are laid down at five feet six inches, in fact, the variations run from four and a half to seven feet.

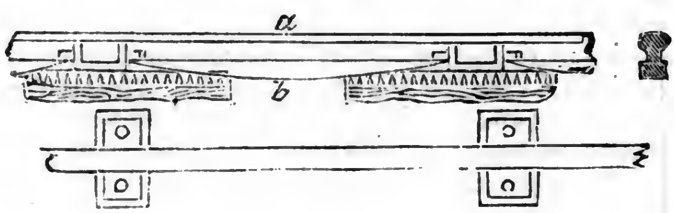
The question of the stability of the carriages on the railway may be left out of consideration in looking at this matter, because the machinery will always require sufficient space between the wheels to insure this. Now, as 4 feet 8½ inches are found to be enough for the good performance of an engine, which with 5½ feet wheel, will go on a level upwards of 69 miles an hour, as with 5 feet wheels, Marshal Slout, on his visit to Liverpool just after the Queen's coronation, was taken over 10¾ miles of favorable ground on the Junction Railway within 10 minutes, & as an engine has gone 60 miles Grand an nour on the London and Birmingham Railway, up an inclined plane, is it wise or prudent to make any change at all, and will any additional speed, which may be gained by increasing the width of the rails and the diameter of the wheels compensate for the greater expense of the outlay which will constantly be required to keep the road in order on account of the increased weight? This will receive light from the experiments on the Great Western, but will not be fully decided until it be tried on the Irish or some other railways, as Mr. Brunel's rails are altogether different from most others in use. The plan recommended by the Irish railway commissioners, of putting the rails farther apart but not widening the carriages, merely making the wheels run outside the bodies, is a good one in some respects; but it would add to the expense of the works considerably, and the result would be exceedingly questionable.

It must not be forgotten, that, where a different width from that in common use is adopted, the railway on which it is used becomes isolated. None but its own carriages can travel on it, and they can travel on no other line. This alone will, in most cases, be a serious objection. For our own parts we should say, let well alone; wait for more experience; we are yet infants among railways, and we ought not to innovate on that which has proved to do well, until we become giants. The majority of opinions, however, are beginning to lean towards some increase in the width, although there is every diversity in the quantity which practical men think necessary. Certainly the machinery under the boiler is compressed into its minimum space, and more room for it would be a great advantage, if it does not induce an incommensurate loss in other ways.

With respect to the form of the rail, it can be proved that a fish belly has greater strength, weight for weight, than any other. A 60 lb. fish belly at three feet bearings, rolled with a lower web, would be the best form of all; and this has been effected, as the original Liverpool and Manchester rails had partially this shape. The question, however, must be looked at in conjunction with the length between the supports. We have given below those forms most approved of in practice, and have added that in use on the Great Western Railway, which is however light, and does not stand well, three feet having been the original distance of the bearings.

Fig. 1 is the old Liverpool and Manchester rail, laid down at three feet bearings; weight thirty-three lbs. yer yard, with square joints. This rail

Fig. 1.



was rolled with a lateral swell at the bottom, which on one side was continued the whole length, but on the other did not quite reach the chair.—One side of the chair was cast with a cavity, into which the lateral swell fitted, and the opposite side had a nearly similar opening, in which was driven an iron key, shaped like a wedge, which, entering in a longitudinal direction, not only forced the swell into the cavity which was formed to receive it, but by this means, at the same time, kept the rail down in the chair.

Fig. 2. Losh's patent rail, in which he sought to gain a still more powerful mode of keeping the rail down in the chair, by having his key tapered vertically as well as longitudinally, so as to act as a wedge downwards, as well as in the direction of its length; whilst, at the same time, the neces-

sary expansion and contraction is allowed to take place. A key on each side has also been used with this form of rail, still, however, the keys were always found to work loose. Losh had also a projection rolled on the bottom of his rail; at the part which lies in the chair, where a corresponding cavity was cut to receive it, so that the effect of expansion or contraction would have a tendency to raise the rail in the chair, and thus wedge it tighter. The upper part of the notch for receiving the key in the chair was also formed with a slight curve, to allow of a small motion in the block, and the rails were made with a half-lap joint, formed not by cutting the middle rib of the rail, but by setting it back, so as to preserve its whole strength.—They were laid down at three feet bearings, and weighed forty-four lbs. per yard, but of course were not restricted to that, or to any other weight.

Fig. 2.

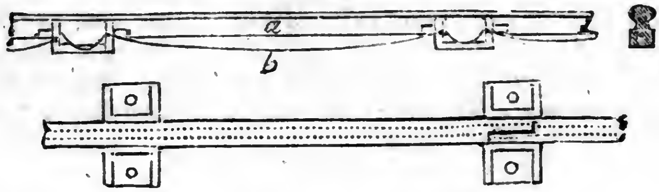


Fig. 3. The London and Birmingham fifty lbs. fish bellied rail. This was laid down at three feet bearings, and the half-lap joint formed by setting back the middle rib instead of cutting it, in the same way as Losh's rail. It was keyed down by a pin going through the side of the chair in a direction sloping downwards. The end of this pin went into a notch in the side of the rail, at its lower parts; the pin was forced tightly in by an iron key acting through the chair, and also through a hole in the pin, by which it was driven both in and downwards; and the end of the key being split, was then opened, to prevent its being shaken loose. Mr. Stephenson has a patent for this chair. The rails did not rest on the bottom of the chair but on a loose piece of iron, the lower part of which was the segment of a circle, and the upper part flat, and of the same width as the middle rib of the rail; and this worked in a circular cavity in the chair, so as to allow a motion when deflection took place in the rail. These rails had no bottom webs.

Fig. 3.

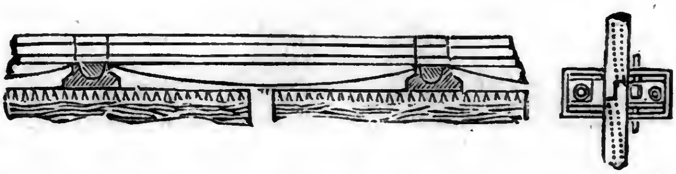


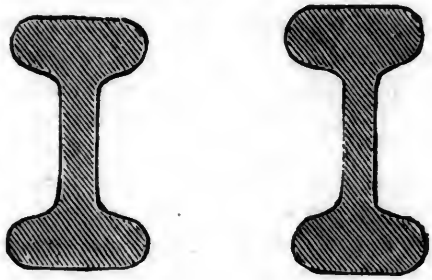
Fig. 4 is the St. Helen's and Runcorn rail, with a bottom web, having a semicircular base. These rails are forty-two lbs. per yard, and were laid down at three feet bearings. A wedge on both sides is used, which acts

Fig. 4.

downwards as well as sideways, from the opening in the chair to receive it being narrower at the top than at the bottom.

Fig. 5 shows the parallel rails laid down on the Grand Junction, and London and Birmingham railways. The left hand one is sixty-four lbs. per yard on the Grand Junction. The right hand one is the London and Birmingham seventy-five pound rail. Rails of this kind are laid on seventy-five miles of that railway, and were intended to be at five feet bearings, but proved a complete failure at that distance, which had to be reduced to three feet nine inches. The left hand one was intended to be at four feet

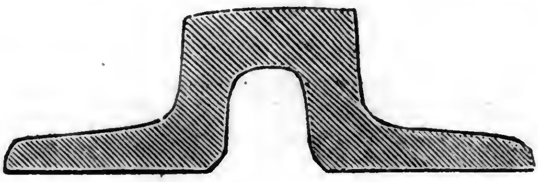
Fig. 5.



bearings. These rails were both laid down contrary to the opinion of the engineer, Mr. Stephenson, and have entailed a vast expense on that company. They have wooden wedges.

Fig. 6 is the Great Western rail, laid on longitudinal timbers, and forty four lbs. per yard. Felt is laid between the rail and the timber, and the

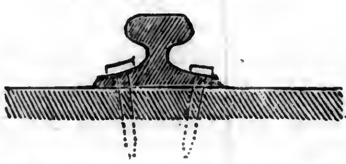
Fig. 6.



former is fastened down with screws. It has been found deficient in strength for the heavy engines used upon that railway.

Fig. 7 has been frequently adopted on railways formed with longitudinal bearings. It is spiked down to the timbers, and requires no chair. The weights have varied from thirty-five to sixty lbs. per yard. Sometimes the spikes have not gone through holes in the rail as in the figure, but have been driven in just outside each edge of the rail; in which case they are made with large heads, which come down and clip the rail firmly to the timbers.

Fig. 7.



The London and Birmingham railway companies, after a long discussion, decided to try four and five feet with a parallel form instead of a fish-belly, which, requiring one-third more height in the chair, had, in addition to other disadvantages, that of being more liable to wring the chair from the block, which is found in practice to take place directly as the height of the chair. The block is also more loosened in the ground by a high chair and the continual repairs arrising from this loosening, amount to one-half the wages expended in repairing the way in general; hence every means of diminishing such a heavy item, which can possibly be devised, should be put in practice." As usual, where all was theory, there were considerable diversities of opinion. Those who wish to enter more at large on this subject, may consult Professor Barlow in favor of lengthening the bearings, and Lieut. Lecount against it. As the matter has had a fair trial, it is only necessary here to state the results.

On the Primrose Hill contract, which was laid with four feet bearings, it was found much more troublesome to keep the permanent way in order, than with bearings of three feet. With the four feet bearings, it was found, that, in a very short time, the rails were put out of gauge, the width continually increasing, until it became absolutely necessary to re-adjust the whole. This was observed in a very marked manner with a part of the line near Kilburn, which had been recently laid down.

On the Harrow contract, from the crossing of the Harrow road to No. 12 cutting, the permanent road was used for conveying away the material from a side cutting. The traffic was of course considerable, but not by any means such as to account for the absolute difficulty which the contractors had in keeping the railway in guage. They were obliged to put sleepers at the joints in addition to the regular number of blocks, which of course kept the rails in guage at those points; but notwithstanding this, the intermediate blocks moved outwards. When the engineer's attention was first called to this position of the permanent way, he was inclined to think that something might be attributed to the blocks being placed anglewise; but after giving this part of the subject his careful consideration, he felt satisfied that the position of the blocks was at least as firm as the square position; and he felt confirmed in this opinion, by the fact, that, in another portion of the line near Kensal Green, where the road was laid in the ordinary manner with blocks three feet apart, and placed anglewise, and where locomotive engines had been constantly running for eighteen months, there was not found any greater tendency to a motion outwards, than when they were laid square to the direction of the rail, in the old manner. If, therefore, the diagonal position of the blocks had been defective, this was the place to try it; for the quantity of material conveyed over this part of the permanent road in wagons without springs, and with heavy locomotive engines, was very great indeed, and under circumstances well calculated to detect any marked difference in the construction.

On the Berkhempstead contract, where five feet bearings were in use, and were a locomotive engine was at work, the contractors made heavy complaints of the greater difficulty they had experienced in keeping the rails in guage than there was with the shorter bearings. In fact, in the eighteen months prior to June 1837, the three feet rails in some parts of the line, had more work than they now have, where the line is open; yet they stood it well, while the five feet have been so put out of gauge by one day's work, that the wagons had to be stopped till one and two additional sleepers for each five feet could be laid down, and even then they were but indifferent; and similar complaints having come in from other quarters, together with the fact that the five feet bearings on the Liverpool and Manchester railway were found to cost double the sum for keeping the way in repair that was required with three feet nine inches bearings, the whole question had to be opened again, and the directors resolved to shorten the bearings from five feet to three feet nine inches.

This lateral deflection is of most serious importance, when we recollect that the rails being out of guage will throw the trains off the line.—The lateral blows which an engine may give are such, that several chairs in succession have been broken or knocked off the blocks and sleepers; and the absolute weight passing over any one rail may be fairly taken as three times the nominal weight, for the effect from lurching has been experimentally found with engines having three tons' weight on each of the driving wheels to increase that weight to seven tons; besides which, we know that four wheeled engines, for instance, will, in practice, be frequently running on three wheels, no railroad being a perfect plane; and when these three points are in the act of shifting, the engine during that time is only supported on two wheels.

The flexure produced by this weight perpendicularly has also this bad effect, that the engine and train are constantly ascending an inclined plane in practice, although the railway is considered as level, and of course where the railway has an inclination, that inclination will be proportionally increased. This was first pointed out by Professor Barlow, and is an important fact; for on the short planes between each block or sleeper caused by the deflection of the rail, the gain in descent is so insignificant, that it may be entirely neglected; consequently the engines and carriages are constantly going up an inclined plane between each support of the rails equivalent to the central deflection divided by twice the distance between the supports. This is, from calculation, ascertained to be as follows, viz.:—

Bearing distance.		Deflection.	Equivalent planes.	Increased Power required per ton.
Ft.	In.	Inches.		
3	0	·024	1 in 3000	·75 lb.
3	9	·037	1 in 2432	·92 lb.
4	0	·041	1 in 2341	·95 lb.
5	0	·064	1 in 1875	1·20 lb.
6	0	·082	1 in 1756	1·30 lb.

Although the deflection of rails will generally be different from the above, and the increase of power required to surmount the consequent planes will also require considerable modification to suit the action of locomotive engines, which depend upon so many other circumstances besides the action of gravity; yet the fact remains the same, namely, that with deflection there is a consequent loss, and the subject deserves much more consideration than it has received, especially as we know that fish-bellied rails do not fail in the middle, but about eight inches from the supports. A rail ought not to act as a spring; but as this to a certain extent must be the case, it should be made to do so as little as possible. A spring should only be used to get over an obstacle where one must be met, but if the rail acts as a spring it creates an obstacle where none existed before. We must also remember that when deflection becomes permanent, fracture begins, as we break a thing we are not strong enough to pull asunder, by bending it backwards and forwards. In fact, the experiments on deflection have hitherto been such that they have merely served to unsettle all opinion, and to place one set of deductions in opposition to another. The mode of estimating this element by two wheels on an axle, loaded at their peripheries, and oscillated on the rails, is one which well deserves attention. In all cases, the firmer the rail is fixed to the chair, as respects rising in it, the less will be the deflection. Of course it must always have a motion in the direction of its length to allow for expansion and contraction, the force of which will vary in good or tolerable iron from nine to six tons per square inch of section. The expansion of a fifteen-feet rail may be taken at ·00126 inches for each degree of Fahrenheit, and as it will not be safe to take less than

$90°$ for the range of our climate, this gives ·1134 inches for the total, or ·0567 at each end of such a rail.

In order to understand the action which takes place in the case of a deflected rail when a heavy weight passes over it, we must know the effect of gravity at the velocities used on railways. For this purpose, if we take three, four and five feet berainGs as those which seem at present likely to be the limits, the following table will give us the time occupied in going over half the rail in each case; and from this we shall be able to ascertain the effect of gravity during that time.

Velocity in miles per hour.	Velocity in yards per minute.	Velocity in inches per second.	Parts of a second in which 18 inches are passed over.	Parts of a second in which 24 inches are passed over.	Parts of a second in which 30 inches are passed over.
10	293·33	176	1-9·8	1-7·33	1-5·86
20	586·66	352	1-19·6	1-14·7	1-11·73
30	879·99	528	1-29·3	1-22	1-17·6
40	1173·32	704	1-39·1	1-29·3	1-23·47
50	1466·65	880	1-48·9	1-36·7	1-29·3
60	1759·98	1056	1-58·7	1-44	1-35·2
70	2053·31	1232	1-68·4	1-51·3	1-41·1
80	2346·64	1408	1-78·2	1-58·7	1-46·9
90	2639·97	1584	1-88	1-66	1-52·8
100	2933·30	1760	1-97·8	1-73·3	1-58·7

Or putting a for the velocity in miles per hour, v for the velocity in yards per minute, and v' for the velocity in yards per second, we have

$$v=\frac{1760\cdot a}{60}=29\cdot333a \qquad v'=\frac{1760\cdot a}{3600}=4\cdot888a.$$

And in the table, taking either of the three right hand columns, according to the length of bearing, for instance the eighteen-inch column for a three feet rail, we have the number of inches through which the engine or any other body would fall by the action of gravity in free space, in the time which it takes to pass over 18 inches at the given velocity, by the formula $s=t^2\times193$, where t is the time in seconds, and s the space in inches. Thus at 20 miles an hour, with a three feet rail, where 18 inches are passed over in $\frac{1}{19\cdot6}$ of a second, the engine would fall during that time

$$\left(\frac{1}{19\cdot6}\right)^2\times193.=\frac{1}{384\cdot16}\times193.=\frac{193}{384\cdot16}=\cdot5,\text{ or half an inch.}$$

Again at 30 miles an hour, with a three feet rail, 18 inches of which are passed over in $\frac{1}{29\cdot3}$ of a second, the engine during that time would fall

$$\left(\frac{1}{29\cdot3}\right)^2\times193.=\frac{1}{858\cdot49}\times193.=\frac{193}{858\cdot49}=\cdot225,$$ or not quite a quarter of an inch.

And denoting by t and s the time and space as above, we have conversely, knowing the space an engine would have to fall, for instance, through a bad joint, the distance the engine would pass over without touching the lower rail, by the formula

$$t=\sqrt{\frac{s}{193}}.$$

Thus when $s=\cdot225$, we have

$$t=\sqrt{\frac{\cdot225}{193}}=\sqrt{\cdot001166}=\cdot0341=\frac{1}{29\cdot3}$$

of a second, in which, at 30 miles an hour, we find by the table the engine would pass over 18 inches of the lower rail without touching it, describing in its fall a parabola modified by the effect of the springs on the engine.

This has been put to the test of experience by bending a rail nearly half an inch, and then painting it. An engine and train of carriages were then run over it, none of the wheels of which touched the paint for 22 inches. This affects a railway in three ways. First, when the engine has to fall, through a bad joint, the rail which it leaves being higher than the rail it is coming upon, the increased momentum from the fall will here occasion a larger deflection than ordinary, and a consequent inclined plane against the engine, from the time it comes on the rail till it passes the next chair. Secondly, when a rail is permanently bent, where the resistance on the second or rising part of the rail will be less than in the first case. And thirdly, when the rail is simply deflected by the weight of the engine, and restores itself to its original level when that weight has passed; here the effect will be least of all, the rail taking the form of a receding wave before the wheel and a following wave after it.

In the second case, where the rail is permanently bent, the formula for the space the engine would fall will be

$$s=\frac{H}{L}\cdot 193\cdot t^2,$$

where H is the height of the plane, and L its length, s and t being as before. For instance, if the bend is ·1 of an inch in a 3 foot rail, we have

$$s=\frac{1}{180}\cdot 193\cdot\frac{1}{858\cdot 49}=\cdot 00125 \text{ of an inch, at 30 miles an hour,}$$

and $s=\frac{1}{180}\cdot 193\cdot\frac{1}{384\cdot 16}=\cdot 00278$ of an inch at 20 miles an hour, or $\frac{1}{360}$ of an inch at 20, and $\frac{1}{800}$ of an inch, at 30 miles an hour, would be descended by the engine by the effect of gravity, in the same time that steam and gravity together take it along 18 inches of the rail.

Let us next suppose we have steam enough to carry the engine along at a velocity so great, that gravity will not bring it down the ·1 of an inch perpendicular, whilst steam carries it along the 18 inches horizontal, we shall find this velocity to be at and above 44 miles an hour, for it takes $\frac{1}{43}$ of a second for a body to fall one-tenth of an inch by the effect of gravity, and $\frac{1}{43}''$: 18 in. $=3600''$: 44 miles; hence at 44 miles an hour, and at all velocities above it, the engine, after arriving on the rail, bent one-tenth of an inch in the middle, and forming two planes, will no longer touch the rail till after it has passed the middle of it, and velocities of 60 miles an hour have been attained.

(To be continued.)

Erie Canal Enlargement.—A series of articles on this subject, have been lately published in the Railroad Journal, under the signature of Fulton, which appear to us to be both timely and appropriate. Other numbers are yet to follow. The writer calculates the whole cost of the enlargement, including damage and loss of interest, at $40,000,000!! He shows from the annual Reports of the Comptroller, that in consequence of the gradual destruction of the forests in the neighborhood of the canals, the down tonnage has fallen off within the last five years to the extent of 140,000 tons, will not, for a long time to come, be made up by the increase of agricultural products; that even double locks are not *now* wanted; and that any enlargement beyond adding 12 or 18 inches to the banks, will be money thrown away. He complains of the impolicy and injustice of making private enterprise, as developed in railways along the line of the canal, *tributnry* to the State, as a means of defraying the interest on the enlargement. He rebuts the doctrine heretofore maintained by some, that the effect of the enlargement will be to reduce transportation 50 per cent. Persons interested in the subject, as every citizen of the State is, either directly or indirectly, will do well to refer to the articles themselves. We perceive, as yet, no decisive movement in the Legislature, having for its object to arrest the enormous expenditure which is being entailed upon us. The subject will be thoroughly scanned by posterity—of that be assured. Forty million dollars, or twenty millions, if such a debt is incurred for the proposed enlargement, will be an incubus upon our credit and resources, which it will not be easy to shake off.—*Jour. of Commerce.*

Locomotive Engines.—The statement of the performance of the Locomotive Engine "Minerva," on the Philadelphia and Reading railroad which we take from the United States Gazette, will be found interesting and useful on account of the business like manner in which it is prepared.

More of the Philadelphia Engines.—We have great pleasure in presenting our readers with the subjoined statement of the performance of the "Minerva" Locomotive Engine, built by William Norris, Philadelphia, on the Philadelphia and Reading Railroad, with a train of 85 loaded cars, January 15, 1840.

	No. cars.	Gross load. Tons.	Running time. h.	m.	Water used. Gallons.	Wood used. Cords.	Distance. Miles.	Fall. Feet.	Average fall per mile. Feet.	Longest level. Miles.	Total level. Miles.	Remarks.
Between Reading & Pottstown,	54	227	1	1	322	0.4	17.5	113.8	6.5	4.3	5.1	Wood seasoned, dry.
Pottstown & Phœnixville	62	261	0	56	329	0.65	13.0	40.2	3.1	2.5	7.4	do. do. do.
Phœnixville & inc. plane,	85	350	2	47	886	1.14	24.0	59.5	2.5	9.1	15.3	Wood green
Total,			4	44	1537	2.19	54.5	213.5	3.92		27.8	

Two quarts of oil only were used by the Engine and Tender in the trip, including oiling before starting. Nett weight of freight 216·3 tons gross weight, 350 tons or 784,000 lbs.

In the above statement the tons mentioned are *gross* of 2240 lbs.

Weather clear and cold, rails in good order.

Weight of engine, empty,	23,040 lbs.
With water to second cock,	25,730 "
With water, fuel, and two men,	26,300 "
On four driving wheels,	15,150 "
On driving wheels, with water and fuel,	17,450 "
On driving wheels, with water, fuel and two men, or in running order,	17,900 "

Her tender holds 504 gallons water.

The engine started the train of 85 cars three times on a level; and on one occasion in a curve of 955 feet radius, without any straining or difficulty, and at various times attained a speed of 14 miles per hour through some curves of the above radius on a level.

The quantity of steam generated, when common dry oak wood was used was more than sufficient to supply her cylinders; and from the surplus quantity which escaped from the safety valve, I have no doubt she could

have taken 20 more loaded cars, or 90 tons, had they been ready, and without any injury to her machinery. Signed, G. A. Nicolls.
Superintendant Transportation Phila. and Reading Railroad.
Reading, Pa. January 18, 1840.

For the American Railroad Journal, and Mechanics' Magazine.

METEOROLOGICAL RECORD FOR THE MONTHS OF NOV. and DEC., 1839.

Kept on Red River, below Alexandria, La., (*Lat.* 31.10 *N.*, *Long.*, 91.59 *W.*)

1839	Thermometer.					Remarks.
Nov	Morn.	Noon.	Night.	Wind.	Weath.	
1	55	70	66	calm	cloudy	light shower forenoon
2	56	69	67	..	clear	light shower at night
3	62	68	66	..	..	cloudy morning clear day
4	66	74	75	s high	..	all day
5	63	69	58	nw high	..	"
6	46	62	51	w	..	"
7	40	54	50	nw	..	white frost
8	36	60	50	calm	..	"
9	38	62	52	..	..	"
10	41	72	65	..	..	rain in the night
11	65	71	64	w	..	
12	46	73	67	..	..	foggy morning
13	47	76	67	sw	cloudy	rain in the evening
14	45	76	68	..	..	heavy showers all day
15	51	53	51	nw	..	morning, evening clear
16	44	53	50	ne	clear	
17	45	65	61	calm	..	foggy morning
18	48	69	66	..	..	
19	51	68	66	w	..	
20	52	52	50	n	cloudy	
21	45	46	42	ne	..	rain evening and all night
22	40	42	42	..	..	" steady all day and all night
23	40	41	40	n	..	all day
24	38	44	48	nw	..	morning, clear day
25	30	31	30	n high	..	all day
26	23	36	37	calm	..	"
27	36	46	48	ne	..	rain light showers and drisling all day and all [night
28	48	52	53	calm	..	light drisling rain all day and all night
29	47	47	48	n	..	
30	44	58	52		..	evening clear
	47	59	56	....	....	mean temp. of the month 54.
Dec.						
1	44	48	47	calm	clear	foggy morning
2	46	60	54	nw light	..	
3	32	61	52	calm	..	white frost
4	32	56	52	..	..	"
5	36	48	49	..	cloudy	white frost, rain in the evening and night
6	53	54	50	..	..	thunder shower in the morning, drisling rain [all day
7	33	69	52	..	clear	white frost
8	34	46	42	nw high	..	"
9	28	52	56	sw	..	"
10	34	62	60	..	..	"
11	56	58	52	nw	..	"
12	31	50	46	w	..	
13	32	62	60	sw	cloudy	all day
14	48	56	50	ne high	..	"
15	36	50	46	calm	clear	white frost
16	33	50	40	.	..	"
17	34	56	44	ne	..	"
18	40	60	56	calm	cloudy	
19	38	48	50	..	..	
20	56	63	56	se	..	rain all the forenoon, evening calm and clear
21	46	48	48	nw	clear	
22	36	47	50	..	..	
23	40	40	40	ne	cloudy	rain afternoon and all night
24	36	40	38	calm	..	
25	36	50	46	..	clear	white frost
26	44	56	50	..	cloudy	rain all the forenoon, cloudy all day
27	38	50	44	..	clear	white frost
28	42	54	48	w	..	"
29	32	50	48	calm	..	"
30	45	63	63	sw	cloudy	rain and thunder at night
31	40	34	35	nw	clear	
	39	56	48	....	....	mean temp. of the month 48.

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AND

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DESTRUCTION OF WOODEN BRIDGES BY ICE.—SUSPENSION BRIDGES.

The breaking up of the winter has caused a recurrence of a specie of accident which is far from being rare. We allude to the destruction of bridges by the combined force of a swollen stream and immense masses of ice. The liability to this kind of accident depends more upon the character of the stream nearer its source than at the location of the bridge itself. A river of any considerable size receiving the drainage of a large track of country, is of course apt to be speedily swollen by a sudden and heavy fall of rain or rapid thaw, and as one or the other of these circumstances are sure to accompany the breaking up of the ice, such streams must present locations badly adapted to ordinary wooden bridges. Shallow streams, from daming up the ice, are rather worse than others in this respect, yet they are the most frequently crossed by these insecure structures.

Bridges of a more durable construction, if not built in the most substantial manner, are likely to suffer from the same cause, if the water way has been too much diminished.

The proper substitute in such localities are *suspension bridges* of iron wire. These claim the preference of all others, whether we regard to economy of first cost, or their superior adaptation to the circumstances of the locality. Over a large portion of our country the character of the streams is altogether more favorable to this than any other specie of structure. The example of the new bridge at Fair Mount will, we hope, speedily be followed in many places.

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK, WITH REFERENCE TO DE PAMBOUR'S MODE OF CALCULATING THE PROPELLING POWER OF A LOCOMOTIVE ENGINE.—BY JOHN A. ROEBLING, C. E.

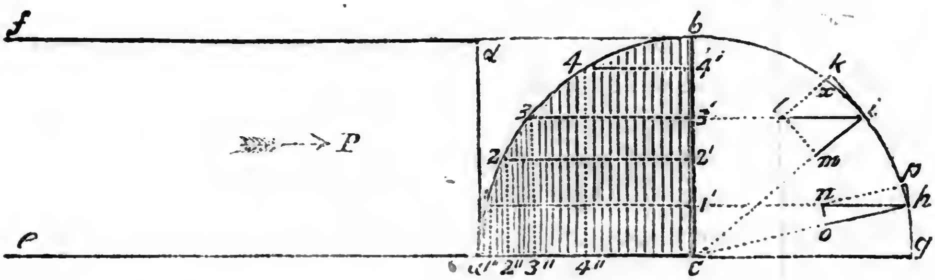
The question, "*Is the change of a straight motion in toa rotary motion, attended with any loss of useful power or not?*" has been the subject of various discussions among mathematicians, and has never been, to my knowledge, satisfactorily settled.

The *Crank*, by which that change of motion is effected, forms, in the present state of mechanics, a most conspicuous part of machinery, and the nature of its action should therefore be well understood.

The following demonstration, which the writer respectfully offers to the public, will prove, that if the amount of power actually expended is represented by 1, the application of the crank occasions a loss of useful effect equal to the expression, (π signifying the ratio of the circumference of the circle,)

$$1 - \frac{\pi}{4} = 0\cdot2146+$$

and, it is believed, that the principle of the crank may now be considered as fully established.



Let the above diagram, *a c b*, represent a crank, moving around the fixed shaft *c*, in the direction from *a* to *b*, and let the power applied be represented by the solid frame *e a d f*, moving in a straight course, corresponding to the direction *e c g*.

When the frame or the power is pressing against the crank at *a*, which point is commonly called the *dead point*, it is obvious, that the whole pressure is transferred to the centre of the shaft, *c*. The centre, being an immoveable point, will press with the same force back; therefore, the crank at *a*, will remain at rest, and will have no tendency whatever to move the shaft around the centre.

On the other hand, when the crank is at *b*, then the direction of the power will be vertical to the crank, and will press in the direction of a tangent; therefore, the full pressure is usefully applied at *b*, and no part of it is transferred to the centre.

Let us presume that the motive power is applied steadily and uniformly, moving the same distance, in the same space of time, and in the same direction.

As the full pressure acts at *b*, in the direction of a tangent, its effect with respect to the centre of motion will be as the radius *b c*, or, as the length of the crank; and if we represent the motive power by 1, then

1. *The effect of the crank or its momentum at b, will be* =R, *the radius of the quadrant.*

It is further clear, and an established principle in mechanics, that if the pressure of the moving power be uniformly the same, the amount of power, actually expended, will be in direct proportion to the distance the pressure has moved.

2. Therefore, when the power has moved from *a* to *c*, the amount of power or momentum, actually applied, is represented by the square *a c b d*$=R^2$; and if we denote the radius by 1, the unity will represent that value.

Let us now examine the effect of the power upon the crank at the intermediate points 1, 2, 3, 4, when moving from *a* towards *b*.

The direction of the pressure upon the crank at 1 will coincide with the line 11′ parallel to *a c*; therefore, the leverage of that pressure, with relation to the centre, must be $=1'c=11''$

At 2 the leverage of the crank is, $2'c=22''$

The leverage at 3 is	$3'c=33''$
" " " 4 "	$4'c=44''$
" " " *b* "	$b\,c=R.$

The different leverage with which the pressure will act upon the crank to produce an useful result, for its motion around the centre, can therefore be represented by an indefinitely great number of ordinates, of the quadrant, as represented in the diagram, and the intermediate abscissas, corresponding to these ordinates, and forming infinitely small portions of the line *a c*, will represent the different extents of spaces through which the motive power has been travelling when acting upon the different levers.

The products of the different ordinates in their corresponding abscissas, will represent the different momenta, which have been produced upon the crank with relation to its motion around the centre, and the sum of these products will give us the whole amount of useful effect of the crank during one quarter revolution.

But the products of an ordinate and its abscissa is the area of the trapezoid formed by them, and the sum of these areas is equal to the area of the quadrant, therefore:

3. The total useful effect of the crank through one quadrant, is represented by the area of the quadrant, or

$$\frac{R^2\pi}{4}=\frac{1^2\times3{\cdot}1416+}{4}=0{\cdot}7854+$$

4. The power applied being $R^2=1^2$, therefore the useful power lost is

$$\left(R^2-\frac{R^2\pi}{4}\right)=1-0{\cdot}7854+=0{\cdot}2146+$$

or equal to the area of the concave *a d b*.

ANOTHER DEMONSTRATION.

Suppose the crank moving from *g* to *b* and passing the points *h* and *i*. We may represent the pressure upon the crank at these points by the lines *h n* and *i l*. Now the pressure *i l* can be resolved into the two pressures *i m* and $i\,k$, at right angles to each other, and forming sides of the parallelogram of forces $i\,k\,l\,m$. The pressure $i\,m$ being directed to the centre, will be useless for the motion of the crank. The pressure $i\,k$, in the direction of the tangent, is the only useful pressure, resulting for the motion of the crank.

The momentum of the crank at i is therefore $= i\,k \times i\,c = i\,k \times R$.

Likewise is the momentum at $h = h\,p \times h\,c = h\,p \times R$,
and so in all other points.

The triangles $i\,k\,l$ and $i\,l\,m$, are similar to the triangle $i\,c\,3'$, therefore

$$l\,i : i\,k :: c\,i : c\,3' :: R : c\,3' :: R : 3''\,3$$

and also,

$$n\,h : h\,p :: c\,h : c\,1' :: R : c\,1' :: R : 1''\,1$$

From this follows, that, if we represent the actual pressure of the moving power by R, then the useful tangential pressures, resulting for the motion of the crank at the different points $h\,i$, will be to the actual pressure as the ordinates $1''\,1$, $3''\,3$ are to the radius R.

We can further represent the amount of power actually expended at each of the different points h, i, by multiplying the pressure R, by an infinitely small extent of the line $c\,g$.

The useful momenta of the tangential forces, resulting for the motion of the crank, will therefore be obtained by multiplying the different ordinates with the same differential extent of $c\,g$. But these differentials are the abscissas belonging to the ordinates, and their aggregate products are represented by the area of the quadrant, therefore;

The useful effect of the Crank is equal to the area of the quadrant, if the power actually employed be equal to the square of the Radius.

The distance the crank travels is equal to the circumference ab of the quadrant, for the same space of time in which the power applied moves from a to c.

5. Therefore, the travel of the piston is to the travel of the crank, as is the radius to the circumference of the quadrant; or as the stroke to half the circumference of the circle; or,

$$R : \frac{2R\pi}{4} = 1 : \frac{\pi}{2} = 2 : 3{\cdot}1416 + = 1 : 1{\cdot}5708 +.$$

Since the whole useful effect of the crank during one quarter revolution is equal to the area of the quadrant, we shall find the *average* force which carries the crank around by dividing the effect by the extent of the travel. Therefore

$$6. \qquad \frac{R^2\pi}{4} : \frac{2R\pi}{4} = \tfrac{1}{2}R = \tfrac{1}{2}P$$

is the expression for the average force: ***or the average useful pressure of the crank is equal to one-half of the pressure applied.***

All the conclusions we have arrived at with respect to the crank, will apply as well to a cylinder, the radius of which is equal to the length of the crank, or the diameter of which is equal to the stroke of the piston.

If we examine the action of the crank by the *principle of virtual velocities*, according to which, the *effect produced*, should be equal to the *power applied*, and we denote the pressure of the power by P, its velocity by v, the useful propelling pressure of the crank by p' and its velocity by V, then the following equations should be correct:

$$P \times v = p' \times v$$

and by substiuting for v its value R, and for V its value $\frac{1}{2} R \pi$ we have

$$P \times R = p' \times \tfrac{1}{2} R \pi$$

or,

$$p' = \frac{2}{\pi} P.$$

If we denote the correct pressure of the crank by p, we have according to No. 6,

$$p = \tfrac{1}{2} P$$

7. Therefore,

$$p : p' :: \tfrac{1}{2} P : \frac{2}{\pi} p :: \tfrac{1}{2} : \frac{2}{\pi} :: \frac{3 \cdot 1416 +}{4} : 1$$

or,

$$p : p' :: 0 \cdot 7854 : 1.$$

The law of *virtual velocities* gives therefore the propelling power of the crank 0·2146 + too great.

When a wheel is connected with the shaft of the crank, then the propelling power of the wheel is to the propelling power of the crank, as is the diameter of the crank, or the stroke of the piston, to the diameter of the wheel.

Let L = the stroke of the piston, and D = the diameter of the wheel, and P = the pressure of the piston, then is

8. The power of the wheel $= \tfrac{1}{2} P \times \dfrac{L}{D} = \dfrac{PL}{2D}$.

Formula for calculating the propelling power of a Locomotive Engine.

According to the principle of virtual velocities, the expression

$$\frac{2}{\pi} P$$

gives the propelling power of the crank, and applying this to the action of the wheel, we have, according to No. 8,

$$\frac{2}{\pi} P \times \frac{L}{D} = \frac{2PL}{\pi D}$$

as the value of the propelling power of the wheel.

Now let d be the diameter of the piston, π the ratio of the circumference, then $\frac{1}{4} \pi d^2$, will be the area of one of the pistons. Let p represent the effective pressure of the piston in pounds per square inch, all other dimensions being given in inches, then $\frac{1}{2} \pi d^2 p$ will be the value of the total pressure of the two pistons.

By substituting this expression for P in the above formula, we have

$$\frac{2}{\pi} \times \tfrac{1}{2} \pi d^2 p \times \frac{L}{D} = \frac{d^2 p L}{D}$$

as the value of the propelling power of the engine, expressed in pounds.

This formula corresponds exactly with that offered by De Pambour, in his work on Locomotive Engines, (see Am. edition, pp. 109, 110.) But we have proved that the principle of virtual velocities, gives the effect 0·2146 + too great.

The correct expression for the propelling power of a wheel is according to No. 8,

$$\frac{P\,L}{2\,D}$$

by substituting for P its value $\frac{1}{2}\,\pi\,d^2\,p$ we get

9. $$\frac{\frac{1}{2}\pi\,d^2\,p \times L}{2\,D} = \frac{\pi\,d^2\,p\,L}{4\,D}$$

which is the correct formula for the propelling power of a Locomotive Engine, allowing only $\frac{\pi}{4}$ or 0·7854 + of the power, produced by De Pambour's formula.

Example.

Let $P = 50$ lbs. per square inch, or 7,200 lbs. per square foot, $L = 1·5$, $d = 1$, $D = 5$. By substituting these values in the correct formula,

$$\frac{\pi\,d^2\,p\,L}{4\,D}$$

we have

$$\frac{3·14 + \times 1^2 \times 7{,}200 \times 1·5}{4 \times 5} = 1695·6 \text{ lb.}$$

as the propelling power of the engine, leaving all other considerations out of view.

De Pambour's formula,

$$\frac{d^2\,p\,L}{D}$$

will produce

$$\frac{1^2 \times 7{,}200 = 1·5}{5} = 2160 \text{ lbs.}$$

for the propelling power of the engine.

Now it is,

$$2{,}160 : 1{,}695·6 :: 1 : 0·7854 + .$$

Or De Pambour's formula gives the power nearly one-fourth too great.

De Pambour in his new publication on the Steam Engine, speaks of the great discrepancy between the theoretical and practical effect of Locomotive Engines, and he appears to acknowledge that the old formulas are insufficient. This distinguished Engineer presumes that the main cause of the error is to be found in the reduction of the pressure of the steam in the cylinders. There are, however, strong reasons to believe that this is not the case, if we take the evaporating power of the engine as the measure of its power, as we should do. One great loss of effect, is owing to the use of the crank, as has been proved above, conclusively. We hope to be able to ascertain the amount of loss arising from other causes, particularly from the reaction of the waste steam, and may at some future period offer formulas which will very nearly agree with practice.

It remains yet to account for the loss of useful effect attending the use of the crank, or the change from a straight to a rotary motion, generally.

It appears that the law of virtual velocities is only applicable to analagous motions, with respect to actual and useful effect. Rotary motions and straight motions differ in their nature totally; they cannot be compared directly by that law.

The philosophical principle—*what matter is in existence cannot be lost, nor destroyed, but can only be changed in form and space,*—appears to be a grand universal law, rendering the existence of the Universe itself, permanent, and independent of time.

This principle, the truth of which will force itself upon the mind, by a concatenation of rigid deductions, must hold out in all cases, and therefore also in the case before us, where matter is brought into action to produce a mechanical effect. The laws of mechanics cannot be in contradiction to an universal law.

If therefore we cannot account for the loss of power in any way, we have strong reasons to doubt the accuracy of a demonstration which is to prove that loss of power.

On the other hand, no law has been established yet, to prove that the whole amount of power applied, can be made available for all purposes for which we want it, leaving of course friction out of view, and other circumstantial causes of loss.

In the case before us, let us suppose the tangential pressure $k\,i$, (see diagram,) is applied to the crank. If the impulse which the point i receives in consequence of that pressure, was allowed to be developed for any *actual extent* of space, in the line of the tangent, which is the direction of the impulse, we would be authorised to compare the quadrant to a succession of inclined planes, and we could prove *no loss* of power. But the impulse which is ready to act in the point i, is not allowed to develope itself in the direction of its natural tendency for any actual extent of space, *without being checked.* And since an inclined plane coincides with a straight line, and a straight line is the result of a point moving through an *actual extent* of space, in a straight course, it follows, conclusively, that we cannot compare the circumference of the quadrant with a succession of inclined planes.

We have made these remarks, in order to object to any demonstration which treats the circumference of the quadrant as a succession of inclined planes.

The impulse of the crank, with relation to the centre, can therefore only be considered for single mathematical points in the circumference, as h, i, without even allowing an initial extent for the display of the tangential forces.

The motion of a crank is therefore to be compared to the motion of a mathematical point at at an uniform distance around a centre; and which motion is the result of the action of an infinite number of tangential motives, successively applied.

On the other hand, suppose the point *i* was allowed to follow the tangential impulse for some distance and arrived at *k*, then the full tangential power would have been developed in conformity with its natural disposition.

But, in the case before us, some power must be expended in constantly diverting the impulse from its natural course. And the line *k x* will represent the amount of that power required to force the point *k*, back towards the centre, to make it move in the circumference of the circle.

We may therefore conclude, that the loss of effect is caused by the abstraction of power from the tangential forces in order to check their natural tendency and to make them conform with a circular motion.

For the American Railroad Journal and Mechanics' Magazine.

It is stated in a short editorial notice at the end of the Journal of 15th February, that "on examining the article in our last number, on Dr. Lardner's experiments, it appears that the writer has fallen into an error, which vitates much of his reasoning. The article was prepared in haste, and the writer is not at present in the city, but will doubtless make the necessary correction."

The writer avails himself of the first opportunity to make these corrections, premising, however, that all the *practical* views and conclusions in the article referred to are, in his opinion, substantially correct, and that he still considers Dr. Lardner to have "signally failed in his attempts to prove that the resistance of the atmosphere has been *underrated*, that the *frontage* is unimportant, and that the resistance increases as the *volume* of the train."

The general results of Dr. L. appeared so palpably erroneous, and it appeared so very easy to show that they were so, that the first part of the article was written without that caution and close examination which should be bestowed even on investigations of the very easiest kind. The assertion, that "the mere ratio of the height to the length of the plane and the velocity which gravity can generate on that plane, are not sufficient to determine the value of the resistances," (p. 73) has some truth when discussing the motion of a body *up* an inclined plane, but has no application in the present case—hence the remarks contained in pages 71, 72 and 73, even when correct in themselves, have little connection with the subject under discussion. When a body, left free to the action of gravity on an inclined plane, attains a uniform velocity, the power and resistance are necessarily in equilibrio and they may be represented by the weight of the body multiplied by the height and divided by the length of the plane. The same error occurs at page 80, where it is said, "Now, if on a plane of 1-89, the entire force of gravity be absorbed in overcoming the resistance, as previously assumed by Dr. L., whence is derived the power, which, by carrying the train up the next plane, so very nearly compensates for the power expended in the descent of the first?"

It is here overlooked that the entire power is absorbed only, *at that velocity*, and that the compensating power of the gradients arises exclusively from variations in the speed. Again, at page 73, speaking of a mode of determining the resistance by observing the actual velocity at the foot of an inclined plane, then calculating the height due to this velocity and subtracting that from the entire height, it is hastily *assumed* that Dr. L. and Mr. Wood would consider the resistance as represented by the total height of the plane because they so estimate it, and very properly, when calculating the resistance at a *uniform* velocity. The two cases are, however, entirely dissimilar, hence there is nothing to justify any such supposition.

It was said that "the late experiments of Dr. Lardner fully confirm the views of Mr. Brunel," etc. It would be more correct to say *some* of the experiments, for many of them are utterly irreconcilable with each other, or with the daily experience of the Whiston plane, as Mr. Brunel positively asserts.

In addition to what was then said to substantiate these opinions, as well as to show the value of the ordinary modes of calculation, the following experiments of Dr. Lardner are examined.

Tables IV and V give the velocity of one coach (5·35 tons) on a plane of 1-89 as equal to 23·15 miles per hour, being the mean of three experiments.

Tables VI and VIII give the velocity of eight coaches (40·75 tons) on a plane of 1-177 as equal to 25·48 miles per hour, being the mean of four experiments.

Now, if the resistance were as the volume of the train, we should have only half the velocity on 1-177, instead of which it is actually greater than on 1-89. In this case then, by increasing the volume of the train 8 times we have diminished the resistance more than one half, or, in other words, a train of 8 coaches will descend an inclination of 30 feet per mile more rapidly than a single coach will run down an inclination of 60 feet per mile.

This great difference would, by the ordinary modes of calculation, be ascribed to the frontage, which is the same in both cases, and, supposing this equal to 50 square feet, we have, with the velocity of 25·48 miles per hour a resistance from the atmosphere $=50\times3{\cdot}25=162{\cdot}5$ lbs. Now, the total resistance was equal to 1-177 of the weight, or 12·65 lb. per ton; and $40{\cdot}75\times12{\cdot}65=515{\cdot}48$ lbs. equal to the entire resistance. Deduct from this the frontage 162·5 lbs. $+(40{\cdot}75\times5=)$ 203·75 lbs. for the friction and there remains 149·23 lbs for the resistance of the air to the other 7 coaches, or 4·26 lb. per ton. Now add 5 pounds for the friction, and we have lb. 9·26 per ton, for the traction of all except the first coach at a velocity of 25·48 miles per hour. De Pambour estimated it at 8 lbs. with an average velocity of about 19 miles per hour, and if Mr. Brunel is correct in stating, (C. E. and A. J. p. 70, vol. 2,) "The passenger train, in descending this plane, with the steam shut off the engine, which then causes some considerable resistance, frequently acquires a very high velocity, exceeding forty miles rather than thirty miles per hour, and requiring the use of the brake," then is he fully justified in saying, (p. 70, ibid.) that calculations "if judiciously made, would give more correct results, though not nearly so large as the experiments before us; they would at least be free from several very serious sources of error."

On Dr. Lardner's hypothesis the resistances ought to be equal in the two cases and the difference of more than one half cannot be explained, whilst with the ordinary modes of calculation, it is easily and satisfactorily accounted for. With a large train, the resistance would have been still less, as the frontage is constant, besides which, it is possible that part of the resistance, that is, the "friction" of the air on the *sides* of the carriages, may not increase as the square of the velocity.

All calculations necessarily suppose an absolute calm, a rare occurrence, and in nearly every practical case it would be necessary to determine the force and direction of the wind, and make the requisite allowances. This would be attended with immense labor, and could hardly lead to any beneficial practical result, hence it is not likely to be undertaken by competent persons. As observed in the previous "remarks," the subject is more curious than useful, or even interesting," and, did the present state of the public works offer any thing more substantial to discuss, the writer would consider himself bound to apologize to the readers of the Journal for filling up so many pages with these "airy nothings."

New York, March 7, 1840. W. R. C

GREAT INCOME FROM A RAILWAY.—20 PER CENT. PER ANNUM.

We have had placed in our hands, the "Statement of the Directors relative to the *Syracuse and Utica Railroad*, to 1st Jan. 1840."

This road was commenced in 1838 and put in operation, the 3d of July 1839, at the following outlay of capital. The distance is 53½ miles.

For land damages,	$71,245 42
For grading, fences and bridges,	322,552 67
For superstructure,	411,751 92
For buildings, coach, engine, wood and water houses,	30,445 65
For engine and shop tools, snow plough, etc.,	1,250 50
For 18 freight cars,	4,979 93
For engineering, including preliminary surveys,	35,294 38
For commissioners' department, and incidental expenses,	36,868 95
	914,389 42

Deduct to show cost of road, this sum, for iron and stock in-

cluded in the above, for repairs *on hand*,		20,500
		$893,889 42

The nett income for the first six months, is as follows.

The receipt from 3d July 1839 to 1st Jan. 1840 was from 48,483 through, and 34,053 way passengers,	121,972 55
Transportation of freight $850, U. S. mail $2,801 08,	2,651 08
	$125,623 63

The expenses of transportation account, are

For superintending, collecting and clerk hire,	$2,177 38	
For services of engineers, firemen, brakemen, and stations,	5,394 40	
For fuel for locomotives,	10,525 93	
For oil,	454 22	
For repairs and alteration of engines,	2,308 96	
For repairs of coaches, and oil for do.,	1,307 69	
For taxes assessed on road,	1,777 61	
For incidental to transportation,	1,973 87	
For repairs of roadway, watching track, clearing away snow, and sundry work on road,	7,037 06	
For incidental expenses, cattle killed, repairs on depot in Utica, and ⅗ths interest on cost of depot,	1,810 96	
		34,768 11
Nett receipts in 6 months, on outlay of $893,889		$90,855 52

Note.—"The payments on transportation acconut in Deeember are more than the monthly average, from the fact that in this years disbursements are included the semi-annual expenses at Utica, and nearly all the taxes for the year."

"The locomotive with business trains have travelled 35,139 miles."—This corresponds in a striking manner, with the estimates made by the Chevalier de Gerstner, that it costs $1 per mile on an average for the expenses of the locomotive engine on a well regulated railway.

J. E. B.

REPORT OF THE CAMDEN AND AMBOY RAILROAD COMPANY.—ANNUAL REPORTS OF THE RAILROAD CORPORATIONS IN THE STATE OF MASSACHUSETTS, FOR 1839.

The perusal of these documents has afforded a most welcome confirmation of our opinion, made up from long continued observation, that railroads afford the safest and most profitable investment of money in the United States. The continued prosperity of complete and well managed roads, amid the most fearful commercial distress, affords the best evidence of the truth of our statement. Railroads must be made and must be used, and the greatest effect that "hard times" can have upon them will be a reduction of fare—accompanied by an immense increase of business.

It is well known that no public exposition of the affairs of the Camden and Amboy railroad, and Delaware and Raritan canal joint company, has ever yet been made until the present time. The whole line and its numerous appendages amounting in all to 92½ miles of railroad, is now complete, and in successful operation, and the Directors now make a report containing a full exposition of all their doings, a description of the work and an inventory of all their property. This document likewise contains the monthly receipt and expenditure, from the commencement of business on the line, and several comparative tables. If we separate the receipt and expenses of the canal, it appears that the railroad has averaged a nett profit of about 11 per cent., since its opening—an interest superior to that yielded by any other mode of investment. There are many interesting deductions to be made from the facts given in this report, the consideration of which is reserved for another occasion. Before leaving it however, we may remark, that the influence of the present untoward state of affairs, manifests itself in a remarkable manner. It will be found, that in the last three years the receipts have been rather less than in 1836, the period of their maximum, while the expenses have greatly diminished since that time, and that the nett profit is still increasing.

The Annual Reports of the Railroad Corporations in Massachusetts, to the Legislature of that State, are succinct statements of the condition of the roads, and the amount of expense and income, made under oath, and therefore are to be considered as excellent authority. Some of the works are but just commenced, others are partly finished, while a few have been in operation for some time. The following are those which have declared dividends.

Boston and Lowell, - - - - -	8 per cent.
Boston and Portland, - - - - -	6 per cent.
Boston and Providence, - - - - -	8 per cent.
Boston and Worcester, - - - - -	6½ per cent.
Nashua and Lowel, - - - - -	7 per cent.
Taunton Branch, - - - - -	6 per cent.
Eastern, (incomplete,) - - - - -	4¾ per cent.

It is to be remembered that on several of these works, heavy sums have been expended for large portions of the line which are as yet incomplete, and yet need but little further outlay to finish them. The dividend is therefore on a capital, part of which is not yet productive.

That such profits should be made upon roads in a portion of a single State, when bank, insurance and every other stock has depreciated, is most cheering to the friends of Internal Improvement, and to the public generally. It is an evidence that we have abundant resources within ourselves, and that we need railroads for their universal diffusion. It shows, too, that what is most necessary, is most profitable; thereby offering a sure inducement to the gradual and universal extension of railroads.

With such prospects we need not despair. Increase of skill and inge nuity have assisted the present condition of affairs, in reducing the expense of labor; and railroad companies have only to conform to the times, by reducing their fares, and a corresponding increase of revenue will take place.

It is a gratifying fact that these are not isolated cases; the reports of all well managed railroads throughout the Union, present the same prospect of a steadily and safely increasing revenue.

The time has almost, if not quite arrived, when the subject of Internal Improvement is to be separated from its unjust association with the bubbles of the day. They have burst, yet it remains sound and strong in the favor of all sensible and intelligent men.

ACKNOWLEDGMENTS.—We are indebted to *J. E. Bloomfield, Esq.*, for a copy of the Report of the Camden and Amboy railroad.—To *Jno. M. Fessenden, Esq*, for the Annual Reports of the Railroad Corporations in the State of Massachusetts.—To *Charles Ellet, Esq.*, for a Report and Plan for a Wire Suspension Bridge, proposed to be constructed across the Mississippi river at St. Louis.

IRON CANAL BOATS.—The success of this class of boats in England. with the arrival of the Iron Steamboat at New Orleans from Pittsburg, (of a very light draught of water, carrying a great cargo,) has lead to the opinion, that iron canal boats, if used on the Erie canal, would double its capacity, and supercede the necessity of the enlargement. We trust that some of our enterprising forwarders will try the experiment. We are not fully acquainted with the cost of this kind of boats, but have been informed, that it will not exceed fifty per cent on the cost of the best Lake boats.

In Pennsylvania, with their mixed line of canals and railroads from Philadelphia to Pittsburg, they now use iron boats, divided into three parts.

The iron boat is carried into Market street, Philadelphia, on the return of the cars, at the Schuylkill canal they are hooked together, forming a complete boat, which afterwards passes the Allegany ridge, by ten inclined planes, when they again take the canal and river, to reach Pittsburg.

With this complicated system, they compete with us successfully for the early spring trade.

RECEIPTS ON THE HARLEM RAILROAD.

Fare for passengers for Feb. 1840,	$4,812 16
do. do. do. 1839,	$2,848 82
Showing an increase in the last month over the corresponding month of the previous year; being equal to sixty-nine per cent. increase.	$1,963 34
Fare from 1st to 8th March, inclusive, 1840,	$1,795 47
do. do. do. 1839,	857 76
Showing an increase for the last eight days, over the corresponding period of last year, of	$937 76

Equal to 110 per cent. increase.

The total receipts for fare for the year ending on the 1st of March, 1840 are $102,691 31; while the total expenses are about $80,000; and the interest upon the debt of the company is $17,500.

TABLE OF COST, RECEIPT, AND INCOME, ETC., COMPILED FROM THE "ANNUAL REPORTS OF THE RAILROAD CORPORATIONS IN THE STATE OF MASSACHUSETTS," IN USE IN 1839.

NAME.	Length of road.	Cost of road.	Cost of road per mile.	Repairs of cars and engines.	Repairs of road.	Repairs of cars & engine per mile.	Repairs of road per mile.	Fuel, oil, and incidental expenses.	Total expenses.	Total receipts.	Total from passengers.	Total from freight	Nett profit.	Nett per centage.	Dividend
Boston and Lowell	$25\frac{3}{4}$	1,608,476	62,465	16,384	18,843	636	731	56,923	92,151	241,220	135,037	106,131	149,069	$9\frac{1}{4}$	8
Boston & Providence	41	1,782,000	43,430	19,467	8,604	474	209	65,491	93,562	313,907	234,237	79,670	220,345	$12\frac{1}{3}$	8
Boston & Worcester	$14\frac{1}{2}$	1,799,255	40.433	25.198	18,035	564	405	83,151	126,384	231,807	122,496	109,311	105,413	6	$6\frac{1}{2}$
Eastern, (incomplete)	25	1,306,196	32,655	8,563	6,527	214	163	33,084	53,174	125,623	113,068	12,564	72.449	$5\frac{1}{2}$	$4\frac{2}{3}$
Taunton Branch	11	250,000	22,791	3.152	1,397	287	127	36,161	40,711	58,018	40,910	17,108	17,307	7	6
Nashua and Lowell	$4\frac{1}{4}$	353,662	24.321	2.273	3.949	156	272	23 663	29,885	55,053	36,647	18,406	25,168	$6\frac{1}{2}$	
Total,	[illegible]61	7,0[illegible]9,5[illegible]9	Cost of	6 roads	yielding	an inter	est of	$8\frac{1}{3}$ per	cent., or	say,	[illegible]82,387	343,240	589,751	$8\frac{1}{3}$	

Messrs Editors, Gentlemen:—

At your request, I continue, in a condensed form, the table of Cost, Receipt, and Income, of the Massachusetts Railroads, completed and in use during the year 1839. The table gives the average cost per mile of repairs to cars and engines, as well as of the road. It is to be regretted that the severel official reports to the Legislature (sworn to by the officers of the company,) do not give more in detail the several items, necessarily placed under the general head of "Salaries, fuel, oil and all incidental expenses.". The comparison of the different roads, and their yearly management, would detect errors of the first importance, to the interest of the stockholders. By a reference to the table furnished the last year, published in your June number, page 327, it will be perceived, that the Boston and Lowell railroad in 1837, received $180,770, and expended $78,503. This year they expend $92,151, and received 241,220, repairs of road and cars, increased. With the Boston and Providence the difference in 1837 is greater, $156,238 was paid out for expenses, to receive $250,-882. This year $93,562, to receive $313,907—whilst the repairs to road, cars and engines have decreased, in about the ratio the Boston and Lowell railroad has increased their expenses in these two items. It should be noted, that the Boston and Providence company purchased the franchise of the Seekonk Co., also the Boston water power and a second track to Roxbury, out of their earnings, amounting to $100,848. This decreased their dividend from $12\frac{1}{3}$ per cent earned, to 8 per cent. The expenses on the Boston and Worcester has greatly increased, while their receipts are nearly the same (?). It appears that the six roads completed, have cost $7,099,589, and have yielded to the stockholders $589,751, equal to $8\frac{1}{3}$ per cent. nett on the capital expended. If these roads were now to be constructed, they could be completed, for full 33 per cent less, they would yield an increase of 10 per cent, which would yearly increase. On the Camden and Amboy railroad, this is reported to be 11 per cent. per annnm. With such facts, can there be a want of enterprise and capital in the city of New York, to complete a line of Railways *from this city* to Buffalo.

J. E. B.

LE COUNT ON RAILWAYS.

(Continued from page 158.)

In the third case, the engine does not go down a plane, as above, but has to make its own curve through its weight, deflecting the rail. The necessity then of knowing the laws of deflection is such, that no idea can be formed of the effects these important matters will have on the economy of railroads; yet we have up to the present day positively no data to go upon, which will lead us at all near the truth; and railways are constructing, at a cost very little short of seven millions, without the means having been taken to put such essential points as these out of the pale of doubt and uncertainty, which could be done by a few well conducted experiments. We know, for example, that in an iron bar, if $l =$ the half length, $x =$ any variable distance, $y =$ the corresponding depth, and $\triangle =$ the sine of the elementary deflection, the sum of the deflections when

$$x=l \text{ is} \int \frac{x^2}{y^3} \delta x \, \triangle$$

for a parallel bar, and

$$\int \frac{x^2 \, \delta x \, \triangle}{(a+b\,x)^3}$$

for a fish bellied rail, in which latter expression $a =$ the least depth, and $b =$ the difference of the depths divided by the half length.

In some cases, where we have good experiments, the mode by which they have been calculated, in order to generalize and render available their results, is inaccurate, and the effect may be shown by the following table, giving the deflection of the rails, with three tons' weight on the middle of them, each column deduced from the same set of experiments, differently computed, and varying to an enormous degree.

Length of bearing in inches.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*
33	·024	·026	·03	·02357	·0272	·0286	·072	·0858
42	·037	·050	·06	·047	·0538	.0569	·111	·1707
45	·041	·063	·072	·056	·064	·068	·123	·204
57	·064	·122	·139	·108	·123	·131	·192	·393
60	·074	·150	·171	·1335	·153	·162	·222	·486
69	·082	·210	·241	·188	·216	·228	·246	·684

Column *a* gives the deflections at 3 tons, deduced from the experiments by the experimenter, except for the sixty-inch, which is derived from the fifty-seven inch bearing. Column *b* gives the deflections derived from the formula given by the experimenter as the results of the same experiments. Column *c* gives the deflections from this formula, recomputed by another person. Column *d* gives the deflections computed from another formula given by the experimenter. Column *e* gives the deflections in column *d*, computed by another person. Column *f* gives the mean of columns *c* and *e*, which appears to be the best approximation we have. Column *g* and *h* give the deflections for 9 tons' weight, the first being derived from column *a*, and the second from column *f*, the difference in the longest bearing 69 inches, being nearly 3 to 1.

With this lamentable uncertainty in the data for a deduction of such importance as that of a deflection in the rails causing an engine to be constantly ascending an inclined plane, there is no hope of arriving at any commonly accurate results. For instance, if we take the bearing of 5 feet which Mr. Barlow gives, as occasioning the ascent of a plane of 1 in 1875 the deflection, with three tons' weight, being ·064, and substitute for ·064 the deflections in columns *a* to *f* successively, we have as follows:

	Deflection.	Consequent Planes.
By column *a*	·074	1 in 1621
" *b*	·150	1 in 800
" *c*	·171	1 in 702
" *d*	·1335	1 in 899
" *e*	·153	1 in 791
" *f*	·162	1 in 741

In which there is more than two and a half to one difference in the results, all of which are drawn from one set of experiments, whilst at the same time the probability is, that the planes ought to turn out less steep instead of being more so.

From the effects which arise in consequence of deflection, it will be well worth considering what advantages are derived from the use of felt under the chair. If the rail was perfectly stiff, then, when the engine came over a chair, and compressed the felt, it would afterwards have to go up an inclined plane, through the rail being depressed at the block it had just passed over; and this would continue to take place till the engine arrived towards the next block, when it would depress the rail again in a similar way, and thus its course would be continually up a partially rising plane, the assistance downwards being almost insensible.

But as every rail deflects more or less, the inclination produced by this cause acts just exactly in the opposite manner to that which takes place through the depression and spring of the felt; for whilst the wheel, from the effect of deflection in the rail, descends during its passage over the first half of the rail, and ascends while going over the second half, the effect which the compression and springing of the felt has upon it, is to make it ascend a plane during its passage of the first half, and to descend during the time it is going over the second half. The felt acting as a spring, however, is exceedingly questionable, although maintained by some persons. Its use will be found to consist more in giving a steady seat for the chair when the block is composed of hard stone, and offering a defence against the grating of the chair on the block, which will otherwise take place, producing a grinding, a loss of surface, and consequently a looseness, which, when once arrived at, rapidly increases.

From the above observations on the effects of inclined planes, we may see how desirable it is to have the blocks and sleepers placed in the most accurate manner, as respects uniformity of height. For we must recollect that in a three feet rail, a difference of one quarter of an inch in the height of two adjacent blocks, or, more properly speaking, in the height of the basis of two adjacent chairs, converts that three feet of rail into an inclined plane, rising 1 in 144.

With respect to placing the blocks diagonally, this is a less stable position in the line of rails than when they are placed square, for the resistance of the ground to the sinking of the block, whether conceived to be similar to a collection of springs acting under the block, or a collection of weights acting above it, must in either case be referred to the centre of gravity of each half of the block, considering it as moved by the passing weights about a line drawn through its middle at right angles to the line of the rails; that is to say, in a block two feet square, and one foot thick, there are 12 inches in the direction of the rails, 24 inches across them, and 12 inches in depth, acting on each side the axis of motion when the block is laid square, the surface of each half being 288 inches. Now, any uniform effect on these 288 square inches drawn into the distance of their centre of gravity from the axis of motion, gives for the stability of each half 1728. Any uniform effect on the 288 inches of a diagonal half block will give a less number; for the distance of the centre of gravity from the axis of motion was 6 inches in the square block, but it will be only 5·65682 in the diagonal, being 1-3d the altitude of the triangle, and hence we have only 1629·16416 for the stability in the direction of the rails. The diagonal block will consequently have its maximum resistance to sinking at 45° from the line of the rails, or in the position where stability is least required. Circular blocks have been proposed in order to get equal resistance in all directions, but the gain would not be equal to the extra expense, and the stability, although a trifle more than that of the diagonal block in the line of the rails, is less than that of the square one; for the area, as before, being 567 square inches, $=\cdot785398\ d^2$, and d being the diameter, we have $d=\sqrt{733\cdot386}$ $=27\cdot0811$, and the radius $=13\cdot5405$, and as the arc is to the chord, so is $\frac{2}{3}$ radius to the distance of the centre of gravity from the centre, or $3\cdot14159 \times 13\cdot5405 : 27\cdot0811 = 9.02703 : 5\cdot74678$ inches, and $5\cdot74678 \times 288 = 1655\cdot$ $=07264$ for the resistance.

We have experimented on the two positions of the blocks, and found that when placed diagonally, there was rather more resistance to lateral motion than when placed square, and they are more conveniently got at to repack in the former position than they are in the latter; but when placed as close as they ought to be, in order to form an economical road, the diagonal position is inadmissible.

THE CENTRAL GEORGIA RAILROAD.

On the first day of February last, one hundred miles of this road was opened for travelling. This is much more than could have been expected, and is what untiring labor alone could have accomplished. We believe the annals of railroad enterprise in the South afford no parallel to the amount of work which has been done on this road, with so slight means, during the same period of time. The chief engineer, L. O. Reynolds, Esq., and his associates, deserve great praise. Economy has been brought to bear on every point for the perfection of the road, while durability has never been lost sight of. As a resident of Savannah, whose abode, in cloud or sunshine, it will be for life, we feel proud of this undertaking—as a citizen of Georgia, we feel doubly proud, that in the teeth of all croaking, at least, one General Assembly of the State, lent its aid to its projection. But, with sorrow we say it, we feel also humiliated—nay, ashamed, that the last two or three Legislatures of Georgia seemed to have lost every vestige of that liberal—that patriotic feeling that should ever actuate them. Yes—they appeared to have forgotten that Georgia had a seaport--that Savannah existed, that the flourishing city of Macon and her wealthy merchants, annually bought and sold thousands of bales of our great staple, which for a long season of the year, are piled up for transportation, to the only real outlet for exports—Savannah. What! surely they should remember that no State in this Union has ever risen in the scale of prosperity, without the assistance of a liberal administration of the public revenue. We would wish to be understood as being opposed to every scheme for internal improvement, that cannot be proved to the understanding of the most humble capacity, as deserving of support from the public coffers—therefore, the Central Railroad, one hundred miles of which have been completed and which already pays a dividend to its stockholders, has our hearty support. It is emphatically a work of public utility, and must enrich our people. It can in no event be stayed; and we hope, for the credit of our State, that no man calling himself a Georgian, will be found to throw a pebble in the way, even though his utmost endeavor can never stop its triumphal progress. Onward it must and will go; then let all, with heart and hand, bid it God speed.

The freight of cotton is now quoted, as worth $4,50 per bale, to be conveyed from Macon to this city, by water. This fact alone is worth a thousand arguments. The planters who send their cotton to the Macon market—the merchants who purchase it—and all concerned, except the boat owners (and it is doubtful whether they should be excepted)—all feel this heavy tax, consequent on a low river. It is for them, then, to lend a helping hand to the Central railroad, that it may be aided at the next session of the legislature—that justice, though tardy, may come at last.—*Savannah Tellegraph.*

EXPERIMENTS ON THE POWER OF MEN. BY JOSHUA FIELD, V. P. INST. C. E., F. R. S.

In this paper are recorded the results of some experiments made to ascertain the working power of men with winches, as applied to cranes. The experiments were undertaken with a view of ascertaining the effect men can produce working at machines or cranes for short periods, as compared with the effect which they produce working continuously.

The apparatus, a crane of rough construction in ordinary use, and not prepared in any manner for the experiments, consisted of two wheels of 92 and 41 cogs, and two pinions of 11 and 10 cogs; the diameter of the barrel, measuring to the centre of the chain, was $11\frac{3}{4}$ inches, and the diameter of the handle 36 inches. The ratio of the weight to the power on this combination is 105 to 1.

The weight was raised in all cases through $16\frac{1}{2}$ feet, and so proportioned in the different experiments as to give a resistance against the hands of the men of 10, 15, 20, 25, 30 and 35 lbs. *plus* the friction of the apparatus.

The resistance occasioned by the friction of the apparatus is a constant element in all machines, and of much the same amount in most cranes, and my object being to obtain some practical results on the power of men in raising weights on a system of machinery, I did not think it necessary to make any experiment for ascertaining the amount of this resistance in the present instance.

In the following table I have set down the statical resistance at the handle, the weight raised in each experiment, the time in which the weight was raised, and the remarks which were made at the time with respect to the men. A column also expressing the power or effect by the number of pounds raised one foot high in one minute is added. It will be necessary to add a few words respecting the construction of this column.

In order to compare these experiments with each other, these results must be reduced to a common standard of comparison, and it is very convenient to express the results of such experiments by the pounds raised one foot high in one minute, this being the method of estimating horses' power.— The number is in each case obtained in the following manner. I will take the first experiment.

Here 1050 lbs. was raised $16\frac{1}{2}$ feet high in 90″; this is equivalent to ($1050 \times 16{\cdot}5 =$) 17325 lbs. raised one foot high in 90″, which is equivalent to ($17325 \div 1{\cdot}5 =$) 11550 lbs. raised one foot high in one minute. In this case then

the man's power $= 11550$.

The same calculations being pursued in the other cases, give the numbers constituting the last column of the following table.

No of experiment.	Statical resistance at handle.	Weight raised.	Time in seconds.	Time in minutes.	Remarks.	Man's power.
I	10	1050	90	1·5	Easily by a stout Englishman	11550
II	15	1575	135	2·25	Tolerably easily by the same man	11505
III	20	2100	120	2	Not easily by a sturdy Irishman	17325
IV	25	2625	150	2·5	With difficulty by a stout Eng'man	17329
V	30	3150	150	2·5	With difficulty by a London man	20790
VI	35	3675	132	2·2	With the utmost difficulty by a tall Irishman	27562
VII	....	....	150	2·5	do. by a London man same as Experiment V.	24255
VIII	....	....	170	2·83	With extreme labor by tall Irishm'n	21427
IX	....	....	180	3	With very great exertion by a sturdy Irishman same as Ex. III	20212
X	....	....	243	4·05	With utmost exertion by Welshm'n	15134
XI	....	....	35	....	Given up this time by an Irishm'n	......

We may consider Experiment IV as giving a near approximation to the maximum power of a man for two minutes and a half; for in all the succeeding experiments the man was so exhausted as to be unable to let down the weight. The greatest effect produced was that in Experiment VI. This, when the friction of the machine is taken into the account, is fully equal to a horses' power, or 33,000 lbs. raised one foot high in one minute. Thus, it appears, that a very powerful man, exerting himself to the utmost for two minutes, comes up to the constant power of a horse, that is, the power which a horse can exert for eight hours per day.

Lambeth, May, 1826. JOSHUA FIELD.

Trans. Inst. C. E.

MOHAWK AND HUDSON RAILROAD RECEIPT FOR 1839.

Receipts from passengers,	$116,664 26
do do freight and U. S. mail, ($4688,)	33,848 82
	$150,513 08
Expenditures, for horse, locomotive and steam stationary power, including incidental expenses, (exclusive of $7000 interest on loan of $100,000 borrowed,)	68,055 27
Equal to near $7\frac{1}{2}$ per cent. on $1,100,000,—cost of the road,	$81,457 81

This company is at last earning an income on the extravagant disbursements for its cost, which exceeds $70,000 per mile, over a sand plain, being three times what this road would now cost, as stationary power can be dispensed with—contemplated by the company. It was an *experimental* railroad. This with others, by which our citizens have suffered, has given them prejudices against railways.

This road now requires the combination of three powers, (over the short distance of 15 7-8 miles) to wit: horse, stationary and locomotive—yet, singular to relate, a report from the Canal Board of 1835, gravely imposed on the public, the assertion (*on the comparison they made of railways with canals*) that the actual *cost* of transporting a ton of goods, per mile, on a railway, was three and a half cents; and in proof, instanced the Mohawk and Hudson railway, without telling us that it costs more to operate on this short road, than it does on the Utica and Schenectady railroad, of nearly five times its length where steam power alone is used.

The errors of this report have retarded railroads in this State, and raised prejudices against them, that we trust will be done away with by the present Canal Board. This report carried the Black river and Gennessee canals, where railroads whould even now be built, if the public interest had been consulted.

When we have facts daily presented to us, of the enormous loads drawn by the locomotive engines since its improvement, it is high time for the present legislature to call on the Canal Board, and their new engineers, to institute inquiries, *into the relative merits of railways and canals*, to do away with the impressions produced by past legislation. These errors derived from the reports of Charles F. Mercer, Esq., in Congress, and those presented to the public by our State engineers. Both parties adopted the arguments and errors of the English *Canal engineers*, opposed to railways, on the commencement of railroads—then supposed (in error) to injure and interfere with the canal investments, when the reverse has proved to be the fact, as the price of English stocks show.

We notice that the Camden and Amboy railroad carried over their road the last week 5000 barrels of flour, at 25 cents per barrel, from Philadelphia to this city, and are now contracting for large quantities at this rate. We have no doubt, and assert, that with suitable arrangements, they could carry freight to profit at 15 cents per barrel. From Wheeling on the Ohio, they are now sending flour via Pittsburg, over the Alleghany, by railways, at $1 75 per barrel. With facts of this kind, and the refusal, so far, to permit railways to carry freight on the lines of railroads parallel to to the Erie canal, [*during the whole year*,] it is no object to go to the expense for the winter, subject to pay to the State treasury, the same tolls as if carried on the Erie canal, it is time for us to ask, if the present legislature can justify themselves to their constituents, by expending $40,000,000 on the enlargement of the Erie canal, while they refuse all aid to private enterprize in constructing railways. They reverse—the order of the day has been, to make enterprize tributary, to pay the interest on a work, *that is behind the intelligence of the age.*

Our friends of the west, and on the line of the Erie canal, will agree with us in this position, if they will examine the question with candor. Let engineers who are not wedded to canals examine the subject, and we venture to assert, they will give it as their opinion, that a line of railway from Dunkirk and Buffalo to the Hudson, will supercede the necessity of *any enlargement* of the Erie canal for the present century. That, if cleared out to four feet, with double locks to Montezuma, it will be all the public will require for cheap transportation and competition, with reduced rates of toll.—*Star.*

Improved Locomotive.—On Saturday last, we had the pleasure, in company with several scientific gentlemen of this place, of witnessing a new and improved locomotive engine, in full operation. The advantages derived from the improvement on this engine, are no doubt very important, and we have no hesitancy in predicting, that when once fully and practically developed, will be generally adapted not only to stationary, but to locomotive engines on our public roads. One essential improvement in the construction of this engine, is the saving of steam, which requires but one half the quantity and maintains the same power as that of an ordinary engine. We were particularly pleased with the neat and elegant finish of the engine, and certainly does much credit to the mechanical genius of the projector and builder, Col. Henry High, of this borough. We understand that a patent right has been secured, and that a thorough trial of its advantages will shortly be made on the Columbia railroad.—*Reading Democratic Press.*

Tunnel through the Alps.—M. Vanino Volta, the engineer of Como, who, in conjunction with M. Bruschetti, of Milan, obtained in 1837, from the Austrian government, a privilege of fifty years for the construction of a railroad between Milan and Como, is now negotiating with the Swiss Cantons of Grisons and St. Gall, an enterprise which would vie in magnitude with the Thames Tunnel, viz., the piercing through the Grisons Alps. Impressed with the importance of the passage of the Splugen, and, at the same time, with the various obstacles which it presents, he thinks it possible to pierce through that mountain, and establish in the passage thus effected, a railroad, the northern portion of which would end, either at Wallenstadt, or even at Schomerkon, on the Lake of Zurich, and the southern should be connected with the Como and Milan Railroad. M. Volta, reckoning that thirty years will be required to execute the works, demands an exclusive privilege of a hundred years, with liberty to establish companies, in order to procure funds, or to transfer privilege to other parties.

OF THE APPLICATION OF STEAM AS A MOVING POWER, CONSIDERED ESPECIALLY WITH REFERENCE TO THE ECONOMY OF ATMOSPHERIC AND HIGH PRESSURE STEAM. BY GEORGE HOLWORTHY PALMER, M. INST. C. E.

Although the question relative to the comparative power of the Cornish and other engines has engaged the attention of this Institution, (and doubtless that of every practical engineer,) still no conclusion has been arrived at satisfactorily explaining upon what principle, the duty of the former engines so far outstrips the best reported duty of the Watt engine. The difference is truly astounding, for it is officially asserted that the average duty of ten or twelve of the Cornish engines amounted to 70,000,000 lbs. of water raised one foot high by the expenditure of one bushel of coals; and in some instances, a result has been brought out so high as 100,000,000 lbs., and even 120,000,000 lbs. by the like expenditure of fuel. Even the 70,000,000 lbs. duty appears to me to be so wide of the mark, as compared with the best stated result of the Watt engine, (viz., 28,000,000 lbs.,) and the maximum effective power hitherto generally obtained by the consumption of one bushel of coals, that I am induced to address the Institution on the subject; and although the statement I herewith submit for consideration only furnishes presumptive evidence, that the statements of our Cornish friends involve some error, the proof is in my mind so powerfully conclusive, that nothing short of the actual admeasurement or weighing of the water, stating the altitude such water is raised, together with the weight of fuel consumed, will induce me to believe otherwise than that the data on which the calculations have been based are in some respects erroneous.— Such is my conviction, on the evidence at present before me, and which I trust will on perusal clear me from the imputation of egotism.

I care not whether the steam applied as a motive power be what is termed atmospheric, or high pressure; whether it be worked expansively or otherwise; whether condensed in a vacuum or blown into the atmosphere —whether the engine be of the description technically denominated single, double or atmospheric; or in fact whether the steam be applied to any other description of apparatus, human ingenuity and wisdom may devise, even in the absense of *all* friction; in short, if all the moving parts of the engine were in equilibrio, and capable of being put into motion by the least appreciable amount of power; and neither the steam nor water meets with resistance in its passage through valves, cocks, pipes, &c., and the steam undergoes no change of density, elasticity, or temperature from the instant it is generated till it has performed its intended duty; supposing these physical impossibilities could be accomplished, I conceive that 70,000,000 lbs. of water cannot be raised one foot high, by the consumption of one bushel of the best Newcastle coals, weighing 84 lbs., unless more than one cubic foot of water of 40° F. can be converted into atmospheric, or high pressure steam, by the consumption of 7 lbs. of fuel.

From the discoveries of the illustrious Italiam Philosopher Torricelli we are all aware that the maximum pressure, or elasticity of the atmosphere, at the level of the sea, does not exceed a column of mercury 31 inches high, or that of water $35\frac{1}{12}$ feet in altitude, which amounts to about 15 lbs. pressure upon every superficial inch of the earth's surface.

We know that one volume of distilled water will, when converted into atmospheric steam, (barometrical pressure 30 inches,) fill a space 1694 times greater than when in its liquid state, (temperature 40° F.,) supposing such steam is kept at the precise temperature and elasticity at which it was generated. We know also that the said steam, when reduced to its original temperature, (the atmospheric pressure being unchanged,) will assume instanter its original state and bulk, or occupy $\frac{1}{1694}$th of the cubic space which it occupied when in its gaseous form.

We have evidence also (founded on the most accurate experiments, and which are not likely to be surpassed by the decomposition of coal in the furnaces of steam engine boilers, with all the "jacketing" that may be applied, in order to avoid the loss of caloric by radiation from the boiler, cylinder, &c.,) that seven pounds of good bituminous coal is required (when the combustion of its inflammable matter is nearly perfected, when no excess of, or undecomposed atmospheric air escapes through the ignited fuel, and when the least quantity of radient caloric escapes from the steam generated) to convert one cubic foot, or $62\frac{1}{2}$ lbs. avoirdupois, of distilled water from 40° F. to atmospheric steam, at an elasticity corresponding with a barometrical pressure of 30 inches.

From the aforesaid data I will show that nature cannot herself produce a result (in the absence of all friction as before premised) amounting to one half of what is stated to be the duty of some of the Cornish engines, if the authorities referred to can be relied on.

If, therefore, one cubic foot of water is convertible into atmospheric steam by the caloric evolved by the combustion of 7 lbs. of coal, 12 cubic feet of water would require, under like circumstances, 84 lbs., or one bushel of coals. Now 12 cubic feet multiplied into 1694 cubic feet or volumes gives 20,328 cubic feet of steam, which amount represents the precise quantity of water which would occupy its place when such steam is reduced to the temperature of 40° F., and which we will suppose would rise 35 feet high which we are aware exceeds not only the average, but the maximum barometrical column. It therefore only remains to multiply the aforesaid 20,-328 cubic feet into 62½ pounds, and that product by the assumed altitude the water is raised in a vacuum, viz., 35 feet when we shall have the maximum effect nature is capable of accomplishing, viz., 1,270,500 lbs. of water raised 35 feet high, or 44,467,500 lbs. one foot high, with one bushel of the best Newcastle coal.

Having shown the maximum effect that can be accomplished by the application of the atmospheric steam, generated by a given quantity of fuel, my next object will be to demonstrate that high pressure steam, when applied expansively, cannot produce so great an effect as atmospheric steam, thereby meaning to infer that no high pressure engine can perform the same amount of duty as a condensing engine, both consuming equal quantities of fuel. This is my deliberate opinion, founded on theoretical and practical experience, and which coincides with the opinion of almost every practical engineer whom I have consulted on this important subject. But what says the authority before refered to?—for in this as well as in the former question, just discussed, my arguments shall be drawn from the established laws of nature.

1st. That the sum of sensible and latent heat in steam is a constant quantity, viz., about 1172° F.

2ndly. That all matter, (steam, of course, included,) whether solid. liquid, or gaseous, from the most dense and refractory to the least ponderable, evolves caloric on compression, or increase of specific gravity, and absorbs caloric on dilatation, or when its specific gravity is diminished.

3rdly. To convert equal quantities of water of any assignable temperature, and under like pressure into steam of given temperature and elasticity, requires equal weights of fuel to be expended; but, although equal weights of water must absorb equal increments of caloric when atmospheric steam is generated, it does not follow that all the caloric absorbed in high pressure steam is exclusively supplied by the fuel expended. The law maintained is simply this, that the same causes produce the same effects.

4thly. That steam of two, three, or more atmospheres elasticity, is not composed of two three, or the like number of volumes of water contained in an equal volume of atmospheric steam, when generated under the same barometrical pressure, but contains proportionably less water as the pressure under which the steam is generated increases.

In proof of the foregoing theorems, I beg to adduce the following experiments and observations.

1st. If steam be blown through and condensed in a given weight of water of any previously determined temperature, until the said water arrives at, say, 212° F., the quantity or weight of water added by such condensation will be precisely the same, whether the steam employed be of atmospheric, double, treble, or more elasticity, thereby establishing the extraordinary fact, that all sensible caloric, exceeding 212° F., positively goes for nothing, it having become latent by dilatation. In this experiment, it is necessary to observe, that the steam condensed has lost no caloric by radiation till after such steam was converted into vapor, and the effect sought had been produced. How then a saving of fuel can arise by the use of high pressure steam worked expansively is to me an evident paradox, unless by some power utterly beyond my comprehension; the sensible caloric can be prevented from becoming latent by dilatation, which, I need scarcely add, no power can accomplish.

Again, generate steam in a suitable apparatus at, say 500° F., and permit a jet of such steam to blow upon the bulb of a thermometer without the boiler; it will be observed, that the steam impinging thereon, registers a temperature below blood heat, (98° F.;) remove the lamp that kept up the aforesaid temperature of 500°, and let the jet of steam continue to play upon the bulb of the said thermometer till it ceases to blow from the boiler at which instant of time the thermometer within and without the boiler will indicate the same temperature, viz., 212° F. In this experiment, it is no more remarkable than true, that while the steam in the boiler is descending from 500° to 212°, that the steam blowing into the atmosphere is increasing in its temperature from 98° to 212°. Here then we have 402° of sensible caloric becoming latent by dilatation, thereby increasing the amount of latent heat in the steam of 500° from 672° to 960°, the quantity due to atmospheric steam; while in the steam of 98° there is 1074° of latent heat. As atmospheric steam can be applied without converting sensible into latent caloric and as the sensible caloric therein contained is of a maximum effective quantity, it follows that its application as a moving power, must, under every possible application, be more economical than high pressure steam worked expansively, on a comparison of the fuel expended in the two cases.

It remains to be explained why steam of 500° temperature, and of an elasticity equal to 44 atmospheres over and above the atmospheric pressure, denotes, when blown into the atmosphere, a temperature of 114° below that of atmospheric steam.

In one measure of steam of 45 atmospheres elasticity and of 500° temperature, there is considerably less water than is contained in atmospheric steam of 45 times its volume or cubic contents, consequently such steam, when expanded under atmospheric pressure, necessarily converts a greater portion of sensible into latent heat, than if the steam thus expanded had contained the quantity of water due to forty-five measures or volumes of steam generated under a barometrical pressure af 30 inches. Another portion of the sensible caloric lost or become latent, is due to the steam expanding beyond what its density and temperature would assign under atmospheric pressure; this result of the compressed atoms flying too far asunder is similar to that in which a spring of certain elasticity, when suddenly let go, recoils beyond its true position, being carried thither, by reason of the momentum acquired and due to its weight, elasticity and velocity; so great indeed is the effect produced by the two causes assigned, that steam of 45 atmospheres elasticity passes instantly, (when expanded under atmospheric pressure,) from the gaseous to the liquid form.

The second theorem admits of innumerable proofs, but a few examples will suffice to establish the fact, that change of specific gravity cannot possibly be effected without caloric being either given out or taken up; that is, either latent heat becoming sensible by diminution, or sensible heat becoming latent by increase of volume. Compress permanent gaseous matter, and in proportion to its increase of specific gravity will sensible caloric be evolved, let this gas cool down to the temperature of the apartment, and let the compressed gas suddenly expand to atmospheric elasticity, when the sensible caloric before evolved by compression will be instantly re-absorbed and become latent, thereby producing a diminution of temperature even sufficient to freeze water. This was a common experiment at the Portable Gas Works in this metropolis. In the Philosophical Tinder Box we can generate with a smart stroke of the hand, sufficient sensible caloric from compressed atmospheric air to ignite Dutch tinder. Liquids as well as gaseous matter will by increase of their specific gravity also give out sensible caloric, as is witnessed by the admixture of about four measures of distilled water with one of concentrated sulphuric acid, when the compound will, in a few seconds, exceed the temperature of boiling water. The very familiar experiment of slacking concrete caustic lime by the application of water, and the caloric thereby evolved, is the necessary consequence of the water assuming the solid state. Solids also, as well as liquids and gaseous matter, are governed by the same law, for an expert smith will, by a few blows of a hammer upon a malleable piece of wrought iron, elicit sufficient sensible caloric to make it red hot, so as to explode gunpowder therewith. The caloric evolved is exclusively the result of the metal's increase of specific gravity by striking the iron at right angles, by which operation the cohesion of the atoms of metal are so destroyed by separation as to require welding before the experiment can be successfully repeated; not that the fractured iron receives a new supply of sensible caloric in a latent state by being heated in the fire, as has been asserted, but by reason of the shattered particles of metal being rendered in a fit state to receive the blows of the hammer without flying to pieces, which would be the case, but for the fact of the fractured metal being again united by the process of welding. Each atom of metal actually contains sufficient caloric in a latent state (when liberated by percussion or any other mode of concentrating the particles of metal) to destroy the metal's identity by converting it into a perfect oxide as is witnessed by the combustion of the particles of iron or steel abraded by the flint, in the act of striking a light, as it is termed. The late Mr. Wedgewood, to his astonishment, elicited caloric by the friction of two incombustible substances, viz., glass and stone; but he seems to have had no idea that this phenomenon was the result of compression or increase of specific gravity by the friction and abrasion of the matter thus acted upon. Of the latter case, we have the most striking proof in the following experiment, viz., that a cast iron bomb, when filled with water and subjected to an intense frigorific operation, does not assume the solid state (ice) till the cast iron shell is ruptured by the combined efforts of the metal contracting, and the water (in the aggregate) expanding, thereby overcoming the cohesion of the metal, when the shell bursts, and the water instantly becomes solid; at that instant caloric is evolved; and to show the beautiful harmonious working of nature in the chain of cause and effect, no evolution of caloric takes place till the water is frozen, thereby showing that a concentration of matter has taken place. The fact of water, in a concrete form, floating on water of the same temperature, is cited by philosophers as one of the exceptions to the general law—namely, that caloric is evolved with a diminution instead of an increase of specific gravity founded on the abstract fact, that ice, (and I may add, saline solutions) at the instant of crystallizing swim instead of sink. The cause of which phenomena should be sought for in the innumerable cells or spaces charged with air; or, in the buoyancy of those cells or air vessels in the aggregate more than compensating for the increase of specific gravity the water undergoes by congelation, thereby producing the paradox in question, viz., an evolution of caloric, and yet an apparent loss of specific gravity, judging from the abstract fact of the ice swimming upon water of the like temperature. We therefore learn the fact, that the water at the instant it assumes the solid form both contracts and expands; by the former, caloric is evolved; and by the latter, (not in each atom, but in the aggregate,) it floats upon water of its own temperature, not because the ice is specifically lighter than the water, but by reason of air cells or vacuities before referred to.

The experiment of Perkins, whereby a soft malleable wrought iron plate, revolving at an immense velocity, not only cuts its way into a file applied thereto, but elicits such a coruscated blaze by the combustion of the steel and iron abraded, as to astonish even the scientific beholder, furnishes evidence of the result of the compound operation of friction, and consequent increase of specific gravity of the metals abraded. Not the least apparently astonishing part of this performance is, that of the hard steel file being cut by the comparatively soft malleable iron plate; but all astonishment will, no doubt, cease on remembering that the density or hardness of the file as compared with that of the revolving plate, is in a much less ratio than the area or the rubbing part of the latter, as compared to the area of that part of the file coming in contact or rubbed therewith. For example, the file is probably not twice as hard as the revolving plate, whereas the grinding surface of the latter probably exceeds the area of the file ground, one hundred times; hence the wear of the file is inevitable. I cannot doubt but that the particles of wrought iron abraded and excited into combustion, greatly exceed in number the atoms of steel. This is not discovable on superficial observation by reason of the great diameter and inreased surface of the revolving plate, viewed in connection with the surface or quantity of the file detached in the operation.

That a soft elastic substance will wear away more dense and inelastic matter, is verified by the well known fact that the cuticle or scarf skin of the hand wears away both cast and wrought metal hand rails; and what appears still more astonishing, but is nevertheless well authenticated, is that of the marble steps leading to some favorite saint, having been worn quite hollow by the friction of the naked feet and knees of pious devotees.

The third theorem partakes of positive and negative qualities, for each abstractedly considered neutralizes the other; in fact, the question admits of no other than a false solution, unless the intermediate cause and effects, dilatation and the sensible caloric thereby becoming latent, form components of the question, viz., that high pressure steam, when applied expansively, as a motive power, is less economical than atmospheric steam when not permitted to expand till the piston has completed its stroke. There certainly appears, at first view, something very peculiar about highly elastic steam when expansively applied, for the fuel saved is positively just so much fuel lost; paradoxical as it may appear, it is really no paradox, but is in strict accordance with the working of nature's laws; and I sincerely wish that all other supposed paradoxes could be as readily cleared up.

In practice, we observe that every additional atmosphere's elasticity steam is generated at, the time is shorter than was occupied in generating the previous atmosphere; even when equal quantities of combustible matter are decomposed, or equal increments of caloric are evolved in equal periods of time; in this case the saving of fuel accruing will be in the exact ratio to the time saved, and is exclusively the result of steam of a given number of atmospheres elasticity containing less water than is contained in the same number of volumes of atmospheric steam, the inevitable consequence of latent heat being evolved in a sensible state as the steam's density increases; which caloric, of course, increases the steam's elasticity, and is therefore the precise measure or amount of fuel saved in generating highly elastic steam, but is unfortunately lost when such steam (as will be hereinafter shown,) is applied expansively. Atmospheric steam registers a temperature of 212°, steam of ten atmospheres elasticity of 358°, twenty of 418°, thirty of 457°, forty of 486°, and that of fifty atmospheres elasticity a temperature of 510°. Here then the quantity of sensible caloric in each atom of steam of 510° temperature produces a power infinitely greater than that of steam in equilibrio with the atmosphere, which when condensed in order to gain the atmospheric effect, is only one-fiftieth part of the power of steam at 510° temperature, although it is barely $2\frac{1}{2}$ times less temperature than atmospheric steam. Here then is evidence of the saving of fuel, or what is the same thing, demonstration of an immense increase of power obtained by the expenditure of a given quantity of fuel; but what it amounts to in practice may readily be inferred from what has previously been advanced relative to the change of specific gravity. If less fuel is expended to generate steam of every successive atmospheres elasticity—(which every accurate experimenter knows to be the fact,) it necessarily follows that every succeeding atmosphere generated, contains a less quantity of water than the preceding atmosphere or volume.

1st. Because equal quantities of caloric are required to convert equal quantities of water into steam, supposing the steam generated to be atmospheric.

2ndly. Because the steam cannot increase in its specific gravity and elastic force, without converting a portion of sensible into latent caloric, and this is the intermediate cause and effect that is lost sight of; and

3dly. Because the latent caloric becoming sensible, necessarily gives an increased elasticity to the steam through which it is diffused, and the increase of elasticity thereby produced is (as before stated) the precise amount of fuel, or caloric, saved in generating high pressure steam as compared with the generation of a like volume of atmospheric steam.

It must be particularly borne in mind, that the fuel saved refers only to the steam's generation (as before stated,) for it is one thing to generate high pressure steam, and another to apply expansively the said steam as a motive power; unless the opponents to the doctrine are prepared to prove that high pressure steam, by dilatation or diminution of specific gravity, does not convert sensible into latent caloric; or that they are further prepared to demonstrate, (upon Mr. Woolf's erroneous principle,) that the second dose of sensible caloric gives an elastic force to the expanded steam, (when maintained at the temperature such steam was generated at,) equal to the atmospheric pressure.

Steam at or above 212° temperature is as much a permanent gas as atmospheric air, unless it be subjected to a pressure exceeding its own elastic force and the trmperature due to such elasticity; in which case it would be converted into the liquid state. Again, steam is known to be governed by the same law as permanent gases, (relating to the law of elastity,) when dosed with caloric, over and above the temperature at which it was evolved. It therefore remains to show, (if not already proved,) that the quantity of sensible caloric lost by working high pressure steam expansively, can never be compensated for by saturating snch steam with a second dose of caloric.

Philadelphia and Columbia Railroad.—Collector's office, Philadelphia, Feb. 28th, 1840.—The following shows the Collection at this office:

	Railway.	M. Power.	Total.
Amount as per last report,	14,574 $74\frac{1}{2}$	15,085 $84\frac{1}{2}$	29,660 59
Do. week ending Feb. 27,	746 82	925 01	1,671 83
Whole amt. since Oct. 31, 1839,	$15,321 $56\frac{1}{2}$	16,010 $85\frac{1}{2}$	31,332 42

A. B. Cummings, Collector.

Railroad Receipts.—The income from passengers alone on the Syracuse and Utica railroad, from July 3d to November 30th, five months, was

$115,301. The cost of the road was $911,959, so that it yielded about eight per cent. upon the cost of construction, or about nineteen per cent. per annum. The Syracuse and Utica railroad is parallel with the great Erie canal, and being owned by a company, is prohibited from carrying freight except when the canal is closed.

EIGHTH ANNUAL REPORT OF THE BOSTON AND LOWELL RAILROAD CORPORATION.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The directors of the Boston and Lowell railroad Corporation, do hereby make their eighth annual report of their acts and doings, receipts and expenditures, under their act of incorporation.

The total amount of capital paid in, is	$1,650,000 00
The amount expended during the past year, exclusive of amount spent and charged to the cost of the road, is	
For repairs on the road, including repairs on bridges and some improvement in drainage,	18,843 09
For repairs on engines and cars,	16,384 54
For fuel, oil, salaries, wages, and all other miscellaneous expenses,	56,923 81
	$92,151 44
The amount received during the past year, is	
For transporting passengers between Boston and Lowell,	119,923 30
" " merchandize, and U. S. mail,	101,745 55
" " passengers for the Boston and and Portland railroad corporation over our road,	15,114 15
" " merchandize for the Boston and Portland railroad corporation over our road,	4,436 04
	$241,219 94

The amount divided during the past year, is $126,000, being two dividends of four per cent. each, one on a capital of 1,500,000, the other on a capital of $1,650,000.

Since the last annual report, there has been expended towards the completion of the road, depots, and appurtenances,	$32,812 71
Whole amount expended on the cost of the road and appurtenances at the time of the last annual report,	1,575,663 50
Whole cost of the road, to November 30th, 1839,	$1,608,476 21
Balance of capital unexpended,	41,523 79
	$1,650,000 00

A portion of the second track has been in daily use for more than a year. Iron rails have been ordered, and other preparations made for its continuation towards Lowell the coming summer.

All which is respectfully submitted,

P. T. Jackson, Wm. Appleton, Joseph Tilden, Geo. W. Lyman, John Briant, *Directors.*

FIFTH ANNUAL REPORT OF THE BOSTON AND PORTLAND RAILROAD CORPORPTION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directars of the Boston and Portland railroad corporation do hereby make their fifth annual report "of their acts and doings, receipts and expenditures," under their act of incorporation.

Soon after their last annual report was submitted to the legislature, the directors proceeded to make provision for the extension of their road from its temporary termination in Bradford, to the line of the State of New Hampshire, there to connect with the Boston and Maine railroad, then and still in progress of construction through that State to the line of the State of Maine.

They proceeded to the erection of a bridge, of the most approved construction for stability and permanence, and 850 feet in length over Merrimac river.

The said bridge was so nearly completed, as to be ready to accommodate the business of the road in the early part of December last; and the remaining portion of the Boston and Portland railroad, together with about nine miles of the New Hampshire portion of the same line was opened for the accommodation of the public on the first of the present month.

The entire cost of the addition to the Boston and Portland railroad, including the bridge, depot buildings in Haverhill, land for the accommodation of the same, will not exceed the estimate of one hundred thousand dollars, as given in our last annual report.

To aid them in defraying this expense, the directors have received from the treasurer of the Commonwealth, scrip or certificates of debt, to the amount of 50,000 dollars, so liberally granted by the last legislature, for the promotion of this important public improvement.

Little now remains for the entire completion of the work. The whole of this railroad (as well as the New Hampshire portion of the line) is laid in the most substantial manner, with a heavy iron rail of the most approved character, for stability, durability, and convenient use; and the rail track is, in other respects, equal to the best structures of the kind in New England. In the construction of the road bed itself, a new principle has been adopted, which the directors are confident will operate in a great measure to secure the rail track against one of the greatest evils to which railroads in this climate are exposed; the injurious effect of frost.

Total amount of capital paid in by stockholders,	$278,165 26
Massachusetts State scrip,	150,000 00
	428,165 26
There has been paid towards the construction of a bridge over Merrimac river and road,	86,923 13
The amount of income the past year is, from passenger train,	53,885 20
From merchandize train,	12.804 23
" transporting United States mail,	1,900 00
" rents, &c.	411 70
	$69,001 13
The amount expended the past year, exclusive of amount spent and charged to cost of road, for repairs of road,	3,609 48
For repairs of engines and cars,	3,931 84
" toll to B. and L. railroad corporation,	19,551 09
" fuel, oil, salaries and other miscellaneous expense,	16,230 26
	$43,322 67
The amount of dividends the past year is, being $6 per share on the stock, one dividend of two per cent. was made in April, the other of four per cent. in October,	18,000 00
Interest paid on State scrip,	5,000 00

All which is respectfully submitted,

Hobart Clark, En. Silsby, Sam'l A. Walker, Thos. West, Amos Abbot,
Directors.

EIGHTH ANNUAL REPORT OF THE BOSTON AND PROVIDENCE RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directors of the Boston and Providence railroad corporation do hereby make their eighth annual report of their acts and doings, receipts and expenditures, as required by law.

During the past year they have settled their controversy with the Boston Water Power Cempany, and have also, under the authority given them by the act of the legislature of the tenth of April last, purchased of the Seekonk branch railroad company, their entire road, with its appurtenances, and all the rights, privileges and franchise to them belonging, and have filed in the secretary of State's office a duplicate of the deed or contract of sale.

They have also erected a large brick store house at the Boston depot, for the accommodation of the Taunton and Dedham branches, and have filled up a large piece of flats, and secured the same from the tides by a substantial stone wall. They have enlarged the machine shop, and erected an additional wood shed and a passenger house in Roxbury. They have also completed the second track to Roxbury, and have incurred a heavy expense in widening the road in various places, and in making drains and bank walls.

The whole amount of the capital of the corporation paid in, is		1,782,000 00
The whole amount of their expenditures the past year is as follows:		
For the purchase of the road and franchise of the Seekonk branch company, including their cars,		31,955 70
For construction of the main road, including sums paid for land and damages, erection of buildings, amount paid to Boston Water Power Company, completion of second track to Roxbury, and other permanent improvements,		$62,424 67
For repairs of road,		8,604 28
" repairs of engines and cars,		19,466 99
" amount paid to the Rhode Island railroad company, for the lease of their road, bridge, and depot, under contract sanctioned by the legislature of this Commonwealth,		6,468 10
For fuel, oil, salaries, wages, and all other miscellaneous expenses,		65,491 74
		$194,411 48
The amount received during the past year, is:		
For transportation of passengers,		234,237 42
" transportation of merchandize,		72,939 11
" transportation of mail,		3,000 00
" interest,	$3,495 74	
From which deduct the balance of interest against the company at the beginning of the year,	661 08	
Leaves the present balance of interest account in favor of the company,		2,834 66
For rents,		896 25
		$313,907 44
The amount divided the past year, is being in two dividends.		142,560 00

The first dividend was declared in Janurry, and the second in July last, each being four per cent. on the amount of capital stock paid in, viz. $1,782,000.

All which is respectfully submitted,

Josiah Quincy, Jr., William Appleton, Joseph W. Revere, William Sturgis. *Directors.*

THE EIGHTH ANNUAL REPORT OF THE BOSTON AND WORCESTER RAILROAD CORPORATION.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

The Directors of the Boston and Worcester Railroad Corporation, respectfully submit the eighth annual Report of their proceedings, and of their receipts and expenditures.

Within the last year, the directors have, by agreement with the directors of the Western railroad corporation, united their road at Worcester with the said Western railroad, and established regular lines of transportation, for the conveyance of passengers and freight, over the whole of the said Boston and Worcester road, and such parts of the said Western road, as is completed and open for use; and in pursuance of said agreement, regular trains of passenger and freight cars, have been run between Boston and Springfield, since the opening of the Western railroad, with the exception of a few days, when the roads were obstructed by deep snows.

They have also agreed upon the terms of an arrangement, with the directors of the Norwich and Worcester railroad corporation, for establishing regular lines of transportation, for the conveyance of passengers and freight between Boston and Norwich, to be carried into operation, as soon as the said Norwich and Worcester railroad shall be completed. The rails are already laid on the whole of that road, with the exception of a distance of about two miles. The work on this part of the road was unfortunately interrupted in December, by a violent snow storm, at a time when it was hoped that with the continuance of two weeks more of mild weather, it might be finished, and the road opened for use during the winter. In consequence of this disappointment, the opening of the road was necessarily delayed, but there is no reason to doubt, that it will be completed early in the ensuing spring, when the arrangements, for establishing regular lines of communication over the whole of the two roads, will be carried into effect.

The directors have, within the last season, caused a second railway track to be laid down, on that part of the road which lies between Natick and Hopkinton, a distance of about seven miles. By establishing a double track for this distance, on the middle portion of the railroad, the upward and downward passenger and freight trains, which will be necessarily increased in number, in consequence of the opening of the Western and Norwich roads, will be enabled to pass one another with less delay and less liability to accident, than if required to meet, as heretofore, at one of the three stations at Framingham, Natick and Hopkinton. The work of laying this portion of a second track, is nearly completed, but in consequence of being retarded by an unexpected delay in the arrival of the iron from England, it was interrupted by the sudden approach of winter, before it was entirely finished.

Some further improvement in the construction of the road has been made during the past season, by enlarging the drains, and widening the deep cuts, for the purpose of rendering the rails more secure against the effects of the frost, and the drains against obstructions by slides of earth.

Some expenditures have also been made in enlarging the accommodations at some of the depot stations, and increasing the number of engines and cars, in preparation for an enlarged amount of business, anticipated from the important extension of the lines of communication. For the purpose of meeting the expenditures for these objects, the stockholders voted, on the 1st day of November last, to increase the capital stock to $1,800,000 by the creation of 1000 additional shares, in the manner authorized by the charter all of which have been taken up at par.

The amount expended during the two last years, and charged to the account of construction, was	$137,791 43
The amount previonsly expended and charged to the same account, as by annual report of 1838, was	1,710,294 39
Making a total of	$1,848,085 82
From which deduct amount reserved from income and carried to reserved fund on account of decay and wear of road, engines, etc., beyond what is replaced by repairs and new work,	$48,830 00
Present valuation of road, land, depot, buildings, engines, cars, etc.	$1,799,255 82
The amount of income received during the past year was as follows:	
From fare of passengers,	$122,495 92
From freight, mail, etc.,	106,251 16
Rents, storage, etc.,	3,060 10
Total, not including a surplus of last year,	$231,807 18
The expenditures within the year, exclusive of the amount charged to the account of construction, were as follows:	
For repairs of engines and cars,	$25,198 46
Repairs of road,	18,035 09
All other expenses,	83,151 28
Total,	$126,384 83
The following dividends of profits were declared within the year, viz:	
July 1, 1839, 3½ per cent.	$59,500 00
Jan. 1, 1840, 3 per cent.	51,000 00
Total,	$110,500 00

All which is respectfully submitted,

Nathan Hale, David Henshaw, Eliphalet Williams, William Jackson, Daniel Denny, Nathaniel Hammond, William Sturgis, *Directors.*

MEMPHIS BRANCH RAILROAD AND STEAMBOAT COMPANY.

At the meeting of the stockholders of this company, held in Rome, on the 7th inst., the following gentlemen were appointed directors for the year 1840:—Messrs. D Mitchell, J. H. Lumpkin, J. Liddell, J. Rogers, G. W. Tuggle, T. Mills, and N. Yarbrough.

On the same day the board was organized by the election of D. Mitchell President *pro tem.*, and N. Yarbrough Secretary.

The Board of Directors have appointed Wm Spencer Brown, Esq., principle engineer, with instructions to organize a party, and proceed forthwith with the survey, and location of the road.

Thus private enterprise will carry out what the State has so blindly neglected.

This railroad together with the Selma and Tennessee railroad, will form the most direct possible connection between the South Atlantic sea coast, and the western States—will be 100 miles shorter than the same connection *via* Ross' Landing—will strike the Tennessee river below all obstructions and at a point of the river navigable for *ten* months of the year.

AMERICAN
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AND
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For the American Railroad Journal and Mechanics' Magazine.

Gentlemen--In the appendix to the last edition of Tredgold on the steam engine and steam navigation, is a paper "on the steamboats of the United States of America, by James Renwick, L. L. D. professor of natural experimental philosophy and chemistry in Columbia college, New York." This account contains so many errors, of fact and opinion, that it appears to us we shall be "doing the state some service," by pointing out a part of them, and cautioning the travelling community, as well as the proprietors of steam vessels, against adopting some of his suggestions, or trusting themselves where such opinions serve as guides in the practical construction and management of the steam engine. He gives a history of the invention, and after stating the extent of country to be benefitted by it, says, "influenced by such considerations, attempts to apply steam to the purposes of navigation were made in the United States, even before Watt succeeded in giving a double action to his engine. The earliest enterprises of this sort, were those of Fitch and Rumsey, which both bear the date of 1783. Both were founded upon the original form of Watt's engine, and both failed, rather from the inherent defects of that instrument, in its power of general application, than from any want of ingenuity or mechanical skill in the projectors themselves." Now the facts in the case are, that Mr. Watt had a double acting engine constructed at Soho in 1782. and took out a patent for it in the same year—and "he had long conceived the idea of this improvement in his mind, and had produced a drawing of it to the House of Commons, in 1774, at the time when he procured the act to prolong his original patent." And with regard to its use by Fitch and Rumsey, neither attempted it, but both thought it entirely too heavy and unmanageable for their purpose; and each set about constructing an engine upon some lighter and simpler plan.

The next material error, is in the account given of the engine used by

Fulton on board his first boat at New York. It is stated, that it was designed by him, and that he made sundry alterations in its form to adapt it to a steamboat. So far is this from being the true account, that in Fulton's last patent (dated Jan. 27, 1811) he says, "I make use of Boulton & Watt's steam engine, or any other steam engine of equal power, my claim to invention not extending to the steam engine but to the proportioning, combining and applying it in such manner, to a boat or vessel of such dimensions as to drive her to a certainty more than four miles an hour in still water." The facts of the case are—the engine was made by Boulton, Watt & Co.—was of a form which they were, at that time, in the habit of making for a variety of purposes—was invented four or five years before, by Mr. Murdock, then a member of that firm—was familiarly known by the name of the "bell crank engine," and was recommended to Fulton by Mr. Watt as the form best suited for his purpose. It is stated, too, that Fulton "had a double provision for uniting the beams to the cranks, and that as it was found most convenient the connecting rod was thereupon extended horizontally to meet the crank." Had he attempted to use perpendicular connecting rods in that case, they could not, with the water wheels he made, have been more than three or four feet in length, and the fly wheel would have divided the air pump through its centre perpendicularly. There *was no provision* made for perpendicular rods, but the bell cranks of the "North River" were cast with large weights on the ends of the horizontal parts opposite to the cylinder, to counterbalance the piston, piston rod, cross head, and connecting rods. The remark, that the engine which Henry Bell built and fixed in the Comet in 1811 (not 1812) on the Clyde, was the model for all the engines used in the British steamers since that time, will require a great deal of illustration before it can be received as correct, by those acquainted with the matter.

We saw the engine of the Comet, at work in a duck manufactory in Greenock in 1829, and have seen many of the engines in use in the British steamers since the Comet's time, and although our's is a somewhat practiced eye, we are really unable to trace the likeness of the copies to the original.

At page 106, it is stated, that in "treatise on the steam engine, which it is believed had some influence in the improvements that have since been made in navigation by steam it was demonstrated, that the power of a given engine might be doubled by loading the safety valve with 57 lbs. per square inch, and cutting off the steam when $\frac{1}{8}$ of the cylinder has been filled, and a saving of $\frac{2}{3}$ of the fuel effected at the same time." If by a "given engine," in this passage, is meant one worked by steam of the force of 4 or 5 pounds per square inch, we have to remark, with due deference to the demonstrator, that practice has, and ever will, and inevitably must prove this and all similar demonstrations, to be drawn from erroneous premises. On this part of the subject it may, perhaps, be well, not to go into an inquiry of what the true theory is, but to state some of the results of the practice recommended. And this we are able to do readily, from the circumstance, that in drawing up answers to certain interrogatories put by persons engaged in the attempt to get up an Atlantic steam ship, we made the necessary inquiries and calculations to enable us to state the relative consumption of fuel by the British engines, which use low steam, and some of the engines of the fastest running American boats, which are worked by steam approaching pretty nearly to the economical pressure of 57 lbs. per square inch—the particulars will be found in the annexed table.

Name of Vessel.	Number of Engines.	Diameter of Cylinder in inches.	Length of stroke in feet.	Power in horses.	Cords of wood per hour.	Pounds of Liverpool coal equal to the wood.	Rate of consumption pr. hour for the power of one horse	Ratio of consumption of fuel.
Champlain,	2	42	10	332	3 8	4167	12 55	2·18
Rochester,	1	43	10	160	3·0	3290	20 56	3·57
Utica,	1	39	10	130	2 1	2303	17·71	3 08
De Witt Clinton	1	65	10	360	4·0	4386	12·18	2·11
N. America,	2	44	8	266	4·0	4386	16·49	2·86
Frigate Fulton,	2	50½	9	392		4480	11 42	1·98
Great Western,	2	73½	7	10 0		2700	6 75	1 17
Liverpool,	2	75	7	460		2645	5·75	1·00

In this table the two English engines are set down at the power at which they were rated by the makers—the power of the others was calculated by a rule which gives 61½ per cent more, or the engine of the Great Western if calculated by this rule, would be found to have the power of 646 horses, and that of the Liverpool 670. From these *facts* some estimate may be formed of the value of the *theory* in question.

There are several other minor matters which might be made subjects of remark, but we pass these, in order to enter our unqualified protest against the grossly erroneous and highly mischievous opinion expressed at page 112, where he says, in speaking of the Great Western, "on examining this vessel and comparing her performance with that of American steamboats, it is easy to perceive that her speed might be very materially increased, without making any important change in her engines, and probably with a saving of fuel. It would be necessary to modify the boilers so as to convert a less quantity of water than they now do into steam, but to furnish it of a tension of 20 or 30 lbs. instead of 3½, which they now carry, no when the boiler is of sufficient strength, need any increase of danger be apprehended from using steam of this medium pressure. It is now well established, that the mere pressure of steam is among the least important causes of danger, and that such as are most to be apprehended are as likely to occur in using steam of a single atmosphere, as that of ten or twelve." This whole paragraph is made up of errors; but the last sentence, in which is repeated the absurd and dangerous idea that the *pressure* of steam has little or nothing to do in the bursting of boilers, when such disasters occur, is the most surprising. What else than the pressure of steam ever yet produced an explosion in a steam boiler? What else can find a place in a steam boiler, while at work, to produce one? The existence of any other cause has not only never been proved, either by reasoning or experiment but the non-existence of other causes which have been supposed to produce explosions, may be inferred from the circumstance, that in every case where the facts could be made out, after an explosion has occurred, the pressure of steam has been found to have been abundantly sufficient to produce the effects observed; and when the same conclusion *must* be arrived at by reasoning from the known laws of caloric and vapor, it is melancholy to find such an opinion promulgated to the world through such a channel, and with the sanction of a respectable name—and it is to be hoped that further reflection, and a more careful examination of the matter, will induce him, at some future day, at least to withdraw his countenance from the practice of using high pressure steam in condensing engines, on board vessels intended for the transportation of passengers—a practice which is far from being economical—which in our own country has already cost many hundreds, if not thousands, of lives, and which, if persisted in, will require the yearly sacrifice of, perhaps, hundreds more.

Respectfully your obedient servant,

JOHN D. WARD.

RAILROADS AND CANALS.

The Camden and Amboy Railroad, its cost and income, compared with the Delaware and Raritan Canal.

The advocates of railways are largely indebted to the directors of the Camben and Amboy railroad, for their full and frank statement of the cost and income of this work, in all its details, as well as of the Delaware and Raritan canal.

The contrast in the receipts, expenses and income, of these two works, (for the same period,) is as great as their comparative utility to the public, and benefit to the stockholders. The *railway*, presents the fact, of gross receipts in six years, (from 1834,) of $4,169,492. Expenses, $1.966,901, —nett income, $2,202,591. This sum is equal to the entire cost of the railway, if we exclude $420,153 charged for steamboats in connection with the line, wharfage $55,6 0, real estate and right of way $396.769, interest on loans $104,242 during the construction of the work. For the details, we refer to the tables. At page 11 of the report referred to, the directors state the gross receipts in seven years, (altered as above to correspond in time with the canal,) to be $4,637,535.—Nett receipts, $2.383,542, they then observe, "supposing there should be no greater increase for the next seven years, the nett profit, will be in seven years, from January 1, 1840, $1,042,000, from which deducting the interest on the loans to wit, $190,000, will leave the sum of $852,000, or, a dividend of 28 per cent. per annum."

"Passengers increased 11 per cent. per annum. Merchandize 123½ per cent. in seven years. The annual nett increase of the profits of the companies, 20 per cent."

Let us now compare the *canal* with the railroad. By the tables of the report, it will be perceived, that the canal has cost the stockholders $2,829,769. "The amount of receipts of the Delaware and Raritan canal. from 1834 to 1839, inclusive, was $306.895

"The expenditures, during six years,	210,344
"Total receipts for dividends,	$96,551

This sum is in the ratio of a fraction over one half of one per cent. per annum; of course the canal, it will be perceived, is a dead weight on the railroad.

The railroad, in the language of the report, "has *furnished. on loan to individuals.* $117,000 *for building boats, for the transportation of coal, through the canal.*" This remark needs no comment. The railroad had to advance capital to the canal, to purchase it business.

It should be taken into consideration, the Delaware and Raritan canal, is of the same dimensions, as the size proposed for the "enlarged Erie canal" The locks, however, are larger, viz. 130 feet long by 30 feet wide, adapted to pass barges, steamboats and schooners. The surface of the canal is 70 feet, by 7 feet in depth. The ratio of cost of this *new* canal, with large locks, compared with the present estimates for the enlarged *old* canal, is more than two to one in favor of the Delaware and Raritan canal, whilst the original work. of the Erie canal is destroyed, or abandoned!!! The Delaware and Raritan, unites the Delaware and coal region, with the Raritan, at New Brunswick, a distance of 65½ miles. The railroad is 92½ miles in length, with a double track, ware houses, work and engine houses, &c. &c. complete. The report states, (page 10,) "the tons of merchandize, transported on the railroad in 1833, was 6 043, in 1839. it was 13,520. The passengers yearly transported, prior to the construction of the railroad, 52.000; in 1839 by railroad, the number was 181.479; in 1839 the increase in nett receipts of both was in the ratio of $181,050 for 1833, to $427,286 for 1839."

We find the railroad has commenced the transportation of flour, at 25 cents per barrel, from city to city, along side of one of the best canals in Union, with natural waters to contend with, by the schooners that now navigate the coast, and Delaware river. In one instance within the last month flour was delivered within 40 hours, after the New York merchant deposited his order in the post office; thus proving the position we assume *that celerity and certainty of arrival, with a commercial people will always command a preference,* particularly in the transportation of valuable and perishable commodities. On the Erie canal one-third of the tolls, are derived from merchandize. As a matter of course, competition and the wants of the consumer, will force rival storekeepers, to seek the railroad, on the completion of a line to Buffalo. The line of railway from Albany to Buffalo, is more than two-thirds completed, the remainder will be finished, even by private enterprize, within two years. Will not the wants of the west and public sentiment, force from the State the monopoly they now enjoy? We think so. Further, will not the early transportation of merchandize on the railway, before the Erie canal is opened, and during the long period it is closed in the winter, reduce its income full 33 to 50 per cent? Of the capacity of a railway *well located*, to effect this, there can be no doubt, with professional and *practical men*, on such a thoroughfare as the line of the Erie canal presents. On it, trains of 250 tons may be drawn at the rate of ten miles per hour, every half hour in the day for 300 days in the year. This would give, as the capacity of the railway 3,600 000 tons. The Erie canal cannot pass to exceed one-fourth of this tonnage, to wit, allowing a boat of 30 tons of goods and produce to pass the locks every ten minutes, (the extent of their capacity,) day and night, for 200 days, the average time it is navigable, which will include Sundays during the season of navigation—excluded in the railroad estimate—and we find the capacity of the canal to be 864,000 tons.

On the Philadelphia and Reading railway, in Pennsylvania, where there is little up tonnage, they calculate to carry a ton of coal from Pottsville to the Delaware river, 98 miles, for 50 cents. From the exhibits they have made of the performance of some of their improved locomotive engines, they have reduced the value of the stock of the Schuylkill canal company (along side of which the railroad is located,) from $360. for $100, to $165. This canal has been one of the most profitable in the United States, yielding dividends of above 20 per cent. per annum to its stockholders. It is clear, that which has been done on one railroad, may be accomplished on another with equal grades, and condition of road. A road from Buffalo to the Hudson can be located, with as favorable grades as that of the Reading railroad; on this road, 423 tons gross, 307 nett, has been drawn 10 miles an hour for 54½ miles, at an expense of $57.

If other instances of the decided advantages of railways over canals for income and general utility are wanted, we would refer to the Boston, Lowell and Nashua railroads. The Boston and Worcester, and Providence rail. roads, these roads having superceeded in a great measure, the Middlesex and Blackstone canals. The New Haven and Hartford railroad, even before it was completed, so far reduced the value of the stock of the Farmington canal that we understand the city of New Haven taxed themselves, to put it in navigable order the past season, until the railroad to Hartford was completed. *It is presumed that this will be the last of the Farmington canal, except for mill races on its line.*

We cannot take leave of this subject without presenting some official facts, from three of the six railways that have been completed in Massachusetts. We find the receipts on the Boston and Lowell, and Nashua, the Boston and Providence, the Boston and Worcester, for 1839 to be

From passengers,	492,770
From freight,	294,044

111½ miles cost $5,189,731, equal $46.545 per mile, produced $786.814 equal to 15 per cent. gross, or 11 per cent. nett, this too, where the turnpike and common roads leading into Boston, are not exceeded by any roads in any State, in the Union.

The following table, presents the increase and comparison for the years 1837, 1838, and 1839, of the three principal roads first constructed in Massachusetts. These roads were among our first experiments, they could *now* be built for half what they cost, exclusive of land damages.

NAME.	Year.	Cost per mile.	Income from passengers.	Income from freight.	Total receipts.	Total expenses	Nett profits.
Boston and Lowell	1837	62,465	117613	63137	180770	78508	102162
	1838		109083	82697	191780	75597	116183
	1839		135037	106131	2412[illegible]	292151	149069
Boston & Providence	1837	43,430	193469	57413	250882	156238	94644
	1838		196974	68140	265114	120044	145070
	1839		234237	79670	313907	93562	220345
Boston and Worcester	1837	40,433	123331	86716	210047	94762	115285
	1838		112032	100292	212324	85572	126752
	1839		122496	109311	231807	126384	105413

In the event of a war with Great Britain, who can calculate the saving to the public treasury, in the transportation of munitions of war, and men to Maine, and to our Canadian frontier.

If such flattering results and advantages are presented at the commencement of our system of railroads, what will they not yield, with the increase of our population. Experience and mechanical ingenuity has taught us to reduce their cost, their management, and to improve on the engine. Ten years has already produced results almost incredible, a few years back $2500 was offered to construct an engine capable of drawing 20 tons on a *level* railroad ten miles per hour.

The prejudice against railroads, which has existed, and continues to exist, must give way "*to the better improvement of the age.*" The doctrine of Bridley "that rivers were made to feed canals," has been carried to an extravagant extent in its application. This obsolete doctrine we trust will no longer be listened to, by intelligent legislators, in this or any State.

The period, we trust has arrived, when the *canal mania*, which has so long governed us must give way to more *sane* counsels. The people are too well informed to submit to taxation, and a forty million debt, for the construction of a work, that cannot be used its entire length, to exceed six and a half to seven months in the year, in fact the enlargement of the Erie canal to the size of 7 feet by 70, we repeat is behind the intelligence of the age; and if persisted in, history *will cover with disgrace all those connected with it.*

The time has come to republish the following extract from "*An appeal* *made to the representatives of the people in relation to the proposed enlargement of the Erie canal,*" in 1836, which few would then listen to.

At page 14, the writer says, "We cannot avoid expressing our belief, that if the enlargement is persisted in, as contemplated, a reaction will sooner or later ensue, highly prejudicial to those who may have assumed the responsibility of the improvement.' The voice of our legislature may not be echoed by another. There is no guarantee that the tones of acquiescence, or approval, but lately heard on this subject, will find an agreeable response from other lips. The spirit of inquiry will be awakened.—The merits and demerits of this great and momentous subject, will be investigated, and unless we mistake the intelligence and spirit of the age, it must result in consequences, *which all will wish had been avoided.*" How true to the letter.

In presenting the foregoing facts, we aim at the public weal. We desire to substitute railways in aid of canals, particularly in latitude 43. Our object is to elicit discussion, and to assist in dispelling errors produced by official reports, in comparing canals with railways. These reports have in part been the means to entail on us the Genessee valley and Black river canals, as "*gentlemen paupers,*" to the tune of $100,000 per annum, and this too, where a vote of the people would now prefer railroads, the R. R. would pay an interest on their cost, and be in use the entire year. The reports alluded to, issued with the sanction of Congress, and our own Canal Board, 1835, carried the above named canals, the Chenango canal, and the greatest of all legislative follies, "*the enlargement.*" A work that no party, or Engineers will now own or be responsible for its completion in twelve years for $35,000,000.

The enlargement of the lateral canals must follow the Erie. Under this view we cannot better close these remarks than by quoting from No. 4, of a series of able essays published in the Railroad Journal, with the signature of "FULTON." The writer says, "*Of all the visionary projects of which the State of New York has been drawn by the influence of unwise counsels, the enlargement of the Erie canal, is the most visionary, and the sooner she makes haste to retrace her steps, the better. The State is already in for about* $60,000,000, *for canals alone, without even a reasonable prospect of being able without a resort to taxation to pay the interest on that amount. Is it not time to pause in this course of extravagance?*".

We answer aye—let the present legislature examine into the merits of well constructed railways, and their capacity to carry all classes of produce, and we venture nothing in stating our opinion, that the Erie canal, with its original size of 4 feet by 40, (it is now filled up with bars and deposits to 3 feet water,) with double locks to Montezuma, will be adequate for the *trade* on it, for the next half century; from the fact, that the packets and *packet line boats,* will be discontinued so soon as the line of railroad is completed to Buffalo. This will take place as soon as permission is given to the emigrant to, and from the west, to pass through this State with his baggage and effects on a railroad, even with the onerous tax to the State treasury, of the same tolls persons pay to the canal. The reason is obvious, he will readily pay this tribute to the State to save 5 or 6 days in time, in transporting his family from Albany to Buffalo. Further, on clearing out the canal to full 4 feet it can be demonstrated, that the well constructed lake boat and scow, (to which the Erie canal should be limited,) will double the present tonnage. For the last five years it has fallen off, 140,000 tons, in lumber, and will decrease yearly, on the completion of the railways to lake Erie. This must occur, as celerity and certainty of arrival, are two of the main elements of commerce, for which the public will pay, as we see in the instances quoted.

J. E. B.

For the American Railroad Journal and Mechanics' Magazine.

CUMBERLAND ROAD.

Of all the works of internal improvement ever undertaken by authority of the general government, under the head of roads and canals, there is none that reflects so much credit upon the nation as the great Cumberland road, connecting Baltimore and St. Louis.

In the direction of Wheeling on the Ohio river, this road has been completed and in use for several years past; that now completed in Ohio to Springfield, has been finished more recently, and the remainder of the distance to St Louis, through the States of Ohio, Indiana, and Illinois, has been in progress, with the exception of that portion between Vandalia and St. Louis, which has only been surveyed. It is contemplated to continue it ultimately to Jefferson city, in Missouri, the surveys having extended that far.

Situated, as are the Alleghanies, between Baltimore and Wheeling, there has been a great variety of difficulties to contend with in the location and construction of a safe and permanent road over this barrier—in fact, the whole distance between the two places is little else than a succession of hills and valleys, scattered in admirable confusion on your front, flank, and rear. Great, however, as have been the obstructions, energy and perseverance have in a measure levelled them, and no reasonable expense has been spared to perfect it in all its details; and as far as completed we have by this road better facility for the transportation of passengers and the mails than on any other route where post coaches are used, so rapid is the transit of the latter, and to insure its expedition, but three passengers are allowed to be conveyed by the mail between Baltimore and Cincinnati.

The topography of the country traversed by this road on the west of the Ohio river is much broken, till near Columbus, when it changes character with its rear, and becomes more uniform and frequently level. In Indiana it partakes more of the latter character, but is undulating in approaching the water courses, and traverses much of a timbered section, denominated

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beech flats. A great portion of Ohio and Indiana on the line of the road is heavily timbered. On the west of the Wabash river, for a distance of twenty-five miles in Illinois, it is undulating and timbered, but mostly oak openings. After this the great praries are met with, and they have the predominance the remainder of the distance to St. Louis.

With the maximum inclination over the mountains, I am not conversant, nor of the exact width of roadway proper, but presume the latter is the same as that adopted in the States in advance, viz., thirty feet. The Macadamizing material is of an excellent quality, and preserves a uniform and hard surface; and the roadway proper on all inclinations of any magnitude is well protected from washing by a series of gentle ridges crossing the road at intervals of two hundred feet, obliquely, serving the purpose of carrying off the water, and at the same time to check the force of gravity in descending.

From Springfield, in Ohio, to Vandalia, Illinois, a variety of work in detached sections of the road has been done, amounting, however, to much less than one half of the aggregate amount necessary. In Indiana, a few miles of the road at Richmond, Indianapolis, and Terre Haute, have been macadamized, but in Illinois, this kind of work has not been began.

The width of this road has been fixed at eighty feet, and the clearing and grubbing carefully extended between the extreme limits of the cuts, ditches, and embankments. The roadway proper, has a width of thirty feet when finished, with a berm of about two feet, except in heavy excavations, and embankments. In the cuts, the depth of the ditches are one foot and a half and their width at bottom, two feet, and those elsewhere, two feet in depth, and eight feet at bottom; and where the slopes of the ditches are such that danger may be apprehended from washing, they are paved. The slopes of the embankments and cuts are two feet horizontal, to one foot of vertical height, and are sodded, or sown in blue grass seed, and protected till the grass is well set. No inclination exceeds one in twenty-five, in Illinois, and as far as I am informed, it will apply to Indiana, and most of the road in Ohio.

When any part of the road is finished, the travel is admitted thereon, and regulated by placing logs or other obstructions, alternately on each side of the road, from the centre to the sides, at intervals of one hundred and twenty feet. These barriers are moved westward twenty feet each day for twelve days, and so on alternately changing the travel on the road daily.

Rock of a lime stone description, and of a quality suitable for the purposes of masonry is generally found in great abundance convenient to the road, but in some locations the haulage is considerable. The rock, when quarried is cut or hammer dressed, and subjected to a rigid inspection before being laid in the walls of a structure; there are, however, a few bridges, the masonry of which is rock work without margin, and the timber generally used in the frame of the latter, is of white or bur oak. There are some very fine specimens of bridge architecture on this road at Columbus, Ohio, and at Richmond and Indianapolis, in Indiana. The one contemplated at Terra Haute, across the Wabash river, will be an ornament to the place, when constructed. The former are completed, but the latter has only been so far begun as to contract for the delivery of the necessary rock for the abutments and piers. The quarry from which this is procured is in Illinois, near the State line, and on the south of the road. A temporary railway of wooden rails, has been laid from the quarry to the Wabash river, a distance of seven miles, and from the place of delivery on the river, which is below Terra Haute. Scows, towed by a small government steamer, are used to deliver the rock at the latter place.

In macadamizing the road, the centre, which was left about one foot above the sides at the time of finishing the grade, is reduced to a suitable convexity, and the broken stone laid on in layers, to an aggregate depth of nine or ten inches, and extended ten feet on each side of the centre.

The yearly appropriations of Congress for the construction of this road, have heretofore been made with commendable promptness, and in the spirit of the compact existing between the general government and the respective States concerned, but in some few instances the appropriations have failed, as was the case the last year, but it is confidently hoped, that Congress will not allow a repetition of that failure for the present year..

MACADAM.

For the American Railroad Journal and Mechanics' Magazine.

RAILWAY CONSTANTS, BY DR. LARDNER.

Permit me to call your attention to the article in your Journal of Feb. 1, 1840, in which Dr. Lardner's paper on Railway Constants, is made the subject of severe, and as it appears to me, unjust criticism. The writer of the article is obviously in error, in the view which he takes of the action of the several forces operating upon bodies when descending inclined planes.

So long as the force of gravity continues to act and the body encounters no resistance, its motion will be uniformly accelerated. If the force of gravity is suddenly suspended, the body will move on without a *uniform* instead of an *accelerated* motion, the velocity being that last acquired at the moment of the withdrawal of the accelerating force. If the accelerating force, or force of gravity, instead of being withdrawn, is *counteracted* by forces which are *equivalent* to it, the result is the same, viz. an *uniform* motion.

Should it be discovered therefore that the velocity of a train of railway cars in descending a plane of a given inclination, becomes uniform, the inference is just that the *entire* force of gravity upon the plane, is at the velocity attained, *counteracted;* or in other words, the combined forces of the resistances from friction and the atmosphere are then equal to it, and both bear the same relation to the weight of the train as the height of the plane to its length.

To say therefore that this force (gravity) "generates and keeps up" the velocity acquired, and "overcomes the friction and resistance of the atmosphere," and *hence* that the height of the plane is the measure of and resolvable into these *three* forces is not correct in point of fact.

The total accelerating effect of gravity upon the train up to the moment of acquiring the uniform velocity is not *counteracted* but is *preserved* in the *uniform motion* of the train, which has no limit to its continuance, but the length of the plane, or the interposition of a resistance additional to that by which the uniformity of the motion was produced.

The writer of the article has evidently confounded what may be termed the *quiescent* force of gravity as indicated simply by the ratio of the height of the plane to its length, with the *momentum* or force expended in producing the uniform motion; which latter depends upon the distance passed over in acquiring that motion and is not impaired by the subsequent resistances which operate *solely* to *neutralize* the *continued* effect of gravity and are correctly expressed by the ratio above given of the height of the plane to its length.

Since the remarks of the writer are based upon premises which are untenable and unsound it is almost needless to say that in his course of reasoning there are many inconsistencies and that the conclusions therefrom are fallacious.

Without expressing an opinion as to the degree of confidence proper to be placed in the experiments of Dr. Lardner and Mr. Wood, it is believed that no exceptions can reasonably be taken to the position assumed by them, that when the motion of a train upon an inclined plane is uniform, there being no other force operating but gravity and the resistance of friction and the atmosphere, these forces are in equilibrio, the two latter as well as the former bearing the same relation to the weight of the train as the height of the plane to its length.

Mr. Brunel who is particularly distinguished for his science and sagacity would not have failed to discover and to point out the "grand error of Dr. Lardner," had such an error in fact existed.

As the paper of Dr. Lardner is one of interest, containing statements and inferences, which *if correct*, are of importance to the profession, I would suggest its publication in your Journal. It may be found in the Civil Engineer and Architects Journal for the month of October 1839.

Yours very respectfully,

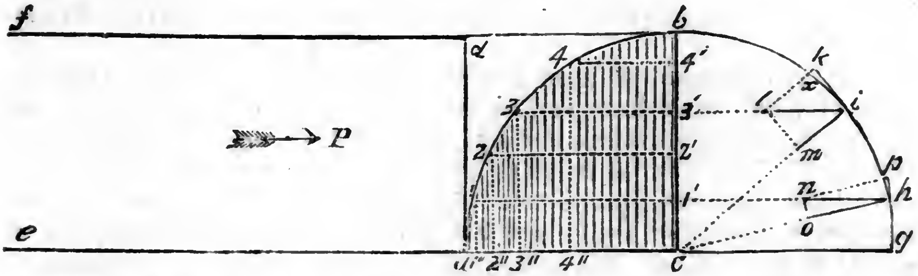
L. Williams.

It will be seen in our last number, that the writer of the article in question, has discovered and corrected the error above mentioned.—*Eds. of R. J.*

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

Mr. Roebling's new "Theory of the crank" appears to be founded on a mode of representing a given force by a surface, instead of, as usual, by a line. Thus he says, "when the power has moved from *a* to *c*, the amount of power or momentum, actually applied, is represented by the square $a\ c\ b\ d=R^2$." If the same reasoning be applied to any of the abscissas with its corresponding ordinate, we shall have a similar result; for "when the power has moved from," a to 3″ the "amount of power actually applied is represented by" the parallellogram having for two of its sides a 3″ and 3″ 3, and, when the power has moved from a to c, the ordinate and abscissas are equal and their product is the square of either$=R^2$.



The investigation will be rendered easy by assuming a line instead of a surface to represent the power. Let the power expended in moving from a to c be represented by the line $ac=1$. When the power has moved from a to 1″ the crank pin has moved from a to 1 and supposing this portion of the arc$=10°$ (as a first approximation) the distance a 1″ will be ·0151922 and the length of the arc a 1 will be ·174533, both being expressed in terms of $ac=1$. The crank pin has therefore moved 11·48 times farther than the power, and, if the force with which it has moved through this distance be in the inverse ratio of the length of the arc a 1 to the line a 1″, the dynamical effects will be equal. Now, as Mr. R. says the leverge of the crank at 1 must be $=1'c=11''$ and, assuming the average power to be $\frac{1}{2}$ of 11″ we should have the value of the useful effect = the length of the arc $a1\times\frac{1}{2}$ the line $11''=\cdot174533\times\cdot0868241=\cdot0151536$, while the actual expenditure of power by the prime mover is$=a1''=\cdot0151922$, the difference being only ·0000386. The smaller the portion of the circumference taken, the less will be the difference; but, as this mere approximation shows a difference too small to be felt in practice, it is unnecessary to go any farther.

The direction of the force in practice is not however parallel to ac, but is continually varying and here will necessarily be some loss to obviate which the connecting rods are made as long as possible, this, however, as well as the contrary varying motion from a to c required to produce a uniform motion throughout the arc a 1 2 3 4 b are practical questions which have no connection with the case under consideration, where the power is supposed always to act in parallel lines and where the general dynamical effect only is considered.

W. R. C.

New York, March 24, 1840.

OF THE APPLICATION OF STEAM AS A MOVING POWER, CONSIDERED ESPECIALLY WITH REFERENCE TO THE ECONOMY OF ATMOSPHERIC AND HIGH PRESSURE STEAM. BY GEORGE HOLWORTHY PALMER, M. INST. C. E.

(Continued from page 187.)

Mr Perkins states in the fourth volume of the Register of the Arts and Sciences, when treating on the subject of high pressure boilers—"In some recent experiments I have heated steam to a temperature that would have given all the power that the highest steam is capable of exerting, which would have been 56,000 lbs. upon the square inch, if it had its full complement of water, yet the indicator showed a pressure of less than five atmospheres."

Here, then, is steam exerting a force, according to Tredgold's rule, upwards of 4500 atmospheres, or, by the French philosophers, of 2567 atmospheres, giving an elastic force of nearly 38,000 lbs. per square inch, (instead of 56,000 lbs., as stated by Perkins,) reduced by dilatation to less than 70 lbs. upon the square inch. Mr. Perkins, in a still more striking experiment, generated steam at 500° temperature, equal to about 50 atmospheres, and suffered it to escape into a receiver, which was destitute of both water and steam, heated to about 1200°, which steam, for want of water to give it its necessary density, the indicator showed a pressure of about five atmospheres.

Proof beyond this, (particularly as it is in strict accordance with the laws of nature,) would be almost superfluous, for here we have steam of 50 atmospheres, (should have been 46 atmospheres,) although permitted to expand in a receiver little short of red heat, indicated no more than five atmospheres elasticity; if, therefore, the second dose of sensible caloric taken up by the expanded steam had been as effective as the sensible caloric become latent by dilatation, the elasticity of the steam, instead of registering only five atmospheres should have denoted upwards of 3000 atmospheres elasticity.

The fourth theorem, viz., that high pressure steam of, say, 10 atmospheres elasticity, does not contain 10 measures of atmospheric steam, or what is the same thing, ten times as much water as is contained in an equal volume of atmospheric steam, is in my mind so fully established by what has been advanced in support of the previous propositions, that it would be wasting the time of this Institution to adduce further proof. In fact, all the questions are so intimately connected, and depend so much the one upon the other, that it is difficult to discuss or prove the one without demonstrating the other.

Who, may I be permitted to ask, can believe the phenomena of nature, and at the same time advocate the principle that high pressure steam worked expansively, is attended with a saving of fuel, as compared with the effect brought out by employing atmospheric steam as a first mover? In my mind, to apply high pressure steam expansively as a motive power, even when kept at its generating temperature, amounts to nothing more or less than gaining an advantage in order to abandon that advantage, and to produce a less effect than can be produced by going a less roundabout or circuitous way to work, and thereby subjected to all the evils consequent upon substituting complexity for simplicity, in addition to the extra capital invested, extra fuel expended, and extra labor and wear and tear of apparatus.

I had hoped the public hints that Mr. Woolf has received would have induced that gentleman, ere this, to correct the erroneous table he many years since promulgated relating to working high pressure steam expansively; the publishing of which has been productive of great evil to practical science; for in addition to Mr. Woolf' testimony of the validity of the theory then launched, may be adduced all those lecturers and authors who in their oral and written opinions do not throw out the least hint, much less attempt to prove the fallacy of the principle, viz., that steam of a given number of pounds elastic force, over and above the atmospheric pressure, when expanded as many times as it exceeds in pounds per square inch the atmospheric pressure, would, when so expanded, if maintained at the temperature at which it was generated, be equal in its elastic force to unexpanded atmospheric steam. The late Mr. Tredgold and Dr. Lardner, (and probably others who have not met my eye,) have exposed the fallacy of this table; and as their remarks are public property, it will redound very little to the credit of those lecturers and authors when made acquainted with the refutation, if they do not follow up the subject till the principle is exploded, as every theory ought to be that is contradicted by, or in opposition to nature's laws.

I exceedingly regret that Dr. Robinson, who was aware of the doctrine of latent heat as expounded by Black, should, (in his formula laid down under the article "Steam," in the Encyclopædia Britannica,) confound steam and permanent gases, by assigning a law to the former (steam) that was only applicable to atmospheric and other uncondensable gaseous matter; in doing which, that celebrated man lost sight of the fact that the sensible caloric becoming latent by dilatation could not be compensated for by saturating the expanded steam with the same number of degrees of sensible caloric. For instance, heat a given volume of atmospheric steam from 212° to 696°, when its elasticity will be about doubled, that is, it will maintain a pressure of about 15 lbs. over and above the atmospheric pressure; whereas steam generated at 696° temperature would give an elastic force equal to about 112 atmospheres, or multiplied into 14, equal 1568 lbs. pressure upon the square inch, by Tredgold's rule; thus then we are enabled to see and judge of the value between a given number of degrees of sensible caloric being applied to generate steam, containing its due proportion of water, and when the same amount of caloric is applied to expanded steam, necessarily deficient of that proportion of water due to its volume, and which alone can give the steam an equally effective elastic form, however, afterwards saturated with caloric.

It was a saying with our late worthy President, "Give me facts, for one fact is worth a thousand arguments." If the statements given to the public by the Cornish engineers, whose sincerity I cannot doubt, are correct, I dare not trust myself to call nature to account for the undue favoritism she confers upon our Cornish friends, by enabling them to perform results in Cornwall, that the London, Manchester and Birmingham engineers cannot approach; and I shall perhaps be excused from expressing my surprise that the question has not been long ago set at rest, by some one erecting in London or elsewhere an engine capable of raising 70,000,000 lbs.—I will not ask so great a favor as 120,000,000 lbs.—of water, one foot high, by the consumption of one bushel of coal. Let this be done, and I shall be the first to hail the result as one of the greatest achievements of man over matter, and give the Cornish engineers that meed of praise they would so richly deserve, whether for the benefits conferred upon science, or upon the manufactures and commerce at large.

Before I conclude this paper, it may be necessary to refer to the fact, that an engine working the steam full power the whole stroke of the piston is found to consume rather more than double the quantity of fuel such engine expends, when working her steam expansively, by cutting the supply off from the cylinder before the piston has completed its stroke; whereas the increase of the engine's power (say a double Watt engine, of 10 horse power) is only in the proportion of 10 to 14·6 horses. Now this difference refers to steam generated at an elasticity balancing a column of mercury 35 inches high, consequently little loss of power takes place on expanding such steam, by cutting it off when the piston has made about four-fifths of its stroke, provided it be maintained when so expanded at the same temperature as the steam in the boiler, because the steam's density is only diminished one-fifth; therefore, the loss of sensible caloric becoming latent by dilatation, and the loss of power consequent thereon, are very nearly compensated for, by the expansive or increased elasticity the expanded steam undergoes, by absorbing the second dose of sensible caloric; excepting, of course, the loss of nearly 3½ lbs. per square inch due to the deficiency of water in steam expanded to one-fifth its volume. This is not the case with steam generated at 40 lbs. or more upon the square inch when suffered to expand as in the Cornish engines, for the loss of elasticity or power is in a greater ratio than that of steam balancing a column of mercury 35 inches high, inasmuch as steam of greater elasticity contains a less proportion of water than steam of less elasticity, for the reasons previously explained.

The causes that may lead to the loss of fuel by working an engine at full stroke, instead of expansively, I will just refer to. One or more of these combined, (independently of the aforesaid cause, viz., sensible caloric becoming latent by dilatation) is quite sufficient to account for the extra quantity or loss of fuel expended, by letting the steam act full pressure during the full ascent or descent of the piston.

1st. The engine not having a constant maximum duty to perform.

2nd. A portion of the steam escaping between the piston and the cylinder.

3rd. The valves, slides, or cocks, may not be perfectly steam tight, in which case a loss of steam power or fuel is the consequence, and that in a greater ratio as the steam's density is increased.

4th. A portion of atmospheric air may enter the condenser independent of that held in solution by the water, and thus throw an additional duty upon the air pump and engine.

5th. Steam blowing from the safety valve when the engine's duty falls below its maximum.

Any of the aforesaid, in addition to bad stoking, by letting undecomposed atmospheric air carry off a portion of the caloric generated, or by a loss of fuel, arising from imperfect combustion of the fuel passing off in the shape of dense smoke at the chimney shaft, contribute more or less to destroy the economy of the engine.

I presume that none will be found to deny, that a constant given power multiplied into a given speed of the piston, will bring out a greater result than the same power multiplied into a lesser speed, which is the precise position in which unexpanded and expanded steam are to each other; in addition to which, must be added to the latter process, (the one universally adopted,) the loss consequent upon sensible caloric becoming latent by dilatation. The very fact of being able to work steam expansively, not only demonstrates that the engine is not working up to, or performing its maximum effective duty, but that the engine is contending with a fluctuating power or resistance, as is the case with the Cornish pumping engines, and are consequently working under disadvantageous circumstances.

If the evidence herein adduced tends to establish the fact that the atmospheric steam produced by one bushel of coal, applied as a motive power, without being permitted to dilate even in the absence of all friction, and when the barometrical pressure of the atmosphere is greater than what is generally witnessed, (namely, a column of water 35 feet in altitude,) can raise no more than 44,467,500 lbs. one foot high, how is it possible for high pressure steam when worked expansively to perform more duty than atmospheric steam, or be a more economical process, if we are assured that sensible caloric becomes latent by dilatation?—that the sum of the sensible and latent heats in steam of every elasticity is a constant unvarying quantity—that all matter, by undergoing change of density, either takes up or gives out caloric—that equal quantities of caloric convert equal quantities of water into steam, whether the steam generated be atmospheric or high pressure—that atmospheric steam expands no more than 1694 times the bulk of water from which it was generated when maintained at the generating temperature—that steam of double, treble, or more elasticities, does not contain double, treble, or the like quantities of water that is contained in an equal volume of atmospheric steam—and finally, that expanded steam, when saturated with the same amount of sensible caloric that it lost, (or that becomes latent by dilatation,) will never acquire the elastic force it possessed previous to dilatation. Admit all the foregoing phenomena to be in strict conformity with the laws of nature, and I cannot conceive it possible, but the conviction must follow, that working high pressure steam expansively is less economical than working atmospheric steam full pressure. Upon what principle, then, permit me to ask, can the Cornish engines perform so much more duty than all the other engines?—Strong, indeed, should be the evidence that ought to out-weigh or cancel the foregoing laws of nature, and induce this Institution to sanction statements of duty more than double that of the best Watt engine, and still more, surpassing the limits nature has assigned steam to perform, (under circumstances over which man has no control, the atmospheric pressure,) unless, as before premised, the Cornish engineers can convert with 7 lbs. of coal, more than 62½ lbs. of water from 40° F. to atmospheric steam; and unless highly elastic steam can be applied as a first mover without converting sensible into latent caloric.—*Trans. Inst. C. E.*

For the American Railroad Journal and Mechanics' Magazine.

HOGSHEAD CAR.

Gentlemen—I was attracted while travelling yesterday on the Charleston and Hamburg railroad, by a huge, or mamoth hogshead, flying with the speed of a locomotive, in company with the other freight cars, along the railway. Though 21 feet long, and 8 feet diameter at the bilge, and capable of transporting 29 bales of cotton, it had been facetiously called by the agents on the road, the "fifteen gallon keg." I conceived, at first, that it was a water cask, for the supply of the engine, in this season of drought, but soon discovered my mistake, in perceiving it freighted with 15,000 lbs. of coffee, and sundry boxes of dry goods. On examination, I found it was an experiment, suggested by Col. Gadsden, to test the superiority of the hogshead form for railroad cars; and that it had been so successful, that president Tupper contemplated substituting them for those of other construction, which had hitherto been in use.

You will readily estimate the improvement, when you are informed, that they are simpler, and cheaper of construction, much lighter in weight, requiring no protection from fire, as, from their rotundity, the cinders from the locomotive are shed as fast as they fall, that the pressure of lateral and opposing winds, is less, and that, most of all, they suffer but inconsiderably from the jarring effects of locomotion, and will admit of wheels of larger dimensions than those now in use. They will not only be more durable than the square frame cars, and thus diminish expense; but will more certaily resist the shock of collision or accident. Indeed, it is believed, that if properly constructed of good materials, the hogshead car may be thrown from the bed of the carriage on which it rests, freighted, and yet receive no injury.

You will readily perceive the great superiority of the hogshead car, and the above is communicated through your useful Journal, for the information of other companies who may be disposed to adopt or test it. Mr. Tupper has now under construction several of dimensions capable of transporting from 40 to 45 bales of cotton, and will soon experiment with one for passengers, which may be ornamented with a dome, or sky light at the bung. Every thing which will diminish expense, from the injury resulting from the jaring and rapid motion on a railroad, is considered an important desideratum gained, and little doubt is entertained that all who use the hogshead car, will acknowledge the great superiority in this respect.

A. B.

FOURTH ANNUAL REPORT OF THE CHARLESTOWN BRANCH RAILROAD COMPANY.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The directors of the Charlestown Branch Railroad Company do hereby respectfully make their fourth annual report of their acts and doings, receipts and expenditures, under their act of incorporation:

In the last report it was stated, that the road was completed from the junction of the Boston and Lowell railroad to Gray's wharf in Charlestown; since which a second track has been completed for a distance of about fourteen hundred feet from the easterly termination, and the road opened for transportation of merchandise.

The act passed at the last session of the Legislature, in relation to this company, has been accepted.

A contract has been made between this company and the Nashua and Lowell railroad company, for the use of this road, (a copy of which is herewith submitted,) and the said Nashua and Lowell railroad company commenced transporting merchandise under said contract of the first of June last.

By a statement of the treasurer, made up to the 1st inst. it appears that the receipts of the company the past year have been,—

From assessments,	$50,075 00

And the expenses for the past year, to same date, have been,—

For miscellaneous expenses,	$3,915 13
" damages for land taken,	19,730 90
" construction of road,	13,417 61
" expenses of road,	242 50
Total,	$37,306 14

In compliance with the sixth section of "an Act concerning railroad corporations," passed April 19th, 1837, the directors further report:

The total amount of capital paid in, is	$100,200 00
The total amount expended is as follows, viz:	
For construction of road,	$60,914 10
" land, and damages for land taken,	23,356 57
" miscellaneous expenses,	6,515 16
" expenses of road,	242 50
Total,	$91,028 33

The length of the road from the junction with the Boston and Lowell railroad to Grey's wharf, viz:

Embankment at westerly end of road, 15 feet wide on top,	1300 feet.
Bridge across the bay to Prison Point, 25 feet wide,	2460 "
From Prison Point to Gray's wharf, principally over land made on flats, (25 feet in width,)	3140 "
Total,	6900

The number of planes on the road are four—two are level, one has an inclination of $10\frac{43}{100}$ feet in a mile, and the other has an inclination of $14\frac{11}{100}$ feet in a mile.

The greatest curvature on the road is on a radius of 550 feet.

The rails are of the T pattern, and are secured to cedar sleepers, laid on a longitudinal sill of pine, 4 by 9 inches, the said sill resting on a bed of beach gravel.

All which is respectfully submitted,

Charles Thompson, T. C. Smith, Abijah Goodridge, Eben'r. Barker, *Directors.*

FOURTH ANNUAL REPORT OF THE EASTERN RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The Directors of the Eastern Railroad Company, respectfully make their fourth annual report.

During the past year the passenger trains have been run on the road between Salem and Boston, and with very few exceptions at the regular times and merchandise trains have been run daily, with few omissions since the first of February.

The construction of the road, bridges, etc., beyond the depot in Salem, has been steadily pursued, including some important structures, particularly the Tunnel under Court street, in Salem, of rising six hundred and fifty feet in length, with a walled excavation at each end of nearly six hundred and fifty feet in length in the whole, and a pile bridge of about eighteen hundred feet in length across the North River between Beverly and Salem about one thousand of which is of oak piling.

These structures have been wholly built and completed during the past season. The road, bed and bridges, including a bridge over Ipswich river has been completed, and the superstructure or railway laid as far as the depot, near the centre of the town of Ipswich, and on the 18th of December last, the road was opened for public traval, to that depot, a distance of about 25 miles from Boston.

An act was passed at the last session of the Legislature, authorising the construction by the company of a branch railroad, "from some conventien point in the city of Salem, to the town of Marblehead." In pursuance of this act, a branch railroad has been constructed and completed during the past season, and was opened for public travel on the 10th of December last.

This branch is nearly three miles in length, and in its course passes over Forest river, by pile bridge of about 350 feet in length.

The grading of the road beyond Ipswich, has been vigorously prosecuted during the past season, and it is expected that the part between Ipswich and Newburyport will be ready for the rails soon after the frost is out of the ground the ensuing spring, and that the iron, sleepers, sills, &c., for the superstructure, will be ready in season to enable the company to open the road for travel before summer.

Satisfactory arrangements have been made for the erection upon the site ofthe Newburyport bridge, of a structure which shall conveniently accommodate the carriage and foot travel passing the Merrimack at that place, and at the same time furnish a firm and durable bridge for the passage of the railroad. This structure is contracted for, and the materials are being collected with a view to its being built in the early part of next season. Beyond the Merrimack river, the grading, bridging, masonry, &c. of the road are contracted for, and in progress to the line of the State of New Hampshire, and the iron rails, sleepers, &c. for the superstructure, also ordered to be delivered in the spring.

At the line of the State, we are met by the Eastern railroad, in New Hampshire. This road has been located to the town of Portsmouth, and all the contracts made both for the road, bed, and superstructure, to be completed in time to be ready for public use before the close of the ensuing summer.

During the year, the number of passsengers transported over the whole or a part of the road, has been 298,813.

The treasurer's books and accounts have been examined, and as posted to the 31st December, it appears by them that the

Expenditures for the construction of the road for depot buildings, engines, cars, and all other expenditures of a permanent nature, up to that time, have been,		$1,306,196 89
And that the receipts have been as follows:		
From the sales of State scrip,		327,000
Leaving State scrip unsold,	$163,000	
From assessments,		879,436 07
		$1,206,436 07
The amount of net profits carried forward from the year 1838, as appears by our last report, is		$19,604 17

The books and accounts of the superintendent have been examined, and as posted to December 31st, it appears that the income arising from the business of the road, exclusive of the amounts reported last year, has been as follows:

Income from transportation of passengers, after deducting the amounts paid for ferriages at East Boston,	$113,068 63
From merchandise transportation,	7,375 67
From mail transportation,	1,310 50
From rents, interests, and other miscellaneous receipts,	3,868 35
	$125,623 15

And that the current expenses, arising from the business of the road, exclusive of the sums reported last year, have been as follows:

For repairs on the road,	$6,527 47
" of engines and cars, and work done in machine shop,	8,563 90
" fuel,	10,234 88

" wages of men, salaries and other expenses,	27,849 92
	$53,176 17

From the income of the road there has been paid,

Interest to the Commonwealth on loan,	$17,416 65
And dividends among the stockholders.	C0,772 00

All which is respecfully submitted

Geo. Peabody, *Pres't.*, Robt. G. Shaw, Sam'l. S. Lewis, B. T. Reed, Pyam Lovett, Isaiah Breed, Stephen A. Chase, Jno. Hooper, Francis J. Oliver, Amos Binney, *Directors.*

FOURTH ANNUAL REPORT OF THE NASHUA AND LOWELL RAILROAD CORPORATION.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The Directors of the Nashua and Lowell railroad corporation, hereby submit their fourth annual report of their acts and doings, receipts and expenditures, under their act of incorporation.

The total amount of capital stock paid in, is	$299,000 00

Besides 500 shares, (or $50,000,) pledged to the Commonwealth.

The receipts from the opening of the road, to November 20, 1839, (a part of which is included in our last report,) have been as follows:

From passengers,	$36,646 92
" freight,	18,198 74
" rents,	207 92
	$55,053 58

The expenses paid during the same period, exclusive of the amount charged to cost of road, is

For repairs of road,	$3,948 94	
" repairs of engines and cars,	2,273 64	
" fuel, oil, salaries and expenses,	22,435 85	
		$28,658 43
Leaving the balance of profits,		$26,395 15
Add balance of interest account, &c., from commencement,		1,227 58
		$27,622 73

Out of which the following dividends have been declared:

May 29, 1839, 3 per cent. on 2,505 shares,	$7,515 00	
Nov. 27, 1839 4 per cent. on 2,990 shares, payable Feb. 1, 1840,	11,960 00	
		$19,475 00
Leaving a balance to be carried to the general depreciation and contingency account, of		$8.147 73

Since the last annual report, in which an account was rendered in detail of the cost of the road up to that time, there has been paid towards the completion of it as follows:

For land, damages, and fencing,	$23.940 24
" superstructure and rails,	18,608 58
" grading, bridging and sleepers,	1,647 79
" depots and fixturers,	11,646 29
" engineering and expenses,	2,273 76
" engines and cars,	16,606 04
	$73,722 70

Amount expended on cost of road, at the time of the last annual report,	$279,939 44
Making total cost of road to Nov. 20, 1839,	$353,662 14

The amount due from the corporation, Nov. 20th, on loan account, was as follows:

For money borrowed on pledge of State scrip,	$49,000 00
" cash received from other loans,	2,931 74
	$51,931 74

It will appear by our last annual report, that we commenced carrying passengers October 8, 1838, and freight on the 23d of November of the same year.

At the last session of your honorable body, application was made by our corporation, to fix the rate of toll to be paid by us, for the transportation of our freight over the Boston and Lowell railroad. By an agreement of parties, however, the subject was referred to three gentlemen to fix the rate until altered by the parties, or the Legislature. They awarded, that the Boston and Lowell railroad corporation, should furnish moving power, and taansport our freight cars, in connexion with their own, over their road to and from the junction of the Charlestown branch railroad, and that we should pay them therefore, the sum of ninety-six cents per ton, or four cents per mile. This agreement took effect June 1, 1839, and under it, we have paid to the Boston and Lowell railroad corporation, up to November 20, 1839, the sum of $5,073 27. By agreement of parties, this award was to operate back to March 1, 1839 and the Boston and Lowell railroad corporation were to repay to us a part of the excess over the rate awarded which had been paid by us to them for freighting; and under this agreement, we received the sum of $1,745 98.

A contract was made by us, March 20, 1839 with the Charlestown branch railroad corporation, by which they were to furnish moving power for the transportation of our freight cars to and from the depot at Charlestown, over their road.

A contract of the same date, was also made with the Charlestown wharf company, by which said company were to erect for our accommodation, a freight depot in Charlestown, near the head of Warren bridge, furnish us with the use of certain wharves and lands, upon which rail tracks are laid so that freight can be easily taken directly from the vessel into the cars, thus effecting a great saving of expense. A copy of the contract with the said Charlestown branch railroad corporation is to be appended to this report. There was due under said contract, up to Jan. 1, 1840, the sum of $277 41. To the Charlestown wharf company, $613 03.

The whole length of the road, is $14\frac{1}{4}$ miles, $109\frac{3}{10}$ feet, of which 8 miles, $5036\frac{2}{10}$ feet lies in Massachusetts, and 5 miles 1673 feet in New Hampshire.

The number of planes in Massachusetts is 20, of which 7 are level.—The inclination of the others in feet per mile, is as follows; 1 of $4\frac{83}{100}$ ft.; 1 of 5 ft.; 1 of $9\frac{12}{100}$ ft.; 1 of $7\frac{45}{100}$ ft.; 1 of $6\frac{48}{100}$ ft.; 1 of $9\frac{78}{100}$ ft.; 1 of $5\frac{28}{100}$ ft.; 1 of $8\frac{44}{100}$ ft.; 1 of $7\frac{5}{100}$ ft.; 1 of $6\frac{68}{100}$ ft.; 1 of $9\frac{34}{100}$ ft.; 1 of $11\frac{27}{100}$ ft.; 1 of $13\frac{70}{100}$ ft.

The number of planes in New Hampshire is 9, of which 4 are level.—The inclination of the other 5, in feet per mile, is as follows; 1 of $11\frac{76}{100}$ ft.; 1 of $7\frac{19}{100}$ ft.; 1 of $5\frac{28}{100}$ ft.; 1 of $3\frac{49}{100}$ ft.; and 1 of $4\frac{29}{100}$ ft.

The changes from plane to plane, are made gradual by means of vertical curves.

The extent of inclined planes ascending from Lowell, is 36,850$\frac{25}{100}$ ft.
The extent of descending planes from do. is 14,283$\frac{60}{100}$ "

The track at the depot at Nashua, is 34$\frac{24}{100}$ feet higher than the track at the junction with the Boston and Lowell railroad.

Curvature.—The radii of the curves in Massachusetts, vary in length from 1,050 to 10,000 feet. The greatest curve is at Lowell.

The radii of the curves in New Hampshire vary from 900 to 6,000 feet; the greatest curve being near the depot at Nashua.

Rails.—Edge rails of the T pattern are used, weighing about 57 lbs. per yard, supported by chestnut sleepers 7 feet long, and about 7 inches in diameter, at the mean distance of 3 feet apart from centre to centre. The sleepers rest on longitudinal sills of chestnut plank, about 3 inches by 8, with a short piece under the junction of these planks, and an additional one under the sleepers, which support the ends of the rails.

Grade.—The width of the embankments at top, is 15 feet; the width of the excavations at bottom, from 21 to 30 feet. And the bridge foundations, which are of stone, are generally of sufficient width for 2 tracks.

NASHUA, *November* 20, 1839—being the time to which the accounts were made up. Signed, *January,* 1840

Dan'l. Abbot, C. H. Atherton, Jesse Bowers, Joseph Greely, *Directors.*

FIRST ANNUAL REPORT OF THE NEW BEDFORD AND TAUNTON RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directors of the New Bedford and Taunton railroad corporation do hereby make their first report of their acts and doings, receipts and expenditures, under their act of incorporation, to the 7th of January, 1840 inclusive.

The first meeting of the stockholders was held on the 6th day of Feb. last, when the corporation was organized by the election of seven directors the act of incorporation was accepted, and by-laws adopted. At a meeting of the stockholders held on the 26th day of Oct. last, the act amending the charter, approved March 26th, 1839, was accepted.

The amount received for assesments on 2991 shares, is		$155,353 00	
Received for $50,000 scrip of the State, pledged for a loan,		48,000 00	
		———	$203,353 00
Paid for preliminary surveys,		3,673 37	
" engineering, including instruments,		7,874 42	
" land, damages and fencing,		37,613 05	
" graduation and masonry,	$60,470 68		
" clearing and grubing,	8,308 00		
" bridging,	3,000 00		
	———	71,778 68	
" lumber and preparing same,		16,587 81	
" transporting lumber,		1,000 00	
" on account railroad iron,		7,210 33	
" " cast iron chairs,		2,000 50	
" miscellaneous expenses,		3,301 76	
		———	$151,039 42

The work on the road commenced in May last, and we expect to get it completed so as to open it for use in the course of next summer.

All which is respectfully submitted.

P. G. Seabury, Joseph Grinnell, Thos. Mandell, Wm. W. Swain, Alfred Gibbs, David R. Greene.

FOURTH ANNUAL REPORT OF THE NORWICH AND WORCESTER RAILROAD COMPANY.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts, now in session:

The directors of the Norwich and Worcester railroad company, in presenting, in obedience to the laws of the State, their fourth annual report, deem it proper, in the present state of the road, and in view of the relations of the company to the State, to present somewhat at length a statement of facts in relation to the road.

The masonry, grading and bridges, of the entire railroad, from the freight depot at Norwich to the depot at Worcester are finished, and the superstructure is laid throughout the entire distance, with the exception of one mile on which the iron rails have not been laid, owing to the severe and repeated storms of snow which have prevailed during the winter.

The length of the railroad is 58 9-10 miles. The greatest inclination per mile is 20 feet, and for fifty two continuous miles, descending toward Norwich, the road is either level or descending the whole distance, there being no ascending grade.

The materials of the road bed are principally gravel. The masonry is throughout of the best materials and exceedingly durable and highly finished.

Although the company have encountered considerable expenses in order to avoid any grades exceeding 20 feet to the mile, and to obviate objectionable curves, the entire expense for masonry, grading and bridges including a tunnel through a solid rock has been but $9000 per mile.

In the superstructure, the company have sought to avail themselves of the experience of other railroads, and to render it in every respect permanent—the rail selected is of the heaviest kind, being 56 lbs. to the yard, and having also the unusual advantage of being in bars of 18 feet in length—although the adoption of so heavy a rail involved a very greatly increased expense—yet the advantages of superior safety, diminished annual repairs, and permanent economy, induced the company to encounter that expense, even in a time of very great pecuniary pressure.

There are eleven depots besides those at Norwich and Worcester, and the depot buildings, at most of these, are either built or in the course of construction. Although this is a large number, the accommodation of the manufacturing and other villages on the route would not allow the omission of any, and there are still other villages desirous of a similar accommodation, which the company are under the necessity of declining. The depots of Norwich and Worcester are very advantageously situated, and the directors have deemed it important at both places to secure, although at considerable expense, a sufficient quantity of land to transact the extensive business which they anticipate. The connexion with the Boston and Worcester railroad at Worcester is complete, and advantageous to both railroads—and it has been deemed expedient to erect the passenger house and engine house, for both railroads, at Worcester, to be used and occupied in common, by both railroads; and the arrangement is such, that the same cars for freight, and as far as is desirable, for passengers, pass without change or transhipment for the whole distance between Norwich and Boston.

At Norwich, the arrangements are in progress, and will be completed early in the spring, by which passengers will be enabled to take the railroad cars at the steamboat wharf, and the baggage car will be transported from Boston to New York unopened, except at the two cities. The only power used is by locomotive steam engines—the great expense of horse power being entirely avoided.

The board have directed contracts to be made for furnishing nineteen eight-wheeled passenger cars, to be constructed by experienced builders, at Cambridge Port and Worcester, designed to accommodate very conveniently, forty-eight persons each, in addition to cars for second class passengers. They have also contracted with the same builders for a large number of freight cars.

The company have purchased four locomotive steam engines, and made contracts for four more, to be delivered on or before the middle of March next.

Arrangements have been entered into for the formation of a steamboat line, between New York and Norwich, in connection with the railroad, which will insure the placing on the line, suitable and convenient steamboats.

It is the design of the company, in connection with the Boston and Worcester railroad, to run a line of cars to and from the steamboat, stopping on either railroad only sufficiently often to supply the engines with wood and water, and to leave Norwich immediately on the arrival of the steamboat. In order to accommodate passengers desirous to stop at intermediate points, an accommodation train of cars will leave Norwich every morning at a fixed hour, and another train will leave Worcester in the afternoon, in advance of the steamboat train, which will receive passengers at all the depots.

In addition to the steamboat train and the accommodation train, both from Norwich and Worcester every morning and evening, it is the design of the company, provided a steamboat shall be placed on the route between Norwich and New Haven, as is now proposed by some individuals, to run an additional train of cars to and from Worcester, in such a manner as to form a daily line each way, by daylight, between Boston and New Haven.

If this arrangement should be perfected, there will be four passenger trains and one merchandise train, each way, over the road every day, except Sundays, on which day it is not expected that any train shall pass over the railroad.

By the steamboat train, the travel between Boston and New York, also to and from Worcester, and the country north, will be specially accommodated.

As to the amount of this business it is of course a matter of estimate; but as the route is exceedingly pleasant, expeditious, and every way desirable, and the charge for passengers will be moderate, there seems to be no reason why this route should not receive at least an equal share of the Boston and New York travel with any other route between these two cities. The distance over both railroads, from Boston via Worcester to Norwich, is 103½ miles, and thence by steamboat to New York, 130 miles; and the time required for the entire distance will not exceed, in favorable circumstances, fifteen hours.

In order to justify themselves to the stockholders of the company, and to the Commonwealth of Massachusetts, to whom the company are so much indebted for so extensive arrangements for business, the directors would present a few facts showing the extent of the business which will be accommodated by this railroad.

The road passes directly through and near a large number of manufacturing villages, there being within five miles of the road, 75 cotton mills and 27 woollen mills, exclusive of Norwich and Worcester.

The cotton mills in New London and Windham counties embrace more than three-fourths of all the cotton manufacture of the State, as shown by official returns.

In Worcester county there are 74 cotton mills, containing 124,000 spindles, manufacturing cotton goods of the value of $1,991,024—and 66 woollen mills, manufacturing 3,748,852 lbs. of wool into cloth, of the value of $3,695,321—452,310 pairs of boots, and 2,357,431 pairs of shoes, of the value of $2,791,298—147,240 hides, of the value of $387,038—129,710 axes, $119,825—chairs and cabinet furniture, $321,100—straw bonnets, $118,971—palm leaf hats, $411,554. Total value of aticles manufactured in Worcester county, more than $12,000,000.

The manufacturers in that county, of cotton, wool, hides, paper, iron castings, scythes, axes, cutlery, chairs and cabinet furniture, combs, ploughs tin ware and tanneries, number 456.

Amount of sperm oil consumed in woollen mills, 61,329 gallons.

The whole amount of manufactures in that county being, in one year, more than $12,000,000. The statistics, in detail, of the towns in Connecticut, cannot be accurately ascertained, but it is believed that a similar examination in New London and Windham counties, would show a similar result.

In the collection district of New London, which embraces the town of Norwich, there were, Dec. 31, 1838, three hundred and thirty-nine vessels, of 28,108$\frac{32}{95}$ tonnage, of the value of $1,250,000. The extent of intercourse between such a section of county and the cities of Boston and New York, fully justify the belief, that there will be a large amount of business in the transportation of passengers and goods to and from those cities — And the experience of all other avenues of travel and transport would indicate still larger returns from the border and local business.

The union with the Western railroad at Worcester, will be highly advantageous to both railroads.

This road will, in connection with the steamboats, furnish a cheap, expeditious, and desirable route to and from New York, for a large portion of the inhabitants of New Hampshire, and a part of Vermont.

In addition to its furnishing, in connection with the Boston and Worcester railroad and steamboats from Norwich, as desirable a route as any other between Boston and New York for passengers, it will it is supposed be entitled to receive a portion of the business connected with the transportation of goods between these two cities.

There will be no transhipment of the goods except at Norwich where it can be made with the greatest ease, and without truckage.

The navigation of the Thames and Long Island Sound, to New York, is unusually safe, so much so that the most prudent persons effect no insurance. And it is believed, that with perhaps one exception, there has been no loss of goods for thirty years, in the regular packets between Norwich and New York, which, if all insured, an insurance company would have been obliged to pay.

The charge for passengers between Norwich and Worcester, is fixed at $2—and the charge per ton for merchandise generally, from Norwich to Worcester, is $3.50, and from Worcester to Norwich, $3.

The charge for passengers between Boston and Norwich, is, by agreement of both corporations, fixed at $3—and the charge by steamboat, by the existing arrangement, which it is supposed will continue to New York, is $2—making the passenger fare between Boston and New York, $5.

The charge for merchandise generally, over both railroads, from Boston to Norwich, will be $5 per ton.

It will be perceived that the foregoing rates of charge are unusually low and the directors have deemed for the interest of the stockholders, as well as for the public, that they should be so.

The accounts of the company have been duly examined by the commissioners appointed under the charters.

By the books of the treasurer, it appears that the amount of funds received into the treasury of the company, from all sources, to the 31st December, 1839, is $1,360,600, and the expenditures to the same time, to the sum of $1,360,527 27. A statement showing the amount of the expenditures under the different heads, is contained in the report of the commissioners, which is appended to this report, and constitutes a part of it.

By the foregoing statements, it is hoped it will be apparent that the public, as well as the stockholders of the company, well be benefited by the opening of this railroad. If the success should attend it which is now promised and expected, the directors will feel themselves fully repaid for a large amount of gratuitous labor in the service of the company.

No motive has operated more strongly upon the minds of the directors, amid the most serious discouragements and obstacles, than to fulfil, in behalf of the company, the engagements which were made to the Commonwealth of Massachusetts, when her Legislature furnished the timely and essential aid of her credit for the sum of $400,000. These engagements we now believe are fulfiled. The road is substantially finished, in many respects in a better manner, in no respect inferior, to what was then promised, and for comparatively a very moderate cost.

It is the design of the company, at the same time that they do what is necessary for the preservation of the road, and the advantageous and convenient use of it, to practise the utmost frugality in relation to the expenses of the company.

All which is respectfully submitted.

John A. Rockwell, John Breed, Russell Hubbard, Ralph Bolles, Jedediah Huntington, Thos. Robinson, *Directors.*

FIFTH ANNUAL REPORT OF THE TAUNTON BRANCH RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directors of the Taunton branch railroad corporation, do hereby make the fifth annual report of their acts and doings, receipts and expenditures.

On November 1, 1839, a contract was entered into between this corporation and the New Bedford and Taunton railroad corporation, a copy of which is hereto annexed, and made part of this report.

The total amount of capital paid in, is	$250,000 00

The Expenditures during the year ending November 30, 1839, have been as follows:

Amount of repairs on the railroad,	$1,397 14
Expenses incurred in improving the railroad and the depot at Taunton,	4,164 83
Amount of repairs on the engines and cars,	3,151 99
Miscellaneous expenses, including the amount paid to the Boston and Providence railroad corporation for their pro-	

portion of the receipts,	30,630 69
Expenses incurred in the construction of the road,	1,367 13
Total amount of expenditures,	$40,711 78

The receipts during the year ending November 30, 1839, have been as follows:

Amount received for the transportation of passengers,	$40,910 73
" " " " merchandise,	15,895 10
Amount of other miscellaneous receipts,	1,212 95
Total amount of receipts,	$58,018 78

Two dividends of three per cent. each have been made, payable on July 1, 1839, and January 1, 1840, respectively, amounting in the aggregate to the sum of $15,000 00

All which is respectfully submitted,

Thomas B. Wales, Samuel Frothingham, Samuel Quincy, William A. Crocker, *Directors.*

FOURTH ANNUAL REPORT OF THE WESTERN RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

On the 1st day of January, 1839, under which date our third annual report was submitted, the grading of the road, eastward of Connecticut river, was nearly completed—the bridges were in construction,—the iron and timber for the superstructure were purchased,—six miles of the track were laid down,—the engines and cars were under contract,—the depot lands were secured,—and the damages for land and fencing were liquidated and principally paid. The directors at that time expressed an opinion, that the road-bed would be ready for the rails by May succeeding, and that if no unforseen obstacle interposed, the whole of this part of the line would be in successful operation by the first of October last.

This anticipation was realized. The grading, masonry, bridging, superstructure and depot buildings were sufficiently completed, the engines and cars were delivered, and the road opened for the conveyance of passengers, on the first day of October, and it has continued in operation to the present time.

Regular merchandise trains were established on the 23d October, and they have been continued to this date.

Throughout the greater part of the road, it is graded for a single track only; and but one track has been laid down, with the exception of the necessary turn-outs at the nine stations. The engineers, at an early period, recommended the grading of the entire line for a double track. But under the uncertainty then existing, of procuring funds for the completion of the whole road, the directors, upon full consideration, deemed it prudent to order the grading generally for one track; at the same time giving the engineers "discretionary power, as to the cuts, embankments, and bridges, to make them of such width and construction, as should best subserve the interests of the corporation and the public, taking into account the contingency of a double track hereafter."

Under this authority, the deep cuts, the heavy embankments, and the masonry and bridges have been constructed of the full width for a double track.

The exact length of the line, from the junction with the Boston and Worcester road, to the east bank of the Connecticut river, is fifty-four miles

184 rods. The intermediate distances are given in a table hereto annexed.

In the construction of this part of the road, the directors have endeavored to make a permanent and substantial structure. Great pains have been taken to remove from the road-bed, all materials which would be seriously affected by frost, and to supply their place with gravel or sand. The superstructure is of the most substantial character; and the masonry will not suffer in comparison with that of any other road in the country. In the erection of depot buildings, and the construction of cars and engines, the board have consulted usefulness, convenience and durability, with little regard to ornament or show. And with the short experience which they have had, the undersigned are satisfied, that these objects have all been accomplished; and they are happy to congratulate the stockholders and the community upon the successful result of their labors thus far.

Although the road was sufficiently completed to be open for use on the 1st day of October last, many parts of it were so unfinished as to require some force to be kept upon the *construction* nearly to the present time; and it is not now found practicable to state the exact cost of this portion of the line. This will be presented in a future report, together with such other information as is required by law.

The accounts for these expenditures are, however, principally liquidated and paid. And it is believed, that an estimate, generally correct, may now be made, of such claims as are yet out-standing. Upon this basis, the following will be found to be a nearly correct statement of the cost of the road east of the river. But it must be borne in mind, that these items may be varied when the final statement is given.

Graduation, masonry, bridging and superstructure, for main track,	54 m. 3036 ft.	
Turn-out and depot, do.	2 1310 ft.	
	or 56 ms.	$1,633,122 60
Engineer department, surveys, instruments, etc., for four years,		64,618 93
8 engines, 5 long passenger cars, 10 short do., 2 forward do., 3 baggage do., 50 merchandise do. 40 gravel do. and 3 hand do.,		100,004 83
Depot buildings for nine stations, furniture, aqueducts wells, machine shop, &c.,		54.412 18
Land damages and fencing,		89,037 47
Depot lands at 9 stations, about 18 acres,		6,038 43
Miscellaneous expenses, including salaries, printing, stationary, office rents and expenses, clerk hire, collecting assessments, postages, &c.,		25,251 53
Total east of river,		$1,972,985 97
Being about $36,135 per mile.		
The estimate for this part of the road, made in December, 1838, was		$1,864,729 12
Surplus cost above estimates,		108,256 85

This excess above the estimates, being a little less than six per cent., is not caused by the extra cost of the items *actually estimated;* for, except in one or two cases of small amount, these in fact, have not cost more than was anticipated. But the principal difference arises, in the *first* place, from the fact, that at the time the estimates were made, the work of graduation was in progress, and the cuts were in a rough s ate, and could not be measured with any great degree of accuracy. The quantities returned as excavated, were deduced in most cases, from the previous monthly estimates, and the estimates were put upon it according to those results. Since it has been completed, it has all been re-measured for the final settlements, and it is now ascertained that the quantity of materials excavated, much exceeds that actually estimated.

In the *next* place, as the work has advanced, it has been found necessary and economical, in order to accommodate the business of the road, to procure larger quantities of many articles for i's equipment than were supposed necessary; to increase the number and size of the buildings at the depots, to add to them expensive aqueducts and fixtures, and to enlarge some of the bridges. The length of the track, including turnout and depot tracks proves also to be about eight-tenths of a mile more than was estimated for —the wheels and springs of the cars are more substantial and expensive than was originally intended and in one or two cases, the cost of grading a section has been necessarily enhanced in consequence of the failure of the contractor, and his inability to finish his work.

The following is a statement of the principal items of cost not estimated, viz:—

Excess of excavation above estimates—addition to bridges —increased length of track, and improved switches, and extra cost of finishing a small part of the grading,	$80,766 13
Additional number of cars, and improved wheels for the whole,	12,946 67
Increased number and size of buildings, and addition of aqueducts and fixtures,	11,500 00
Additional quantity of land purchased for the depots since the estimates,	2,638 43
Total,	$107,851 23

And in view of these expenditures, it should, be borne in mind, that the depot arrangements at Springfield are designed, and are on a sufficiently extensive scale, to afford the necessary accommodation for the business of the road west of the river. The same remark applies to the machine shop tools and fixtures, and in part also to the engines and cars already provided.

The whole of the expensive depot arrangements at Springfield, will be as necessary to the western as to the eastern portion of the road and, the cost of them ought in fact to be apportioned upon both sections of the line equally.

At the date of the last report to the Legislature, the whole line of the road *westward of Connecticut river*, a distance of 62·6 miles, had been definitely located, with the exception of a few miles in Westfield and the south part of Russel—about 34½ miles of the western part of it had been under contract for grading from March, 1838, and excepting ten miles immediately east of Pittsfield, the work had been commenced in June and July succeeding, and was then in successful progress.

In March, 1839, the board, after a full and personal examination by a committee, directed the definite location of the road through Westfield and the south part of Russell, to be made entirely upon the northerly side of the Westfield great river, and as near the village of Westfield as was practicable without two crossings of the river.

Early in the last season, the grading was commenced upon the 10 miles east of Pittsfield, and upon this, as well as upon the residue of the 34½ miles between Henry's and the State line, the work has been vigorously prosecuted to the present time.

The 28 miles between Connecticut River and Henry's in Chester, were put under contract for grading in April last, and as soon as was practicable after the passage of the act of the last Legislature; the contractors engaging to complete the grading and masonry by the first of July, 1840.

Upon the greater portion of this part of the line, the work was commenced in July succeeding, and the whole is now in progress. It is confidently believed, that the graduation and masonry will be finished in season for laying down the rails in the course of the present year.

Preparations are also making for materials for the bridge across the Connecticut at Springfield; the lumber having already been contracted for. And the directors hope to finish the same, and to lay down the track for at least 20 miles westward of it, and open the same for use during the year.

The graduation west of Pittsfield is nearly completed, with the exception of two sections. The cuts upon each of these proved to be much more difficult than was anticipated. The contractors have been always impeded by water, and in the winter months, by the constant freezing and thawing of the materials. On one of these sections the principal work, was entirely suspended during last winter from this cause. Upon another, the embankment has for a long distance settled from 40 to 45 feet below the natural surface of the meadow. And upon these, as well as some others in the vicinity the work has been entirely interrupted by the recent snows;—the contractors having been obliged to employ their whole forces, in some instances, for two or three weeks in removing the same.

This part of the road, however, being 11½ miles, will be graded, the superstructure put upon it, and the whole opened to the public in the autumn of 1840.

The undersigned anticipate, also, that a further portion of 10 miles of the road, east of Pittsfield, and extending eastward to the summit division, will be graded by the 1st of August next, with the exception of two sections in Hinsdale and Dalton. The contracts for these require them to be completed by the 1st of October, and they are already in a good state of forwardness.

The remaining *Summit Division* of about 13 miles, extends from Henry's in Chester, through the *gorge* of the mountain, and over the summit in Washington, to the Hinsdale Meadows, embracing the whole range of the mountain pass. This is by far the most difficult and expensive work upon the whole line. And such have been the obstacles interposed by nature to our progress, that it may not be amiss to advert, briefly, to the extent and character of this part of the work.

The west branch of the Westfield river, or the Pontoosuc, as it is now called, winds its way from the summit, by a rapid descent, down a narrow defile of the mountains, pursuing a very circuitous route,—frequently turning the point of an abrupt rocky spur, only to be again thrown out of its course, by a similar spur upon the opposite bank, which, in turn, it is obliged to double by curving suddenly in another direction. The road follows up the general course of this stream to the summit. And in order to avoid excessive curvature, and to maintain uniform grades by a continuous ascent, the line of it necessarily crosses these spurs, successively. It passes them by heavy rock excavations, spanning the stream, often obliquely, and in some cases, at a height of 60 and 70 feet above the water, and with very heavy and expensive masonry.

Within the 13 miles, the river is passed by 21 bridges, 9 of which are stone arches, and 3 of these are of 60, and 5 of them of 45 feet span; and they sustain embankments, severally, of 40, 37, 52, 62, 70, 60, 42 and 31 feet above the water. Many of these require also heavy bank or river walls, some of which are 60 and 70 feet in height. The embankments must, of course, in many instances, await the completion of the bridges and walls. The masonry has been pushed vigorously, and as much of it is in progress as can well be carried on at one time. On the 1st of December last, 15,300 perches of it, (of 25 feet,) were finished, and 37,500 were yet to be built; 25,000 of which, however, are bank walls; of earth 136,000 cubic yards, and 86,000 of rock, had been excavated, and 304,000 yards of earth, and 97,000 of rock, remained to be taken out.

The *Summit ridge* is passed by a thorough cut above 2,600 feet long, and its deepest point 52½ feet. About 57,000 cubic yards of this is estimated to be rock, and much of it is of the hardest kind. The whole material of the cut should come out in one direction, in order to form the large embankment east of it; and while the rock continues, but comparatively a small force can be employed upon it.

The grade immediately east of the summit is at the rate of 77.6 feet per mile; and still farther east it is 79·9 feet for two miles. At the summit, the road bed is 1378 feet above the Springfield depot, and about 1440 feet above tide water at Boston.

From present appearances, these summit sections will be the last work finished upon the line. In our report of last year it was stated, that in the condition in which it then was, no definite opinion could be formed, as to the time when it would be completed, and that this point could not reasonably be ascertained, before late in the year 1839, when the character of this rock cutting might be more clearly developed. The work is now so far advanced, as to justify an op inion, that the grading and masonry of this *whole division* may be finished in season for laying down the superstructure during the year 1841.

The parts of the road west of the river, already graded at different intervals, are as follows:

Between Springfield and Henry's in Chester,	5th Div.	4·5	miles
do. do. do. do.	6th "	4·8	"
On the summit division, or	7th "	8·4	"
On the 8th division, east of Pittsfield,		5·72	"
do. do. west of do. to State line,		9·68	"
Total, graded Dec. 1, 1839,		33·1	"
Leaving to be graded about		29·5	"

From this view, it will be seen, that of the 62·6 miles of the road west of Connecticut river, if no unexpected obstacle interposes, about 50 miles may be graded and ready for the superstructure during the present year, viz., 21½ miles at the westerly end, 28½ miles at the easterly end, that by the same time the superstructure may be placed upon at least 11½ miles of the westerly part, and 20 or more miles of the easterly part, and the same be opened for use, that in the spring of 1841, the rails may be laid upon all the residue, excepting some 10 miles of the summit division; which may be completed in all that year.

Of the *Iron* for the superstructure, 3.500 tons have been purchased;—about 2,000 tons of it have arrived, and the ballance for the whole line having been ordered to be purchased, will be forthcoming, as the work may require it.

(To be continued.)

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 8, Vol. IV. New Series. | APRIL 15, 1840. | Whole No. 356. Vol. X.

ERRATA.

In the number of the Journal for March 1, article on "Atmospheric resistance to locomotion on railroads, etc.," page 139, 17th line, for "palaces now flying," read, *palaces now plying.* Page 141, 4th line, for "Nos. 288 to 291 and 288," read *Nos.* 285, *to* 291 *and* 288.

Last No. of the Journal, article on "Theory of the crank," page 205, 30th line, for "contrary varying motion," read *continually* varying motion.

CIRCULAR.

Addressed to the Engineers in the vicinity of, or resident in the city of New York—also to those in the habit of visiting New York, from time to time.

New York, April 15, 1840.

At the solicitation of several professional gentlemen I have been induced to establish a *Reading Room* and *Exchange* for Civil Engineers. It is well known that, while every other profession has some one place, at least, in this city, for occasional meeting, and as a resort open to them at all times, Civil Engineers have hitherto been without this convenience. It is proposed to furnish the reading room with the various domestic and foreign scientific periodicals relating to the profession and also with papers from various parts of the Union.

To increase the usefulness of such an establishment, the valuable collection of reports, documents, etc., belonging to the office of the *American Railroad Journal,* will be placed in the Reading Room, as also some of the most important professional treatises. It is understood that several gentlemen are willing to deposite various works for the benefit of the establishment.

The number of Civil Engineers at any one time in the city, is much greater than is generally imagined, as the subscriber has often had occasion to remark. By the method proposed, these gentlemen would have frequent and easy intercommunication, and as Civil Engineers, from all parts of the Union, are frequently in the habit of visiting the city,it is conceived that, by the plan proposed, the interests of the profession would be in no slight degree advanced.

The Reading Room will be attached to the office of the American Railroad Journal, and I pledge myself, in conjunction with Mr. ***Egbert Hedge,*** joint proprietor in that paper, to offer every facility in our power to accommodate gentlemen resorting thereto.

Those gentlemen who choose so to do, can have boxes provided for the reception of letters and other communications; and strangers or visiters can have an arrangement made whereby all letters and papers addressed to them, while in the city, can be taken charge of.

It is proposed to open the Reading Room on the first of May next.

Your co-operation and that of your friends is respectfully solicited.

Your obedient servant,

George C. Schaeffer,

Editor American Railroad Journal.

SEASONING TIMBER.

Some time since we received the following note, which should have received attention in an earlier number. Circumstances have prevented us from taking it up until now, and as there are two totally distinct questions, we purpose to consider at present only the first, in the meanwhile soliciting communications on the subject from our readers.

Mr. Editor—Will you, or one of your readers, oblige me by an answer to these questions?

1. In what does the process called "*seasoning*" of wood consist? Is it in merely drying up the sap and evaporating the water contained in it? If so, can this be as well done by the heat of an oven or furnace, in a short time, as by exposure to the sun and air for a long time?

2. What is the Dutch mode of making the little yellow bricks of which the oldest houses of our city are composed? Is their color owing to the kind of clay used—the mode of burning them—or to both? Are they very much compressed in making, or to what cause is owing their great hardness and durability? Can bricks of such quality be made in this country, and what place furnishes clay of proper quality?

I make these inquiries partly for obtaining information for my own use; and partly in the hope that they may lead others to think of the superiority of the Dutch brick, both as a matter of taste, as regards color, and of durability, (of both of which, I think, there is little room to doubt,) and thus promote the adoption of them in place of the crumbling, staring red bricks of which our cities are so generally built; and the chief qualities of which are, hardness to the eye, and softness under the mellowing hand of time.

Yours, D*** F*****.

The process called "*seasoning*" is a twofold operation depending upon the constitution of living wood. In general terms, the wood of a tree contains fibrous matter, arranged in the form of minute vessels containing the sap. This sap is chiefly water, but contains besides a variety of soluble salts and organic matter. Wood taken in this, its *green* state, gradually contracts in bulk, and is, therefore, unfit to be used in any permanent construction. The watery particles may be expelled, or the wood dried by heat—and green wood baked in an oven is no longer liable to alter in dimensions; but a more serious evil is then met with. Wood when suddenly dried is cleft or "checked" so much, that in some kinds of timber, its parts may be pulled assunder as easily as if cleft by a wedge. The process must therefore, be gradual, so that the particles may have time, slowly to arrange themselves in a new order, which if suddenly assumed, would tear them from each other. This operation requires time, and hence we suppose the word "seasoning."

The work of Duhamel, "*Sur l'Exploitation des Bois*," contains many excellent experiments and practical observations on this subject, a few of them with some additional information, may be found in "Barlow on the strength of materials."

Duhamel gives an illustration of this process in the preparing of pottery ware for the oven. Vessels of any form, but more particularly solid cylinders, require a very gradual drying or they fall to pieces. The potters to avoid this, expose them in a cool situation, out of the sun for many days, and as the moisture very gradually flies off, the still soft clay has time to re-arrange itself without splitting. Now in wood the matter is less homogenous than in potters clay—and the density of the external and internal portions are never the same. Experiment proved that by delaying in a similar manner the drying of timber the danger of checking was greatly decreased. It was also found, as might be predicted, that when the wood was reduced while green, to a size near that intended for use, the liability to crack was removed, while a thorough seasoning took place in rather less time than when left in the original form.

As a general rule, Duhamel states that *timber* grown in a rather dry soil is denser, harder, and stronger than that grown in a damp or marshy soil. Barlow also says that "generally in a sound tree the density is found to decrease from the butt upwards, and from the centre to the circumference. He likewise gives a table showing the difference in the loss of weight by drying, in their different portions. It follows from this, that a different period of time is necessary in seasoning different woods, or even different parts of the same tree.

Barlow has a very interesting table of some experiments on the seasoning of English oak. Eight pieces of various size were cut from the tree and exposed on the beams of a smith's shop to a dry, but not warm air.—They were weighed at the commencement of the experiment, and afterwards at intervals for five years and a half.

The total weight at the commencement was $972\frac{1}{4}$ lbs., at the end $630\frac{1}{2}$

lbs., being a loss of 341¾ lbs., or more than one-third in seasoning, Nearly all of this decrease took place within two years and a half. A remarkable fact is to be noted in this experiment, viz., that the wood again increased in weight when a rain even of two days occurred immediately before the monthly time of weighing. It may hence be assumed that damp or rainy weather may retard the seasoning of timber, and even cause it to retrograde.

The remains of the sap being conceived to operate against the durability of timber, various processes have been devised to assist in removing the organic matter originally held in solution in the sap, and also to expedite if possible the seasoning. Barlow has a paragraph on the subject so much to the purpose that we give it entire.

"The process of seasoning may be facilitated by boiling, steaming, &c., as appears from the following experiments of Mr. Hookey. The three pieces marked Nos. 1, 2, and 3, were English oak, each four feet long, and three inches square; all cut from the same timber. No. 1 was placed in the steam kiln for twelve hours, No. 2 was boiled for the same time in fresh water, and No. 3 was left in its natural state. The weights of the three pieces, previous to the experiment, and at the end of each month for half a year afterwards, were as stated below.

Times of Weighing.	No. 1. Steamed.		No. 2. Boiled.		No. 3. Natural State.	
	Weight.		Weight.		Weight.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.
Previous to the experiment,	16	12½	16	15	16	14
After do.	16	6	16	14	16	14
June,	15	1	15	10	16	5
July,	14	2	14	12	15	14
August,	13	13	14	0	15	5
September,	12	10	13	6	15	0
October,	12	5	12	10	14	12
November,	11	10	12	5	14	8

"Each of the pieces was placed in the same place, in the open air, and in the same position, (i. e. vertically,) after the experiment, and were continued so during the six months that their weights were taken.

"From the above, it appears that the process of seasoning went on more rapidly in the piece that was steamed than in that which was boiled; but that in the latter, the process was carried on much quicker than in the piece which was left in its natural state:

The first had its specific gravity reduced from 1050 to 744.
The second from 1084 to 788.
And the third from 1080 to 928.

"We must look to the philosopher for a satisfactory solution of the problem presented in these results. Mr. Hookey* accounts for the facts by supposing, that the process of boiling or steaming dissolvs the *pithy* substance contained in the air tubes, by which means the latter fluid circulates more freely, and that the seasoning thereby proceeds with greater rapidity."

But these are not the only means of facilitating the seasoning of timber. In a process for preserving timber which we have several times noticed, (and of which an advertisement may be seen on our cover,) the wood is subjected to such a heat as fills all the vessels with steam, and on its immersion into a cold solution of a peculiar resinous compound, the steam is condensed and the antiseptic compound forced quite through the stick.

It is manifest, that by this, or any analogous process, the sap is deprived of all power of injuring the quality of the wood—while the greenest timber is immediately seasoned, for all moisture is expelled, and checking cannot take place, as the pores or vessels are instantly filled by the resinous matter which keeps them distended to near their former size. No shrinking or alteration of fibres need take place, and hence the whole object of "seasoning" is answered without waiting "*a season.*"

The importance of thus accomplishing two important objects by one operation and without loss of time, is not to be overlooked. In the construction of railroads in timber countries, an immense saving of money and time might be made at the same time that the durability of the structure is insured.

The following is one of many excellent papers in the *Annals des ponts et chauesees* which have never yet appeared in an English dress, and which we have translated for the benefit of our readers.

Although the article on breaking stone was published some time ago, it has not lost its value. In fact, an additional interest belongs to it, when considered in connection with the more common modes of constructing railroads—broken stone constituting no small portion of the material. It will be seen on refering to the Report of Camden and Amboy railroad company, that they have expended the enormous sum of $103,372 64 cents for *broken stone.* How much of this might have been saved by the substitution of mechanical for intelligent power, we do not pretend to say, but that *some* saving would result, is beyond all doubt.

We hope that American ingenuity will yet supply the desideratum so well delineated in this article.

ON BREAKING STONE.

Extract from an article by M. E. F. Noel, Ingenieur des ponts et chaussees.

The breaking of materials intended for working stone roads, is a yearly work of considerable magnitude. Without being able to state precisely the bulk of stone broken annually in France, and applied simply to the working of the royal and department roads, I do not think it can be less

*To this gentleman is due the ingenious idea of bending large ship timbers.—See Transactions of the Society of Arts, vol. xxxii.

than 4,000,000 cubic metres. To this amount is to be added that of the stone employed for roads in process of construction, an uncertain amount, but considerably augmenting the number of millions of cubic metres. The art of stone breaking is thus employed upon an immense mass of material, and becomes a matter of great importance. Nevertheless, the operation is carried on exclusively by manual labor, and in the most imperfect manner.

It is well known that the blow is the most disadvantageous employment of power, and that in all kinds of machines, it is important to avoid all shocks on account of the loss of power which they occasion. Now, the breaking of stones is nothing but a repetition of frequent blows, and what is worthy of remark, the power which is thus lost in these multiplied blows, is the most valuable and the most dearly purchased—that of man. The imperfection of the operation is manifest, for it is very costly. English engineers have advised, and with propriety, to cause the breaking of stone to be done by women and children, seated, and furnished with a light hammer, having a short handle, this method is in fact preferable to breaking with heavy blows of a long handled sledge, used by a strong man, standing up. But it is only applicable when the materials are already reduced to a size not more than double that which is desired, for when they are larger, when, for example, rough stones from the quarry are to be used, breaking them by children, seated, is impracticable, and it will then be necessary to use a sledge, and to work it standing. In this case, there must be a double breaking. The first, to crack up the rough stone, and the second, done by children, seated, to reduce the stones thus broken, to the desired size, which should be such that each piece can be passed through a ring ·06 of a metre (about 2·3 inches) in diameter.

Besides this mode of operating, by short hammers and seated workmen, although, in fact, far preferable, has to encounter pejudices very difficult to overcome, both in the contractors and in the workmen themselves, so that the use of the long sledge, worked by strong men, standing, and constantly bent over, is the plan most generally followed.

To the most striking inconvenience of this method, which consists in employing, at a dead loss, a large amount of intelligent power, must be added the difficulty of breaking the stones properly and uniformly—the scattering of the broken stone, which must be picked up—the loss of the detritus which is spread on the ground and cannot be collected—and also the opportunity which the workman has to defraud by neglecting the breaking of the centre of the heap.

Under these circumstances, it would be desirable to apply some mechanical means to the breaking of stones. It appears that there can be employed for this purpose, a machine composed either of a core or spindle, furnished with projections, and turning upon its axis in the interior of a circular piece likewise furnished with projections*—or of two cylinders horizontally channelled or fluted, and turning towards each other, with a space left

*Resembling a coffee or brick mill. [Ed.]

between them—or lastly, of a single moveable cylinder, revolving on its axis over a fixed parallel plane, and producing the crushing between itself and the plane. These instruments should be made of very hard steel, and in order to avoid their fracture, by reason of the hardness, or particular position of a stone, the pieces against which the strain is exerted, might be so arranged as not to be altogether rigid and fixed, and to give way before the strain when it approaches a certain limit.

Thus, for example, the circular piece, in the centre of which the spindle of the stone mill turns, instead of being fixed, might be made of three or four segments, susceptible of a movement *from* the centre, to let pass unbroken fragments offering too great resistance, when these pieces shall have exerted upon them a strain capable of moving the springs which keep them in their proper position.

A very strong fly wheel will also be necessary to assist the power, since this will have to overcome very variable resistances.

There must also be arranged between the breaking instrument and the recipient of the broken material, a suitable apparatus for sifting these materials, so as to separate the fragments of various sizes, from those which have passed through the machine without being broken down to the detritus or powder.

It is very probable, that a single instrument will not suffice, and that to obtain the size desired, there must be, when rough quarry stones are used, a series, more or less numerous, of this sort of tools.

The solution of this problem will render a great service, in point both of art and economy—and in this view it will be desirable that those engineers who have already made any experiments upon breaking stone by machinery, should give to the profession the results of their labors, through the medium of the *Annales.*

GREAT WESTERN RAILWAY IN UPPER CANADA;* EXTRAORDINARY ADVANTAGES OF THIS ROUTE TO THE CITY OF NEW YORK AND TO SOME OF THE WESTERN STATES.—W. R. Casey, Civil Engineer.

"The aim of this paper, is to place in their true light the objects and advantages of the Great Western Railway. It does not profess to embrace all the merits of the question, but it is an attempt to bring forward the more prominent and the very peculiar advantages offered by this route to the city of New York, and some of the most flourishing parts of the West. It does not dwell on the beneficial effect the road must have on the general prosperity of the Province—and especially on that part through which it will pass, for this is much better understood by the permanent residents of the country—but it investigates the claims of the Great West-

* The Great Western Railway is to run from Hamilton, at the western extremity of Lake Ontario to the river, or Lake St. Clair, its western terminus not having been decided on. The quoted passages and the substance of the remarks generally, are from an unpublished memoir written in 1837, in which year a copy was given to the Hon. John Hamilton of Queenstown, U. C.

ern railway to rank as an important link in the BEST chain of communication between the West and the waters of the St. Laurence and the Hudson.

These two rivers may be considered as the grand feeders of the Great Western railroad. By the former it will receive travellers and emigrants from both provinces, as well as from the northern parts of New York and of the Eastern States embarking on the St. Lawrence and on lake Ontario; by the latter, travellers and emigrants from all parts of the world, by the way of New York. Now, it is obvious, that the western railroad is the best possible route for the former, and it remains to be shown, that it offers the quickest, easiest, cheapest and earliest route to the country west of Sandusky for all travellers by the Hudson, whether they take the direct route across Ontario, or continue, on the New York railroads to the Falls.

A large proportion of the present population of the States of Ohio, Indiana, Illinois, Michigan and of the Territories still farther west is supplied with goods from the city of New York, to purchase which, the country merchants make annually one or more trips to that city. These form a very profitable class of passengers, paying the highest fare, and producing a fixed income. Although the agricultural products of the country will continue to go by Lake Erie, the merchants themselves will take that route to New York which requires the least time. The number of travellers between the north western part of Ohio, the northern part of Indiana, and of Illinois, the State of Michigan and the western Territories is well known to be very great and steadily increasing, in addition to which, crowds of emigrants must yet for centuries flock to the boundless west. It should be the object of the Great Western railroad to secure this business, which it can only do by offering superior advantages to travellers between the Atlantic and the mouth of the Maumee river and Detroit —the keys to the country west of Sandusky. As already observed, local business is omitted, not because its present importance and steady future increase are not appreciated, but, because it is believed, that the western travel alone exists, and may be commanded to an extent sufficient to ensure an immediate and handsome return for the capital invested in this undertaking."

It would appear at the first glance that the Great Western railway must contend, on something like equal terms, with the roads from Boston, New York and Philadelphia, striking Lake Erie at Buffalo, Dunkirk and Erie, but the grand rivalry is between lake Erie and Ontario, and it is to the superior natural advantages of the latter, as regards position and navigation almost uninterupted throughout the year, that the Great Western railway will be indebted for its importance as forming part of the best avenue to the western States.

The most striking feature in this route is—that a railway from Syracuse to Oswego only 35 miles long, will complete the communication by steam between the city of New York and a point as far west as the extreme western boundary of the State, that is 50 miles west of Buffalo. The next important advantage is, that this point may be reached in the spring from one to two months before the navigation of Lake Erie is open at Buffalo. The third peculiarity of this route arises from the happy division of land and water travelling—the former being accomplished by railway in the day time, the latter by steamboat in the night time—the mode of travelling preferred to all others in this country. Although passengers may be landed 50 miles to the westward of Buffalo by the middle of March or as soon as the Hudson is navigable, their further progress is cut off, and without the Great Western railway the route thus far is useless. It is for the want of this road that the winter and spring route from Detroit to New York is by *way of Philadelphia*, and not unfrequently by Columbus (*Ohio*,) Wheeling (*Va.*) and *Baltimore*. The city of Detroit is frequently alluded to, and it may be well to state, that it is the travel through and by that place, which the western railroad should endeavor to draw to itself. Two or three steamboats leave Detroit daily for Buffalo during the season of navigation, and the number of passengers and emigrants is immense. Next to Detroit, Toledo and other towns at the mouth of the Maumee will furnish the greatest number of passengers, and numerous intermediate places, as well as others north of Detroit will also add to the travellers by this route.

At the time the original paper was written, the western terminus had not been fixed. There was also a project for a railway, from Berie (opposite Buffalo,) to Sandwich, (nearly opposite Detroit.) The relative merits of the western termini, or rather the principles on which they should be compared, were investigated. The difference in distance of the rival western termini, (Sarnia at the southern extremity of lake Huron and Chatham on the Thames near Lake St. Clair) from Hamilton on Ontario was considered one of the leading points, but as an article on this subject, part of which was copied from the paper on the Great Western railroad, was published in this Journal of August 1839, it is unnecessary to make any further remarks upon it; besides this, circumstances, which have occurred since that time, point out the propriety, if not the necessity, of placing the extensive establishments at the termination of so great and important a thorougfare in a more secure position than immediately on the bank of the St. Clair river. This consideration will also outweigh any trifling advantage possessed by Sarnia as regards distance from Hamilton, or from Detroit, or better navigation, and though an open question in '37, can scarcely be viewed as such at the present time.

The route by Bertie (Buffalo) was also examined and compared with that by Hamilton and the following are the concluding remarks:

"In comparing the routes by Bertie and Hamilton they have been considered only as valuable to travellers by the St. Lawrence and Hudson rivers, and, even in this point of view, the superiority of the latter is evident, but it would be preposterous to overlook the vast advantages which a railway through the heart of the Peninsula would confer on the Province, as compared with the benefits to be derived from a road skirting the northern shore of lake Erie. The route by Bertic sacrifices the shipping of Ontario, opens the least possible extent of country and is anything but Canadian in its objects, though it is readily admitted, that it will find favor with the inhabitants of Buffalo and perhaps with some of the railroad companies to the westward of Syracuse."

If these views were entertained early in '37, when the incursions from Detroit and Buffalo could not have been imagined, it is needless to say, that they apply with tenfold force now to the interest and security of the British and American traveller, as well as to the general developement of the resources of the peninsula by the great western railroad. The advantages offered by railways for the rapid transportation of men and munitions of war have been advanced as prominent if not principal arguments in favor of certain railroads in this State. It is very true that railways have this power, but they have in a still greater degree the infinitely higher and nobler power of preventing war by the rapidity with which communications, preventing serious misunderstandings, are carried over them, as well as by the ease with which a competent military force can be, as it were by magic, placed at once in the midst of those, on whom any other argument is wasted. Unfortunately such characters abound on the frontier and any means of communication by which either the Canadian or American authorities can act energetically and without loss of time, is of equal importance to the honor and interests of both countries. War is the very worst purpose to which railways can be applied, and it would be much more politic as well as just to advocate their great importance in a "pacific," rather than "a military point of view." The Great Western railroad will, like the Great Western steamer, aid powerfully in maintaining those relations of peace and good feeling so evidently important to both countries, that not a shadow of an argument can be brought forward in favor of a contrary policy.

The discussion of the relative merits of the routes by Buffalo to Detroit (Bertic and Sandwich railway,) or by Hamilton to Detroit (Great Western railway) as well the comparative claims of the rival termini of the latter route (Sarnia and Chatham) could be attended with little interest now, though leading questions in '37. The advantages of the Great Western railroad running from the head of Ontario (Hamilton) to Chatham on lake St. Clair will, therefore, now be considered. Passengers leaving New York at 5 in the evening, reach Albany (150 miles) early next morning; the distance thence to Oswego by railroad is 180 miles which can easily be accomplished by 5 o'clock in the evening, then embarking on Ontario, they will reach Hamilton (160 miles) at 9 or 10 o'clock in the morning of the second day. thence by the Great Western railway 140 miles to Chatham, where they would arrive at 4 or 5 o'clock in the afternoon, thence by steamboat to Detroit, which they would reach at 8 or 9 o'clock in the evening of the second day—requiring in all 51 or 52 hours from New York to Detroit, or 48 hours only if a speed of 20 miles per hour could be maintained on the New York railways, or 12 miles per hour across the lake, both of which will eventually be done.

Passengers by way of Buffalo, will in a few years, accomplish the distance between that city and New York in 32 hours; embarking then for Detroit they will reach their destination in from 30 to 36 hours, requiring 12 hours more than by way of Oswego and Hamilton. The two routes coincide from New York, to Syracuse when they separate, and, calling the distance from Buffalo to Detroit 310 miles, the route from Syracuse to Detroit, by way of Buffalo will be about 485 miles, that by the Great Western railroad about 385 miles, hence the saving of 10 or 12 hours in time, as well as some fatigue and expense. This difference in time would scarcely be affected by a railroad 350 miles long on the southern shore of lake Erie, and is in itself abundantly sufficient to draw to the Great Western railway the best part of the travel of lake Erie.

The next advantage of this route arises from the well known facts that lake Ontario and the western part of lake Erie are always navigable, at least as soon as the Hudson river. Thus in 1837 the ice left Oswego harbor (the lake never freezes) on the 1st March, and though a light steamboat from Buffalo did slip through the ice and reach Detroit on the 20th May, yet the navigation again closed and was not fairly opened till June. In 1838 the navigation was free through the lake about the end of March and thus it varied 2 months in two successive years. In 1837 a schooner from Detroit reached Sandusky on the 1st April, and as Ontario was open long betore this, passengers and goods might have been landed at Sandusky, Maumee and Detroit more than two months earlier than by way of Buffalo. Thus in the year 1837, the entire spring travel would have been over before the ice had left lake Erie, and the country merchants of Ohio, Indiana, Illinois, Michigan, etc., would have not only received, but would have sold a large portion of their spring goods long before they could have been shipped at Buffalo. In the present year (1840) the steamboat Erie of Detroit reached Cleavland on the 10th March, and with the Great Western railroad passengers could have reached Cleavland in 2½ days by way of Detroit instead of going by way of Philadelphia in from 6 to 10 days, and with a proportionate expenditure. The great rival lines of Pennsylvania are to strike lake Erie at Erie, and as passengers and goods can, on an average of years, reach Detroit by the Great Western railway several weeks before thenavigation is open at Erie it is obvious, that in addition to all its other advantages, New York would have the *earliest* communication with the very best part of the western country, were this road in operation.

With the existing laws of this State the spring trade could not go by the Great Western railroad, but as a modification is confidently expected, which will grant to private enterprise the privilege of carrying freight when the laws of nature prevent the State from doing it herself, there can be little doubt, that the western traders will gladly avail themselves of the permission and, during the four or six weeks of navigation of the Hudson, before the opening of the canal, would transport as much as possible to Oswego, whence they could, at their leisure, send it to its western destination. By this route they will also save the "canal tolls," which the State exacts from the railways, on about 160 miles of canal, and, as the rush of spring business does not last more than four or six weeks, this route will offer great advantages to the trade and travel of the country west of Sandusky, as it may be nearly all done before the canal opens.

This route would confer still greater advantages on emigrants. By reaching New York by the end of March, they could be settled in their new homes in the wilderness of Michigan, Illinois or Indiana, about the end of April, in time to plant a crop of corn and potatoes, and thus save nearly a year. As the baggage of emigrants is called "freight," they can even with the modified law which is expected, only be allowed to use the railway when the canal is frozen; at all other times they must go by the State canals. The Oswego canal is, however, a State canal, hence the emigrant will, by leaving the Erie canal at Syracuse, and embarking on Ontario, at Oswego, be enabled to pursue his journey from the latter port to Detroit, at the rate of 10 miles per hour, instead of continuing on the Erie canal, at the rate of 2 and 2½ miles per hour, to Buffalo. The Government cannot force him to travel by canal any further than Oswego, so that during the season the canal is navigable, he will be enabled to avoid nearly 200 miles of canal travelling, and will consequently save 2 or 3 days, besides the ordinary expenses for that time. To the emigrant, therefore, this route offers such advantages as to distance competition, either before or after the opening of the Erie canal.

The subject of early freight to the West, has been introduced as a specimen of business which *might* be created by this road, and though of vast importance to the city of New York and the Western States, is of comparatively little importance to the Great Western railway, for this will depend more for its income on the numerous passengers who now pursue the tedious and tortuous course of lake Erie, than on all other sources together.

"The third peculiar feature in this route is, that the nights are passed in steamboats. Thus the first night is passed on the Hudson, the second on lake Ontario, and passengers for Maumee or even Sandusky would, by passing the third night on the Detroit river and the eastern end of Lake Erie, reach their destination early in the morning of the third day, thus requiring two days and three nights from New York to Sandusky or Maumee."

The length of railway by the two routes is the same, about 320 miles, but half the distance on the *continuous* railway from Albany to Buffalo, must be accomplished in the night time, besides changing cars two or three times; whilst the travellers by Oswego, may pass the night in comparative comfort on the Lake, reaching Hamilton in the morning. By Buffalo there is 320 miles of continuous railway, and 310 miles of continuous lake navigation from Albany to Detroit; by way of Oswego, 180 miles of railway, then 160 miles of lake navigation, then 140 miles of railway, then 50 miles of river and lake navigation.

Experience on the great northern and southern lines on the coast, has shown that passengers are glad to avail themselves of change from railway to steamboats, especially in the night. Very few persons are liable to be seasick when lying down in the night, and almost as few escape it in the day time; on this account, the passage across lake Ontario in the night, would be in a great measure free from that dread with which most travellers regard the passage of lake Erie, on which they must spend, at least, one day.

Still, the Great Western railway cannot be considered exactly as a rival of the line from Albany to lake Erie, for it will offer the best route from the falls to Detroit throughout the year, thus furnishing rather a continuation of that line. Passengers at the falls, may take steamboat thence to Hamilton, and reach Detroit as soon as those going all the way by lake Erie, and persons wishing to avoid the great lakes "in toto," can, by riding 45 miles from the falls to Hamilton, avoid the risk of seasickness, by losing 10 or 12 hours in time. "The railway between Syracuse and the falls, will compete with the boats on lake Ontario, but both will be tributary to the Great Western railway." The great object of the latter will be, to divert to itself the most profitable part of the present immense travel on lake Erie, which it will endeavor to do, by offering a *cheaper*, *quicker*, *easier* and *earlier* communication between the city and State of New York, and the country west of Sandusky, than can possibly be had by *any* route terminating on lake Erie.

The effect of this road on winter travelling to and from the West, will be very beneficial, and will materially add to the income of the line from Albany to lake Erie. Indeed—taking into consideration the number of travellers wishing to see western New York, the falls, and those desirous of avoiding the lakes, and, adding to these, the great number of winter travellers which these new facilities will necessarily produce—it is not unreasonable to infer, that the railways west of Syracuse would, on the whole, be rather benefitted than otherwise by the construction of the Great Western railway.

Not so, however, with the travel on lake Erie. The Great Western railroad, by offering superior advantages to the merchant, traveller, and emigrant, must infallibly draw to itself a large proportion of the "through passengers," the most profitable part of the business; it will also aid materially in changing the *time* of travelling in the spring; this can scarcely be said to commence now till May, whereas, with this new avenue to the

West, the best part of the spring travel would generally be over by the time lake Erie was free from ice. It is true, that in '38, the difference between the two routes would have been trifling; but in '37, the difference would have been more than two months! This extreme uncertainty of the route by Buffalo, is its worst feature. At the present time, (18th March,) the navigation has been open 2 weeks from Detroit to Cleavland, and, if westerly gales do not prevail, it *may*, in a few days, be free to Buffalo, otherwise it *may*, as in '37, be closed till June. In this state of things, many of the western traders would come to the city before the opening of lake Erie, (in ordinary years,) and not unfrequently return before that event, by means of the Great Western railway, and a considerable portion of the present spring travel by lake Erie would be over, before winter would permit the steamboats of the lake to enter into competition with the steam-car of the Great Western railway.

To form a *perfect* communication throughout the year, would require a railway 45 miles in length, from the falls to Hamilton, and from Chatham, or wherever the western terminus might be, to Detroit. When the roads are in their worst state, the navigation at Detroit is nearly always open, and steamboats can ply on Ontario nearly all winter. In the most possible event it would only delay the traveller a single day and he would reach New York in 3 days, instead of, as now, occupying from 10 to 14 days incessant travelling round lake Erie to Cleaveland, and thence through Philadelphia to New York. These two railways, connecting the termini of the Great Western railway with Buffalo and Detroit, would be used by a comparatively small number of travellers during the winter, and very little during the principal travelling season, hence it would be, in every point of view, injudicious in the Great Western railway to extend itself beyond what is absolutely necessary to give it a decided advantage over the route by lake Erie. Great thoroughfares, only, will justify the construction of large works in a new country, and the vast importance of reducing the length of a railway as much as possible, a subject which occupied some space in the original paper, has been, as already observed, published in this Journal. When there is no difference in distance, passengers may be carried in steamboats for much less than on railroads, and this would give a decided advantage to the boats from Chatham to Detroit, moving through smooth water, over a railway between the two points, for, at least, 9 months in the year, comprising, probably, more than nine tenths of the travel. The Camden and Amboy company, owning both railway and steamboats from Bordentown to Philadelphia, use the latter during the entire season of navigation, and as this company is eminently well managed, and as this practice still continues, after seven years experience, we must admit it to be very strong evidence of the superiority of steam navigation, on rivers, over railways—when the *distances* are nearly equal.

"It is an important object to know the minimum amount of income nessary to repair and renew the road and pay interest on the capital."—

This subject was examined in detail, but now it will be sufficient to state that the cost of the Great Western railway may be assumed at $16,000 (4,000*l.* currency) per mile with everything requisite for an extensive *passenger business* and of course a single track. This is about the cost of the Utica and Schenectady railroad, deducting the cost of right of way, superstructure, and graduation of second track, and for 140 miles would amount to $2,240,000 (560,000*l.*) or in round numbers 600,000*l.* ($2,400,000.) The interest on this sum would be, at 5 per cent. $120,000, and is entirely independent of the amount of business, as will also be the repairs and renewals of roadway, to some extent. Estimating these latter at $400 per mile, and we have for repairs and renewals $56,000 and adding the interest $120,000, in all $176,000. The cost of engines, cars, buildings, etc., will be in proportion to the business, as well as the wear of the same, fuel oil and wages. To arrive at any definite statement of expenditure, it is necessary to assume a certain number of travellers, and supposing these to be 50,000 per annum, and that the cost of transportation, exclusive of interest and repairs of road, is one cent per passenger per mile, we have $70,000, which added to $176,000 gives $246,000 (61,500*l.*) per annum as the minimum income required to pay interest and all expenses on the transportation of 50 000 passengers over a railroad 140 miles long, the entire capital expended being 600,000*l.*; or a gross income of very little more than 10 per cent. on the capital. Judging from the cost of other works in the Province, this estimate may be considered very low, but a railroad in the Lower Province has been built for much less and there can be no doubt that a railway through so easy a country, could be completed with the heavy iron rail for from $20,000 to $22,000 (5,000*l.* to 5,500*l.*) per mile, with all complete for an extensive business in passengers *only*.

The usual fare on railways is 4 cents per mile or $5,60 for 140 miles, but assuming only $5 as the charge and the income from 50,000 passengers would be $250,000. Although $250,000 be but a small part of the sum paid by passengers on lake Erie, some years will elapse before the country through which the road passes will furnish that amount of business, yet this is indispensable if the work be expected to support itself. That the western travel alone exists to a far greater extent than this is well known, and whether the reasons given in this paper for supposing that the Great Western railroad will be able to divert to itself a large proportion of the travel on lake Erie, are sufficient to justify this assumption as well as to establish its claim to rank as the best route from New York to the country west of Sandusky, is respectfully and confidently submitted to the intelligent reader.

The ultimate, though not very distant prospects of this work are worthy of notice. An inspection of the map will show, that the navigable waters and artificial communications from the East convirge towards Ontario, those from the West towards lake Erie. Thus we have the St. Lawrence, the Hudson and the railway from Boston to Albany to bring the traffic of the country bounded by the St. Lawrance, the ocean and the State of New York to Ontario, and on the other side, the Maumee canal and the Detroit, and St. Joseph's railroad both point to the western end of lake Erie. The completion of these two works may be looked forward to as not very far off, now that the grand "systems" have exploded, and the construction of the Great Western railroal would do much towards hurrying on the Detroit and St. Joseph's railroad which will eventually be its most important tributary, for it will necessarily command the travel of Michigan, part of Indiana, the best part of Illinois, all Wisconsin and Iowa, forming with the Canadian Peninsula, the most valuable agricultural district in N. America.

Other topics, which would be uninteresting here were alluded to;—among the rest, the impolicy of commencing active operations until it is certain that the amount required to pnt the road into efficient operation can be commanded, and the still worse policy of opening, in part, a road which depends principally on "through passengers" for its success; to which causes may be principally attributed the insignificant progress of the Baltimore and Ohio railroad for the last 5 or 6 years. The propriety of adopting this as a Provincial work was suggested, but, although the most important work which could be projected in either Province, the experience of Pennsylvania held out little encoragement to the cause of Government railways, even at that time, and, after the union of the Provinces, the case will be hopeless, for the French paaty will go "en masse" against the system of government works from their general dislike to innovation, and many of the other party, including some of the most influential, are strongly opposed to it on constitutional grounds; besides which, the, with one exception, complete failure to meet their ordinary expenses, and interest—of all the State works in the Union would, of itself, be sufficient to cause men of sound judgement to move with the utmost caution. Whether the experience of Upper Canada proves, that the very large sums expended on internal improvements in that Province have been laid out on these works which the wants of the community most and soonest reqnire and which the means of the Province are adequate to carry through, is a question which, if answered in the affirmative, would show a state of things the reverse of what exists here, and would constitute one honest argument in favor of a policy which, its best friends must admit, is utterly at variance with British institutions.

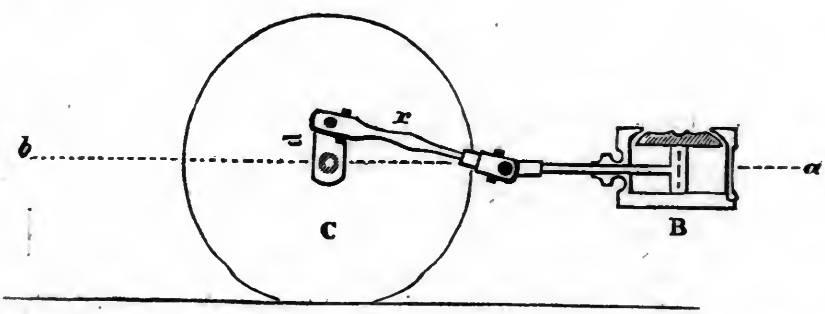
It is impossible, at the present time, to form any idea of the effects to be produced by the great political change about to take place in the Canadas but, whether ever completed or not, the route of the Great Western railroad offers advantages which can never be found in any communication between New York and the West by way of lake Erie. It is impossible to point out, on this continent, a work of equal magnitude, requiring only an expenditure of from 2 to 3 millions of dollars, the completion of which will be attended with such important results to the Eastern States, New York and the best part of the Western country.

The Great Western railway will offer the cheapest and quickest route, because it will be shorter than any other—the easiest, because the night will be passed in steamboats, and the earliest, because Ontario and the western part of Erie open long before the eastern. However long its completion may be delayed, it will, when completed, become, at once, the great western thoroughfare, for its advantages over any other route which can be projected, are owing to natural causes which no competition can affect, and it is not unreasonable to infer, that the opening of this very properly styled "Great Western railway," will produce as great a change in the "travel," as the opening of the Erie canal did in the "trade" of the West.

CRANK MOTION AS CONNECTED WITH DE PAMBOUR'S EXPRESSION OF THE POWERS OF LOCOMOTIVE ENGINES.—By W. McClelland Cushman, Civil Engineer.

Attempts have been made on many occasions, by different individuals, to account for the failure of de Pambour's formula by attributing the errors to loss of effect from crank motion; and this suggestion is in some degree plausible, as that gentlemen does not notice, in direct terms, the effect of the crank in modifying the force actuating the piston. It may, however, without any trouble be shown to be inadequate to account for the well established deviations of this formula. It has not indeed any degree of pertinance to such an inquiry.

These positions are easily made out. But in the first place, I will illustrate briefly the operation of the crank in transferring the power from the piston to its working point upon the wheel, which will best be done through the medium of a diagram.



In the annexed sketch, B represents the piston, C the wheel worked by the crank, r the connecting rod, and d the arm or throw of the crank. The expansive force of the steam is of course exerted, reciprocally, in the direction ab. Now this force in passing from this its primitive direction to its final direction in the tangent to the rotary circle of the crank, must evidently lose two proportions—one determined by the sine of the angle included between r and ab, the other by the sine of the angle included between r and its final direction. It would be easy to express generally, in terms of these angles and of r and d the amount of power actually operative upon the end of the crank at any point of its revolution; and by means of the calculas to sum the total amount of force expended during a complete revolution. This compared with the amount of expansive force exerted upon the piston (after allowing for virtual velocity) during the same period—that is a double stroke of the piston—would exhibit precisely the proportion of power lost through the intervention of the crank and its gearing. A procedure like this is conceived to be the only means of arriving, mathematically, at a true result. A theoretic investigation of this point, is, however, quite unnecessary to relieve the main question of all embarrassment—for these reasons.

1. Because the loss of effect from crank motion will not account for the errors of the formula.

A decisive circumstance is entirely overlooked by those who rely upon this principle for this purpose. It is quite evident, that whatever may be the absolute loss from the crank, that it will be on some constant relation to the power expended on the total resistance. Unfortunately, however, the results of experience and those deduced from de Pambour's formula bear no such relation to each other. On the contrary, the two results are sometimes nearly coincident, and then deviate very widely, &c. For instance, (Railroad Journal, vol. IX, p. 45,) we have deviations from experiments of 10, 31, 18, 11, 26, 57 per cent. in one set of trials; and 35, 30, 38, 19, 5, 10, 18, &c., in others. Those, therefore, who refer the errors of the formula to the intervention of crank motion, are reduced to the dilema of explaining results which differ in every assignable degree from experience, without order or rule, upon the principle of an invariably proportionate loss; and if the formula had been constructed without any reference to crank motion, its deviations from experience would, for this reason, require some very different cause to explain them. But,

2. The suggestion is not in any degree pertinent, inasmuch as the loss of effect from crank motion is already provided for in de Pambour's formula!

This last is a palpable paradox, but a glance will suffice to render it intelligible. For let it be observed that this *resistance* of an unloaded engine is incorrectly named, when designated friction. It is indeed a compound result, including within it the effect of the crank: and is, in fact, the *friction proper* to all the rubbing parts of an engine *increased* in the ratio of the loss from crank motion. So when an engine is tracking a train of cars, the total tractive force is made up of the friction proper to the cars and of the resistance of the engine, now still greater than when unloaded, in proportion to the degree of pressure thrown upon its rubbing parts by the train in convoy; which resistance includes, as before, the effect of crank motion.

When, then, the value of the total resistance of the engine, per ton* of

* The actual loss of power from crank motion in engines of this class is always less than 6 per cent. For the friction per ton of load upon a level being 8 pounds, and the in-

its own weight and of its load, is ascertained and employed in estimating the total tractive force, the effect of the crank is exactly provided for in a very unexceptionable way, viz., experimentally.

Now both these quantities were determined by de Pambour as elements of his formula; and, therefore, although he nowhere notices in direct terms the effect of the crank in reducing the power, it is by implication, in this way perfectly eliminated. Nothing, therefore, can be more absurd, than to look for the discrepancies of this formula in the omission of elements which its author proved by experiment to be inseperable from it, and for which exact provision had been made.

Every fair and competent valuation of de Pambour's expression will reproduce the train of disorderly errors detailed in the above numerical statements, and that, too, without omitting the effect of the crank; and will hint sufficiently the necessity of having recourse to other primary causes than crank motion, or any other influence bearing a given relation to the power, for an explanation of them. It will be matter for astonishment to me if any engineer will prove that the evaporating capacity of modern locomotives, (and, therefore, their power,) is not increased with the velocity of motion, and in a very great degree; and that the air does not oppose the motion in proportion to the amount of actuating surface; or that these two elements (the one retardative, the other a much more powerful auxiliary, which will exert the utmost influence upon the powers of these engines in the future,) taken together, each according to its specific law and coefficient, do not solve every difficulty.

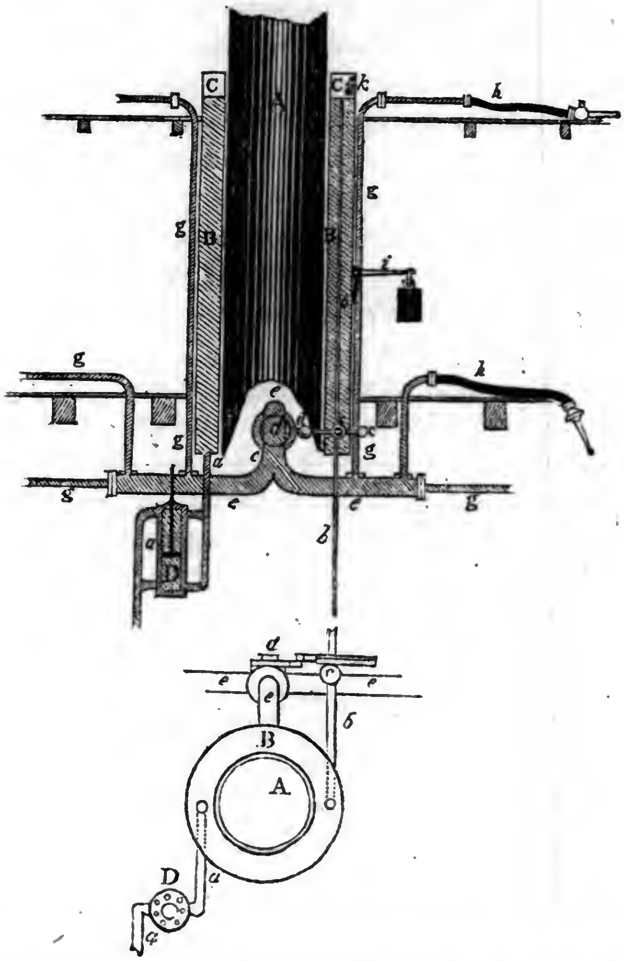
Albany, March, 1840.

For the American Railroad Journal and Mechanics' Magazine.

DESCRIPTION OF H. R. & J. E. SERRELL'S IMPROVED MEANS FOR PREVENTING AND EXTINGUISHING FIRES ON BOARD STEAM VESSELS.

A double cylinder, B, closed air tight at both ends, is to form a ring around the smoke pipe A, and to be about two inches clear, around the same; the cylinder to extend from the top of the boiler upwards, above any wood or deck work near the smoke pipe; the cylinder is to be nearly filled with water, by a force pump D, worked by the engine when running, or by hand if required, when the engine is not running. A waste pipe *b*, inside the cylinder whose top shall reach within about one foot of the top of the cylinder, is to carry off the surplus water from the cylinder, either to the boilers, or over the side of the vessel; and the space left in the top of the cylinder, becomes an air chamber C.

crease of resistance in engines rating 1 pound per ton of load reduced to a level, the fraction 1-8=(12 per cent.) expresses the total proportion of resistance brought into action by the operation of the engine; and but a part of this is due the effect of the crank. Again, the total resistance of an engine, per ton of its own weight is 15 pounds, and 8 pounds of this at least is due the friction of the wheels; consequently $\frac{1}{8}\times\frac{15\cdot8}{15}=\cdot058$ (less than 6 per cent) is the greatest diminution of power attributable to crank motion. It has often been erroneously estimated at 3 or 4 times this amount; but a proper theoretic investigation fully confirms the result which has been established by experiments.



A main pipe *e*, and branch pipes *g*, leading from the cylinder, are to terminate in hose, with cocks and nossels *h*, in any part of the vessel, and a cock *c*, in the waste pipe *b*, is connected to the cock *d*, in the main *e*, by the communication *f*; and shutting the cock *c*, in the waste pipe *b*, opens the main cock *d*; converting the whole apparatus into an effective fire engine, (whose power is regulated by the capacity of the force pump) and at the same time supplies all the pipes which have the hose with cocks and nossels, making them available for quenching a fire in any part of the vessel.

A safety valve in the cylinder prevents breakage, through the pressure given to the water by the force pump. The reverse valve R, allows the ingress of air when wanted in the air chamber.

FOURTH ANNUAL REPORT OF THE WESTERN RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

(Continued from page 224.)

The *timber* wanted for the same purpose, has been, principally, contracted for; and that for the part of the road west of Pittsfield, is in course of delivery.

The *damages for land and fencing* have been settled and paid, and the titles secured for about	40½	miles.
They have been liquidated by agreements in writing, for	11¾	"
Settled by appraisals of commissioners, for	6¾	"
And are unsettled for	3·6	"
Total,	62·6	"

Convenient depot lands have been secured for seven stations, west of the river; and those for others are offered upon advantageous terms, when the locations shall be agreed upon. No one of the stations has, as yet, been actually located by vote of the directors; but the subject is in the hands of a committee, for a personal examination.

The receipts and expenditures of the corporation, for the year past, as stated by the treasurer, as of January 1, 1840, are as follows, viz:

Receipts.

Balance of 4th annual account, Jan. 1, 1839,		$354,055 56
Received on 3d Assessment,	$2,975 00	
" 4th "	4,485 00	
" 5th "	7,350 00	
" 6th "	8,505 00	
		23,315 00
" for sale of timber lands,		990 64
" on transportation department,		17,425 63
" for state scrip sold (profits paid sinking fund) par, is	501,329 54	
" for exchange drawn agt. scrip unsold	655,114 52	
		1,156,444 06
Outstanding drafts by engineer, in favor of contractors, accepted, and not yet due,		57,850 05
Amount due Baring, Brothers & Co., Liverpool,		12,526 05
" " Geo. W. Whistler, agt. moving power,		1,490 85
		$1,624,097 84

Expenditures.

Amount paid for incidental expenses,	15,921 38	
" " construction, including iron,	1,225,235 55	
" " engineer department,	38,053 16	
" " land damages,	54,591 23	
" " depot lands,	6,439 27	
" " interest on bonds or scrip,	39,965 91	
" " engines, cars, etc.,	69,670 21	
" " fuel etc.,	6,596 68	
" " depot buildings, etc.,	60,751 15	
" " expenses transportation depart.,	13,299 47	
" " contingent fund,	1,290 97	
Balance,	92,282 86	
		1,624,097 84

Transportation Account.

The total amount of *receipts* from the business of the road, for 3 months prior to January 1, 1840, was,

For transportation of passengers, three months,	$13,472 94
" merchandize, two months nine days,	4,136 21
Total receipts,	17,609 15

The *expenditures* of this department for the same time, were,

For repairs of the road,	1,076 00	
" " engines and cars,	1,004 43	
Miscellaneous expenses, including clearing snow,	12,300 21	
		14,380 64
Balance,		$3,228 51

The amount of *capital paid in*, is the proceeds of six assessments of $150,000 each, laid upon the stock, amounting in the whole to $900,000.

And there has been collected upon these on the first of January, inst. the following sums, viz:

On the 1st assessment,	$150,000	
" 2d "	150,000	
" 3d "	148,835	
" 4th "	148,455	
" 5th "	148,450	
" 6th "	148,175	
		893,915
Balance due and uncollected,		$6,085

This small deficiency is constantly diminishing by means of collections. And the treasurer anticipates but a very small eventual loss upon all the assessments, including notes secured by a pledge of stock.

And it is believed that a contingent fund, on hand, will cover a considerable part of it.

The act of the legislature of 1838, authorized the loan to the corporation, of the scrip of the State, having 30 years to run, for the sum of $2,100,000, on the condition of the collection of certain proportions of six assessments upon the stockholders. The whole of these assessments was $900,000, and there has been collected thereon, on the 1st of January inst. as before stated, the sum of $893,915, being a much larger amount than was required by the act. A small portion of the 4 last assessments was in notes, secured by sureties or a pledge of stock.

The act further required, that the corporation should execute to the Commonwealth, a *bond*, to apply the proceeds to the construction of the road, and to pay the principal and interest of the scrip, as it should fall due; and should *mortgage* the whole road, and all the franchise, and property belonging to the corporation, to secure the performance of the conditions of the bond. This requisition has been complied with, the bond and mortgage were given, and the interest on the scrip has been punctually paid by the corporation.

Another provision of the act required, that the premium or profits on tce sales of the scrip should be paid to the Treasurer of the Commonwealth and, that to this should be added, annually, after the road should be opened for use, a sum equal to one per cent. on the amount of the scrip, from the income of the road; and that the whole should by the Treasurer be placed at interest, and the same, with the interest annually accruing thereon, should constitute a *Sinking Fund*, for the future purchase or final redemption of said scrip. The premium or profits on the sales of scrip heretofore, so far as the accounts of sales have been received, have been duly paid over to the Treasurer of the Commonwealth, as will hereafter appear. And the whole is now under the care of the commissioners of the sinking fund, as provided in an act of the last Legislature.

The act of March 23, 1839, authorized a further issue of scrip, upon terms similar to those of the first act, for such a sum as might be necessary to enable the corporation to complete their road, not however exceeding

$1,200,000. Of this snm, the issuing of $400,000 is on condition that the corporation previously collect the sum of $75,000 upon a 7th assessment upon the private stockholders, and another $400,000 is upon condition of a similar collection upon the 8th assessment.

The act further provi les, that the Commonwealth *may, at any time after its passage*, purchase the road, and all the property of the corporation, by paying therefor the cost, and 7 per cent. interset.

This act has been assented to by the stockholders at a legal meeting; and the bond and mortgage thereby required have been filed with the Treasurer.

The whole of the scrip authorized by the act of 1838, has been received by the corporation, being	$2,100,000 00
And also the first instalment under the act of 1839,	400,000 00
Of the former, there had been sold in England, at the date of the last advices,	$1,228,000 00
And the Treasurer of the corporation has drawn upon the agents, against the balance of scrip unsold, and in anticipation of farther sales,	655,114 52
Making total amount drawn for,	$1,883,114 52

The scrip disposed of has been sold at an advance or profit above par value, averaging $3\frac{1}{4}$ per cent., and it has always commanded a much higher price than any similar American scrip.

Sinking Fund.—The profits arising from the sale of the scrip above mentioned as already sold, being $1,228,000, result, 1, from the *premium* for which the same has been sold above the par value, and 2, from the premium on the exchange drawn for the same, and they amount to the sum of	$137,605 30

These profits are regularly paid over to the commissioners of the sinking fund, as fast as the accounts of sales are received from the agents;—and occasionally transfers are made to that fund in anticipation of those accounts. The amount so paid over from time to time, was, on the 1st inst., $115,528 29. And about $22,000 more will be paid over during the month of February next.

To the above sum is to be added the premium on the exchange heretofore drawn against the scrip unsold, as before stated, viz., $655,114 52, which is	$64,251 25
And which makes the amount *in hand* to accrue to the fund from profits on $1,228,000 sold above par, and the premium on exchange already drawn on $1,883,114 52,	$201,856 55
This is exclusive of any advance on the future sales of the scrip to meet the $655,114 52 drawn against it. But as the whole scrip has been sold at an average premium of $3\frac{1}{4}$ per cent., it is safe to say, that that amount of scrip will, on sale, yield an advance of 1 per cent. *net*, say,	6,551 14
Total profits on $1,883,114 52 of scrip, or a little over 11 per cent.	$208,407 69

If it shall be found necessary to use the whole of the $1,200,000 of the scrip authorized by the act of 1839, in order to complete to road west of Connecticut river, there will remain unsold and undrawn for,

January 1, 1840, the whole of that amount,	$1,200,000 00
And the balance of that issued under act of 1838,	216,885 48
Total as the basis of further profits hereafter,	$1,416,885 48

If the same profits are realized upon this as upon the preceding—11 per cent., the amount from it will be	$155,857 40
To which add proceeds realized as above,	208,407 69
And it gives the total amount of the principal of the fund, *from this source only,*	$364,265 09

Which is exclusive of the 1 per cent. on the amount of the scrip, or $33,000 annually to be paid to the fund from the income of the road.

This sum of $364,265 09, is to be placed on annual interest as received and secured in the manner prescribed in the sinking fund act, and to accumulate until the scrip falls due. It is understood, that the amount already paid over to the commisioners of the sinking fund, being $115,528 29, has been readily loaned on the best security, at 6 per cent. interest, payable semi-annually. And no doubt is expressed by them, that the whole may be loaned at the same rate. As the fund is *managed without charge* we may then safely assume that for the whole time, the fund may be made to produce at least 5½ per cent. annually.

The scrip is all payable 30 years from its date; and being dated and issued at different periods, it is found that to *average* the whole, it is equivalent to a scrip of $3,300,000, falling due about April 1, 1869.

Upon the whole principle, the *average* time, at which the whole profits will be paid over to the fund and put on interest, will be about October 1, 1840.

The interest, therefore, should be computed on the whole $364,265 09 from October 1, 1840, to April 1, 1869, or 28½ years. This at 5½ per cent. annually will increase this item to $1,610,031 53

To this is to be added, the one per cent. on the amount of the whole scrip, or $33,000 annually, required to be paid to the fund from the income of the road, *after it is opened for use.* Should the first payment from this source be made October 1, 1842—and the annual payments extend to April 1 1869, the average time the whole scrip falls due—it will give 26½ years. The annual interest at 5½ per cent. on these yearly payments will increase them to the sum of	1,937,880 14
Giving the proceeds of the sinking fnnd, when the scrip falls due at 5½ per cent.,	$3,547,911 67
Which will over pay the princpal by	247,911 67

As stated in last year's report, "this surplus may be applied to the expenses of remitting the money to England, when due, if, as is probable, exchange should then be against us. And if a larger amount should be wanted for that purpose, a portion of the income from the business of the road, may be set apart, annually, for a few years prior to the time when it may be wanted."

"It is intended that the semi-annual interest falling due upon the scrip, shall be paid by the corporation from the accruing income of the road.—And a net income from the business, of 6 per cent. on the cost of the road, will pay the 1 per cent, annually to the sinking fund—5 per cent. interest on the scrip, and give a dividend of 6 per cent. to the stockholders, on the amount advanced by them.

If as is now the fact, the fund is loaned at 6 per cent. instead of 5½, it will produce, when the scrip falls due, the sum of $3,870,449 10

Which will over-pay the principal by 570,449 10

A surplus amply sufficient to meet unexpected losses, deficiency of interest for short times, expenses of the fund, and cost of remitting the principle when due.

In view of these facts, and of the uninterrupted success which has attended all the financial operations of the corporation heretofore, the undersigned cannot omit the expression of their entire confidence, that the Commonwealth is perfectly secure for the whole amount of the loan of credit to the corporation, and that neither the State, or the stockholders, will ever be called upon to pay a single dollar of that loan.

Unless there is some fallacy in the foregoing calculations, which no one has, as yet, been able to detect—although they have, in effect, been before the public for two years past—the sinking fund will, of itself, be amply sufficient to meet the principal of the loan. The accruing interest upon it has been heretofore paid by the corporation, and there is no reason to doubt that it will be punctually met by them hereafter. If it is not, the Commonwealth, holding a mortgage of the entire road, and all the franchise and property of the corporation, have a right, by the terms of the grants, to take *immediate possession* of the whole, receive the income, and apply such part as may be necessary, to pay the interest;—or they may farm it out for the purpose, at their election. This they may always do, without re-paying to the private stockholders the $800,000 which they shall have paid in assessments towards the construction of the road.

Supposing the whole scrip to be necessary to finish the road, the mortgage is of a property costing four and a half millions of dollars, to secure a loan of $3,300,000, and a property too, which must produce an ample income, to be annually increased by the increasing business of the country. It cannot, therefore, by any reasonable man be doubted, that the Commonwealth have most abundant security for this loan of their credit to advance this great public enterprise. They have, in effect, only indorsed the paper of the corporation, or guaranteed their credit; taking, not only sufficient eventual security, but such as they may take into immediate possession on the first defalcation.

And, in order further to provide against loss, four of the nine directors are annually chosen by the Legislature; thereby giving the State certain means of knowing the whole operations of the corporation, and of watching even the minutest expenditure of its funds.

But, superadded to all this, is the provision of the act of 1839, that the Commonwealth may *at this moment*, or at *any* future time, near or remote, purchase the whole road, with all its appurtenances, and all the property of the corporation, by paying therefor, the amount of capital paid in, and seven per cent. per annum interest, or profit thereon from the times of the payment of the same by the stockholders, deducting any dividends that may have been received—thus securing to the State the right to buy the road, virtually at cost, if it should prove profitable, and leaving it with the stockholders, subject to the mortgage, if it should not be so productive, as to tempt to its purchase.

It should be borne in mind also, that the enterprise was one too great for private capital; that no one subscribed to it for investment, merely, but in order to promote a great public improvement, and that it could not have been accomplished without this extended aid from the State.

It would seem, then, in view of all these considerations, that no citizen of Massachusetts who values her prosperity, however fastidious he may be, can persuade himself, that former legislatures have been unwise in these grants, or indiscreet in the manner, in which they have been protected.

The directors improve this opportunity, also, to express their conviction, that the whole road to the western line of the State, will be finished, with all the equipments necessary to put it in order for use, by means of the funds already provided for the purpose.

The *resources* provided for the work, results,

1. From assessments on the stock,	$1,200,000
2. Scrip of the State,	3,300,000
Total,	$4,500,000
The cost of the part of the road completed east of the river, is before stated at	$1,972,985 97
Leaving applied and applicable west of the river,	$2,527,014 03
The cost of road west of the river, was estimated in December, 1838, with as much care as was practicable, after all the principal objects of expenditure were under contract; and when the principal items of cost were well understood, with the exception, perhaps, of the grading and masonry through the mountain division. The total estimate for putting this part of the road in order for use, was, as stated in the report of last year,	$2,326,442 61
Leaving a surplus of resources, above the estimates of	$200,571 42

And it can hardly be believed, that the actual cost will exceed the estimates by this amount.

As to the probable *income* of the road, there has as yet been no opportunity to test it. It cannot be fairly judged of, until the western part of it has been for at least one year opened for use. The part east of the river had been in operation for passengers three months, and for merchandise two months only on the 1st of January inst, the time to which the accounts are made up. And this was under the most discouraging and adverse circumstances. It embraced a season of the year, when even in prosperous times, few railroads in New England receive an income equal to their current expenses. The whole period was one of unusual depression with the business community;—and when no one travelled except from necessity. The embarrassments attending the manufacturing and other active interest of the country were such, that all engaged in them have forborne to procure supplies beyond their immediate wants. The proper department having declined for the present to transfer the public mail to the cars, the stage-coaches having the advantage of the contracts have been running, on the same line of travel, in active competition with the road, and at fares much reduced.

The winter thus far has been one of uncommon severity, attended by a succession of deep snows, now accumulated to an extent unknown for many years, and requiring heavy and repeated expenditures in clearing the track, and access to the road, both by passengers and for merchandise has been, from this cause, seriously interrupted. It may be added also, that the business upon the Connecticut river, from which much is expected hereafter, has been entirely closed for a great part of the time.

It will readily be seen, therefore, that the results in the short period during which the road has been opened, can afford no criterion by which to judge of its productiveness. The undersigned have never anticipated that, for the first six months of its operations, the income of the road would more than meet its expenses. But they are happy to find, by the statement of the account before given, that, under all the discouragements to which they have alluded, *the road has more than "paid its way,"*—the receipts having exceeded the expenses by about 22 per cent.

Upon the opening of the spring, and the revival of business from its present depression, the Directors anticipate a successful and constantly increasing business upon the road. The advantages of this means of communication are more and more felt in towns remote from the line; and new lateral roads are opening, and new lines of stages establishing, to accommodate the new courses of travel. The Hartford and New Haven railroad has but just commenced operations, thus presenting a continuous and more inland communication by steam, between Boston and New York. The produce and merchandise of the populous and flourishing towns in the valley of the Connecticut, for near 200 miles north of Springfield, have heretofore been transported, principally, by teams, to and from Boston, at a great expense. And it has been ascertained, that, at the distance of, at least, 50 miles north of Springfield, about 50 per cent. of that expense may be saved by the river and railroad transportation united, and a corresponding advantage gained, in the more nothern towns. In order to attract public attention to this subject, and to procure and give information, an agent is now on a tour up the river, and it is believed, that a new and valuable business may be realized from this source the coming season.

But all these arrangements require time and long continued attention for their completion, and the results, so far as they may affect the income of the road, must not be looked for too hastily. In conclusion, the undersigned see no reason to doubt, that the early anticipations of the friends of this enterprise, will in time be fully realized; and they are encouraged to believe, that those friends will be stimulated to contiuued effort, until they shall see this great thoroughfare in successful operation, through the centre of the State, from the seaboard to its most western boundary.

Thomas B. Wales, Josiah Quincy, Jr., John Henshaw, George Bliss, Amasa Walker, Charles Hudson, John Howard, *Directors.*

SECOND ANNUAL REPORT OF THE WEST STOCKBRIDGE RAILROAD CORPORATION.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The directors of the West Stockbridge railroad corporation do make this their second annual report of their acts and doings, receipts and expenditures, under their act of incorporation.

The length of the said road being only about two and three-fourth miles in length, it was originally contemplated by said corporation and by the Hudson and Berkshire railroad company, to unite said roads, and both companies passed resolutions to that effect, and leave was obtained of the legislature of the State of New York so to do and both corporations filed their respective petitions to the legislature of this Commonwealth at their last session, praying for this liberty, which petitions were not acted upon, in consequence of the right reserved to the Western railroad to buy the West Stockbridge railroad, but were continued to the present session.

With these views, the Hudson and Berkshire railroad corporation, (by James Miller, their president,) subscribed a large amount to the stock of the West Stockbridge railroad corporation, and put on the superstructure, and nearly completed the stone depot, at the eastern termination of said railroad, before the first report was made. Since making said report, said company have completed said stone depot, and have erected a stone engine house, and store house, and wood house, at said depot, and have been running their locomotives and cars over said West Stockbridge railroad, since making the first report under a lease, in which said company were obligated to pay an equal amount of the nett proceeds of both roads, proportionate to the cost of each road, by the first day of April next, the expiration of said lease. By reason of this understanding, said West Stockbridge railroad corporation, have not been as particular, as they otherwise would, but have permitted said Hudson and Berkshire railroad corporation to put on said superstructure, and erect said buildings, and are unable to state the cost of the same, or the income of the road, as the account has not yet been rendered.

By a statement of the Treasurer now exhibited, it appears that the rents of the corporation, have been,

From stockholders and advances made by directors,	$11,644 02
And the expenditures for land damages, grading the road, and building bridges, and incidental expenses,	11,310 14

All which is respectfully submitted.

Daniel Spencer, Jr., Erastus Crocker, Thomas Cone, Martin Hendrix, Lyman Hinman, Sylvester Spencer.

RECEIPTS ON THE HARLEM RAILROAD.

Fare for passengers for March, 1840,	$6,444 39
" " March, 1839,	4.634 16
	$1,810 23
Fare for January, February and March, 1840,	$15,369 83
Fare for January, February and March, 1839,	10,651 52
	$4,718 31

Showing an increase the first quarter of this year over the corresponding quarter of last year, of $4,718 31, equal to 44¼ per cent.

Total receipts for fare for the year ending on the 1st of April, 1840, is one hundred and four thousand, five hundred and one dollars fifty-four cts.

Erie Canal Tonnage.—The tonnage moving on the Erie Canal during the year 1839, by a late report of the State officers, amounted to 845,167 tons. Of this quantity 282,244 tons came on to the canal west of Montezuma intermediate to Buffalo, and from beyond our own State. The Oswego Canal yielded 221,014 tons; the Cayuga and Seneca, 26,300; Chemung, 36,089; Crooked Lake, 26,823; Chenango, 16,928—all entering the Erie canal east of Montezuma.

The product of the forest, in lumber, timber, etc., floated on the Erie canal, amounted to 437,736 tons. From agriculture, in breadstuffs, the tonnage was 124,683, being less than the average tonnage in these articles for the last six years. The forest is decreasing, while it is certain that agriculture, manufactures, and other articles will not supply the deficiency for a long period of time.

That the capacity of the Erie canal, *in its present state*, even with single locks, is adequate to the transportation of all the products of the forest, agriculture, etc., is proved from the report of the commissioners of the canal fund, in Assembly doc. No. 63. It is stated page 12, that the tonnage has decreased from 753,191 tons, coming to tide water in 1835, to 602,128 tons in 1839; a falling off of 151,062 tons. Further, the lockages, at the most crowded point (Alexander's lock, three miles east of Schenectady) has decreased during the last six years from 25,798 to 24,234—to 1564 lockages. It is stated that 242 lockages have taken place in one day, without full employment to the canals, viz. 177 lockages east, and 65 west. This would give at the same rate, for the last season of navigation, 51,186 lockages, instead of 24,234; in other words, it is a true indication of the capacity of the canal.

Under this view, is it not better to let the Erie canal rest for the presen and turn our resources, if they can be safely used, to complete our railroad system? The west will soon think so—the north and the south are already of this opinion. The improvements in the locomotive engine, and its capacity to draw large loads, at cheap rates, is claiming the attention of our neighbors. Massachusetts with her great western railway, will soon have a line from Boston to Buffalo. This will soon convince us in New York, that we must depend on something more efficient than canals and the Hudson river, to compete with our enterprising and prudent neighbors.

J. E. B.

[The great importance of the following report induces us to publish it entire, with the exception of the details of the property, depots, &c. which are of no use to the professional reader, and occupy many pages of the pamphlet.

It may be remarked that this report contains the first complete description ever given of these works by the company.]

REPORT OF THE JOINT BOARD OF DIRECTORS, TO THE STOCKHOLDERS OF THE DELAWARE AND RARITAN CANAL, AND CAMDEN AND AMBOY RAILROAD AND TRANSPORTATION COMPANIES, ON THE COMPLETION OF THEIR WORKS; WITH THE PROCEEDINGS OF THE STOCKHOLDERS—AT THEIR MEETING ON THE 29TH OF JANUARY, 1840.

The works of the Delaware and Raritan canal, and Camden and Amboy railroad and transportation companies, are all completed in the best manner, and the heavy expenditures constantly accruing during the progress of their construction, are now at an end, upon which auspicious events, the directors offer their hearty congratulations to the stockholders.

A detailed statement of the property, owned by the companies, of all moneys received and payments made on account of the same, with the books of entries, authenticated by vouchers for the smallest sums expended, are herewith submitted for your inspection.

The management of your affairs, either good or bad, as you may this day determine, devolves upon the present board of directors. They have superintended them from the commencement to the present moment, and they welcome you most cordially to this examination, and hope for their credit, as well as your own and the public satisfaction, that you will give to it, the character of a most thorough and rigid scrutiny.

The accompanying statements will so clearly show the value of your canal and railroads, and the unexampled prosperity of the companies, that the directors feel it necessary to make some apology for indulging themselves in a single remark on the subject, and hope to find there excuse in the pride they feel in having directed these works, from their begining to their final and triumphant completion. Formerly the passage between Philadelphia and New York occupied from eleven to twenty hours; and was performed with great personal discomfort, and no small hazard of limb and life. Merchandize was transported from city to city at great expense of insurance as well as of freight, and subject to all the difficulties, uncertainties and dangers of a coasting voyage. Now passengers are carried from city to city, during the most inclement seasons, in from six to seven hours, and with nearly the same comfort as they enjoy at their own fire sides. Merchandise is transported in less time, with less expense, and with an entire saving of the insurance.

They congratulate you on the immense public good that you have done. You have, at a less cost than other works of like magnitude, finished the greatest and most valuable part of a system of internal improvement, you have completed for your country the most important link in the chain of communication between the northern and southern sections of the United States, which will afford to the general government the means of transporting their troops, and all the munitions of war, as well as the mails, in much less than half the time heretofore occupied, and at prices, which in comparison with like transportation during the last war, will save many millions of dollars to the public treasury. You have been mainly instrumental in bringing New York and Philadelphia in close proximity; in increasing the intercourse between these cities, from fifty-two thousand to one hundred and eighty-one thousand five hundred persons a year, and in reducing and equalizing the price of travelling, and also of fuel in New York and in the Eastern States. But while you have had such high aims for the general good, you have nevertheless regarded the interests of New Jersey as the "chiefest thing;" nor have you in our judgment miscalculated those interests.

You have constructed for *sixty-five* miles, through the heart of New Jersey, the *most* spacious canal, which adds year after year, thousands to the value of her agricultural interests, while it carries with it wealth and happiness to her citizens generally, and which may be referred to, as a lasting monument of the sagacity of New Jersey statesmen, and of your patriotism and munificence.

Besides making this expensive canal for them, you now furnish to the State of New Jersey an annual sum sufficient to pay the expenses of the State Government; and which will no doubt increase, so as to enable her to lay by the means to purchase all your works at the expiration of the lease, which you hold under her.

It is a matter of especial congratulation, that these gratifying results to the puclic have been obtained under the protection and patronage of various Legislatures, without distinction of party, and without any infringement of private rights, and may well stir up the pride of Jerseymen, when they look around and see the mortification and embarrassments, which have followed other systems of improvement adopted by different States of the Union. We, therefore, most earnestly congratulate you upon these public benefits, which through you have been achieved.

We now proceed to say a word or two in relation to the value of your property, and the tenure by which you hold it. Although you have paid for it, and New Jersey has not advanced or even loaned one dollar towards it, still the fee is in her, not in you. You are the lessee for a term of years only, and the State can, after re-imbursing you, dissolve the corporations; the railroad at the expiration of thirty years from and after its completion; and the canal at the expiration of fifty years from and after its completion. The relation that exists between you and the State, is simply that of landlord and tenant, with leave to improve, under limitations and restrictions, dictated by the State, on full advisement, accepted by you, and ratified year after year by different Legislatures, with all the solemnities of constitutional enactments and plighted faith; and it is with high emotions of State pride that we thus publicly bear witness, that amid all the taunts and reproaches heaped indiscriminantly upon corporations; amid the most earnest and plausible supplications of intriguing and designing men, amid the most extravagant offers of remuneration, New Jersey, her people, and her Legislators have stood firm to their own laws, and have invariably treated with contempt all efforts made to seduce her from her honor or her obligations towards you; and you may rely upon it that she never will allow you to be disturbed in the enjoyment of your corporate rights, especially as it has been your pride and constant endeavor to observe, on your part, the obligations you are under to the State. And why should she?—It is alike her interest, as well as her duty and wish to maintain inviolate her contract with you. She has leased for a valuable consideration, the rights you possess by your corporations, for the periods before specified. And what is thirty or fifty years in the lifetime of an Empire? Scarcely time enough to give a fair opportunity to determine whether your untried and adventurous experiment would succeed. The State is satisfied with the lease; she gives nothing, and gains every thing; she has furnished to her own citizens and the public, a communication as cheap, safe and expeditious as any in the country. Not only have these important works been secured, but the companies by their contract are restricted to the sum of three dollars for the transportation of passengers from city to city. If there is truth in experience and figures, you ought likewise to be satisfied your property, after a careful examination, is thought to be worth more than you have paid for it, if judged by the cost of other works of like kind here or abroad. The works have been constructed with rigid economy, having a proper regard to their durability, and will compare advantageously with any other, either in this country or elsewhere. A distinguished engineer from England, has recently examined them with attention, and has pronounced this opinion. The great object with the directors has been to preserve your capital unimpared; and so to construct the works as to keep them as far as possible from deterioration, and up to this time they are as good as the day they were first used. They have become settled and firm.—Your capital, therefore, is not only quite safe, but has been improved.

We will now inquire how profitably it has been invested.

The receipts for the last six months show a profit of seven per centum, which, considering the depression of all kinds of business, is, in itself, enough to satisfy you as to the value of the investment. But to make "assurance doubly sure," let us look throngh the accounts for years past, and ascertain whether these receipts have been the effects of sudden and unexpected good fortune, or the quiet and natural result of a regular increasing business. It will be seen that there has been, from the commencement up to the present time, a regular and progressive increase of nett profits. As will appear from the following tabular statements, which have been taken from the books of the company by the committee, and may be relied upon as the true results of the several designated years:

An annual statement, showing the number of passengers and tons of merchandise transported across the State over the Camden and Amboy railroad.

Columns A. A. show the *relative* increase or diminution, of the number of passengers and tons of merchandise transported across the State. The year 1833 being estimated at a hundred.

	Number of Passengers.	A	Weight of merchandise	A
From Jan. 1st to Dec. 31st, 1833	109,908	100	6,043	100
" " 1834	105,418	95½	8,397	139
" " 1835	147,424	134	10,811	178¾
" " 1836	163,731	149	12,508	207
" " 1837	145,461	132½	10,642	176
" " 1838	164,520	149¾	11,765	194½
" " 1839	181,479	165	13,520	223¾

Yearly statement of receipts and comparative statement of the same.

No. 1. Date. No. 2, Gross amount of receipts. No. 3, Comparative statement, showing the relative proportion that the receipts of the different years bear to the receipts of the year 1833. No. 4, Gross expenditures. No. 5, Shows the relative proportion that the expenditures bear to the receipts of the year 1833. No. 6, Nett gain. No. 7, Shows the relative proportion of the nett gain to the receipts of the year 1833.

No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
From Jan. 1, to						
Dec. 31, 1833	468,142 50	100	287,091 90	61½	181,050 60	38½
" " 1834	546,993 54	117	313,261 69	67	233,731 87	50
" " 1835	679,463 63	146	317,491 76	69	361,971 87	77
" " 1836	770,621 28	165½	363,344 90	78	407,276 38	87½
" " 1837	731,995 24	156½	359,510 44	77	372,484 80	79½
" " 1838	754,989 89	161½	355,249 10	76	399,740 79	85
" " 1839	685,329 76	146½	258,043 48	55	427,286 28	91¼

From this statement it appears that there has been an annual increase of the nett profits of the companies of 20 per cent.

From the derangement of the monetary affairs of the country, and the stagnation of business for several years past, it will be at least fair to judge of the future prospects of the companies by the past. Supposing then there should be no greater increase for the next seven years, the nett profits will be in seven years from this time, one million and forty-two thousand dollars; from which deducting the interest on the loans, viz. one hundred and ninety thousand dollars, will leave the sum of eight hundred and fifty-two thousand dollars, or a dividend of upwards of 28 per cent. per annum.

It would make this report too long to enter into all the particulars that might be stated, fully to illustrate the causes of such a constantly increasing business. The following may serve to give you some idea of it, and of the progressive value of the investment. Two years since, at the request of some market people, in New Jersey, a line called the pea line, with two cars, was occasionally started from Camden to New York, with no other view or expectation than the accommodation of a very useful and respectable class of men. This line has steadily increased, until it has become profitable beyond all expectation. During the past year, it has been running daily, sometimes taking with it as many as sixteen cars laden, at the appropriate season, with peas, peaches, potatoes, asparagus, cabbages, live stock, and upon one occasion, (as incredible as it may seem) thirty tons of green corn. This connected with the gradual increase on the other lines, will enable you to judge, what you may fairly expect in a few years hence; always bearing in mind, that the expenses do not increase in the same ratio with the receipts, because the same capital can do a larger business, whilst the interest to be paid remains the same.

(To be continued.)

A Good Move on the Western Railroad.—At the annual meeting of the stockholders, held on the 12th inst. it was voted unanimously, to instruct the directors to reduce the rates of fare and freight between Boston and Springfield one-third. The rates will be now 2.50 from Boston to Springfield, for passengers, and 3.75 per ton for freight. Thus inviting to the Boston market the trade of the whole Connecticut valley, by the strongest inducement, viz., a cheaper rate of fare and of freight than to any other market for sales or for supplies.—*Boston Gazette.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 9, Vol. IV. New Series.	MAY 1, 1840.	Whole No. 357. Vol. X.

☞ We request the attention of our readers to the article in this number entitled "English and American Railroads." We have reason to believe that it comes from a gentleman who from vast experience and information, knows when and where to institute comparisons, and independently of the merit of the article, its authority renders it worthy of notice.

In the number of this Journal for April 1st, we published an article containing strictures upon Prof. Renwick's paper, appended to the last edition of Tredgold on the Steam Engine, etc. The tone of these remarks is not as calm and philosophical as it might be, we should rather say—as it ought to be. Had the writer been more sparing in his epithets, and exhibited less warmth of manner, we think far more weight would have attached to the article in question, than in its present form. However, we are not now about to quarrel with words—neither do we profess an intimate acquaintance with the detail of certain historical questions—but we propose at present to point out a few portions of the paper which appear to need particular notice.

The following remark occurs in the paper of Prof. R. "in a treatise on the steam engine, which it is believed had some influence in the improvements that have since been made in navigation by steam, it was demonstrated, that a power of a given engine might be doubled by loading the safety valve with 57 lbs. per square inch, and cutting off the steam when 1-8 of the cylinder has been filled, and a saving of 2-5ths of the fuel effected at the same time." It is thus replied to by Mr. Ward. "If by a 'given engine,' in this passage, is meant one worked by steam of the force of 4 or 5 lbs. per square inch, we have to remark, with due deference to the demonstrator, that practice has, and ever will, and inevitably must prove this and all similar demonstrations, to be drawn from erroneous premises." If this is correctly understood by us, it is, we conceive a most sweeping assertion, not borne out by "practice." To prove, however, that it is borne out, a table is introduced, showing the "relative consumption of fuel by the British engines, which use low steam, and some of the fast running American boats, which are worked by steam approaching pretty nearly to the economical pressure of 57 lbs. per square inch."

To render this table complete, we should have the *average velocity* of the vessels—the number of strokes per minute, and the area of the immersed portion of the transverse section. We should then be able to form some idea of the proportion of the engines to the vessel, and of the amount of power expended in obtaining high velocities. Without these elements the comparison, to be fair, should only be between vessels having the same size and moving at the same rate. We should then be better able to oppose "facts" and "theory."

It is hardly necessary to refer in this place to the various statements to be found of the value of the "expansion" mode of working. But two references will suffice. Dr. Lardner in his work on the steam engine, after pointing out the error of Woolf's views, as set forth in his patent, says, "yet so far as his invention suggested the idea of employing steam at very high pressure, and allowing it to expand in a much greater degree than was contemplated either by Watt or Hornblower, it became the means of effecting a considerable saving in fuel, for engines used for pumping on a large scale, the steam being produced under a pressure of forty or fifty pounds, or more upon the square inch," etc. He then goes on to say, that this principle is now applied in the form originally proposed by Watt.

But lest it should be asserted that Dr. Lardner's statements are *theoretical*, we beg leave to refer to the article in the first volume of the Papers of the Institution of Civil Engineers, for a full account of the measured duty of the Cornish engines, together with their consumption of fuel. In these engines the pressure is raised to about 40 lbs. to the square inch, and the steam is cut off at one-third, one-fourth one-fifth, one-eighth, or even one-tenth of the length of the stroke, according to the work. In the English Journals, numerous statements under the highest authority, show the economy of this mode of working steam, and although intended for quite different purposes, these engines will give some idea of the value of the principle.

The next criticism is upon the opinion expressed by Professor R. as to the mode of improving the performance of the Great Western, stigmatised by Mr. Ward as "grossly erroneous and highly mischievous." This opinion is as follows, "on examining this vessel and comparing her performance with that of American steamboats, it is easy to perceive that her speed might be very materially increased, without making any important change in her engines, and probably with a saving of fuel. It would be necessary to modify the boilers so as to convert a less quantity of water than they now do into steam, but to furnish it of a tension of 20 or 30 lbs. instead of 3½, which they now carry, nor when the boiler is of sufficient strength, need any increase of danger be apprehended from using steam of this medium pressure. It is now well established, that the mere pressure of steam is among the least important causes of danger, and that such as are most to be apprehended are as likely to occur in using steam of a single atmosphere, as that of ten or twelve." The comment runs as follows, "This whole paragraph is made up of errors; but the last sentence, in which is repeated the absurd and dangerous idea that the *pressure* of steam has little or nothing to do in the bursting of boilers, when such disasters occur, is the most surprising. What else than the pressure of steam ever yet produced an explosion in a steam boiler? What else can find a place in a steam boiler, while at work, to produce one? The existence of any other cause has not only never been proved, either by reasoning or experiment, but the non-existence of other causes which have been supposed to produce explosions, may be inferred from the circumstance, that in every case where the facts could be made out, after an explosion has occurred, the pressure of steam has been found to have been abundantly sufficient to produce the effects observed; and when the same conclusion *must* be arrived at by reasoning from the known laws of caloric vapor, it is melancholy to find such an opinion promulgated to the world through such a channel, and with the sanction of a respectable name—and it is to be hoped that further reflection, etc." Here is a very serious misapprehension of the latter portion of this "unfortunate opinion." How any one can construe the statement that "the *mere* pressure of steam is among the least important causes of danger," into one like this, "the *pressure* of steam has little or nothing to do in the bursting of boilers," it is not easy to conceive, if we bear in mind the meaning of the English word *mere.* If in the first sentence we substitute the words "existence of a boiler," for the words "pressure of steam," and we shall have by this new mode of translation, "the existence of a boiler has little or nothing to do in the bursting of boilers." In fact, the whole concluding paragraph contains an insinuation that Professor Renwick believes in the existence of some mysterious agent capable of bursting boilers, *ad libitum.* Where such belief is expressed, we cannot say; and it is rather remarkable, that in all the writings, conversations, or lectures of Professor Renwick, his opinion should have lain dormant until elicited by this new mode of translation.

But lest we should be considered as evading, by a mere form of words, we beg once more to refer to authority. Mr. Redfield, in his communication made to the commissioners appointed by the English Government for conducting an inquiry into the causes of steamboat accidents and the practical means of preventing their recurrence, has the following. "That the safety of steam boilers from explosions does not necessarily depend upon working with so low a pressure as five or seven pounds to the square inch, and that a reasonable increase in the proportionate strength of the boilers in steam vessels would remove all immediate hazard, and nearly end the catalogue of these disasters, is rendered apparent by the facts which relate to this branch of navigation as it has been carried on in various directions from the city and port of New York." Again, "It must not be supposed, however, that the average pressure of steam now used on the New York steamboats can be greatly increased, without incurring material hazard. The thickness which is found most suitable for boiler metal and the practical and economical limits of form and size, are such as should prevent us from allowing a maximum pressure exceeding one and a half or two atmospheres above the common boiling point, for condensing engines; and an addition of about one atmosphere for high pressure engines, which are worked without a condenser and air pump. To these limits, *if an adequate system of boiler construction be adopted*, the pressure may with safety be carried, as is done in locomotive engines, in the use of which, owing to a better system of construction, fatal accidents have been less frequent, perhaps, than with low pressure marine engines."

In making the foregoing remarks, we have not pretended to advocate any system of extra high pressure, but merely to point out the fact, that the opinion so severely remarked upon, is not an uncommon one, and that we have the authority of a *practical* man, and a very cautious one too, for considering that there may be another opinion than the one entertained by Mr. Ward.

The testimony of almost all practical and well informed men is, that the *mere* use of steam of 40 or 50 pounds pressure per square inch, as in locomotive boilers, etc., is not the *cause* of danger; and that the use of such pressures in boilers of competent strength, skilfully and carefully managed, is less dangerous, if not more economical, than a low pressure, depended upon as safe, merely because it is a low pressure.

For the American Railroad Journal and Mechanics' Magazine.

ENGLISH AND AMERICAN RAILROADS.

I have lately seen the last half yearly reports of several English railway companies, and thought that a comparison of the results contained therein with those of the American railroads, would be of some interest for your readers, and as the railroads constructed in Massachusetts bear the most resemblance to the English, I have chosen for a comparison the rai lroads near Boston, for which the last "Annual reports of the railroad corporations in the State of Massachusetts," furnish the necessary data.

The following statement is extracted from the reports of five of the most frequented railroads in England.

Name of Railroad.	Length in miles.	Cost of whole road.	Cost per mile.	halfyearly gross receipts.	half yearly expenses.	Nett profit.	Proportion of receipts to expenses.
		£	Dolls.	Dolls.	Dolls.	Dolls.	
Liverpool & Manchester	32	1,398,552	211,909	706,878	401,483	305,395	100 : 57
Grand Junction,	79 1-4.	1,900,000	94,756	1,099,422	523,218	576,204	100 : 48
London & Birmingham,	112 1-2	5,600,000	241,422	1,674,385	681,202	993,183	100 : 41
London & Greenwich,	3 3-4	608,000	786,347	134,078	90,914	43,164	100 : 68
Leeds and Selby,	20			134,054	98.256	35,798	100 : 73
Total,	265 1-2			3,748,817	1,795,073	1,953,744	100 : 48

In making the reductions, the pound Sterling is taken at four dollars eighty-five cents.

The average cost per mile of the above first four railroads with an aggregate length of $245\frac{1}{2}$ miles, is 38,723*l.*, or $187,706, while the average half yearly receipts are $14,120 per mile, being at the rate of 15 *per cent* annually in the cost of the railroads; at the same time the expenditure per mile of road was for the half year 6761 dollars, equal to 48 per cent. of the gross revenue, and leaving 7359 dollars as the net profit, which is at the rate of $7\frac{84}{100}$ or nearly 8 *per cent. per year on the cost of the roads.*

It therefore appears that although the railroads in England are constructed at an enormous expense of 187,706 dollars per mile, the nett income per year is nevertheless 8 per cent. on their cost, which favorable result can only be attributed to the immense number of passengers, conveyed annually over these roads. The number of psssengers which passed over the London and Birmingham railroad in the year 1839, was 608,564, of which each performed, at an average, a distance of sixty-five miles. The number of passengers on the Greenwich railroad during the same year, was 1,513,435.

The following is now an analogical statement of five railroads in America, showing the results of their operations in the year 1839.

Name of Railroad.	Length in miles.	Cost of whole road.	Cost per mile.	Yearly receipts.	Yearly expens's	Nett profit.	Proportion of receipts to expenses.
Boston and Lowell,	26	1,608,476	61,864	241,220	92,151	149,069	100 : 38
Boston and Providence,	42	1,850,000	44,048	313,907	100,031	213,876	100 : 32
Boston and Worcester,	44 1-2	1,848,085	41,530	231,807	126,385	105,422	100 : 55
Nashua and Lowell,	15	353,662	23,577	55,054	28,658	26,396	100 : 52
Eastern,	13 1-2			125,623	53,176	72,447	100 : 42
Total,	141			967,611	400,401	567,210	100 : 41 2-5

The average cost per mile of the first four railroads is $44,394; the Eastern railroad has only been in operation through the year, on a length of $13\frac{1}{2}$ miles, the cost of which will not materially differ from the average of $44,394 per mile. The English railroads above specified, are therefore $4\frac{1}{4}$ times more expensive than those near Boston; the latter have, however, for the greater part, only single tracks, while the English have double tracks throughout.

The gross income per mile of road, was $6862, or $15\frac{1}{2}$ per cent. of the cost of the roads, which is very near the same as on the English railroads. The expenditure per mile was $2840 (41 per cent. of the income,) leaving as nett revenue per mile $4022, or *nine per cent.* on the capital expended. Thus it appears that while the gross receipts bear the same proportion to the cost of the railroads both here and in England, the expenses are less here, leaving therefore a greater nett income in proportion to the capital invested.

It is a known fact, that the expenses on railroads do not grow in the same proportion as the traffic increases, and the greater the latter therefore, (the charges for transportation remaining the same,) the better proportion will the nett profit bear to the gross receipts; that is, while the nett profit on the railroads in Massachusetts is now 59 per cent. should the traffic increase four-fold, the nett profit would be 70 or more, per cent. of the gross receipts. Now the gross receipts on the English railroads above mentioned, *are* four times as large as on those in Massachusetts, the charges for transportation there, being at least, equally high, and the nett profit is only 52 per cent. of the gross revenue; thus showing that the management of the railroads in America, is in a considerable degree cheaper than in England.

Your's truly,

K.

A Constant Reader of the Journal.

Philadelphia, April 6, 1840.

For the American Railroad Journal and Mechanics' Magazine.

Cuba, Allegany Co., March 27th, 1840.

Messrs. Editors—If the writer of the article on crank motion in your last number (March 15th) will examine Tredgold on the steam engine, vol. I, appendix p. p. 173 to 182, new edition by Weale—he will find a correct general investigation of the crank motion, by W. S. B. Woolhouse, F. R. A. S., &c.—from the concluding remarks of which, I have copied the following, which may be interesting to some of your readers.

Yours, &c., Henry Tracy.

"We have gone thus far into an investigation of the motion of the crank, as it forms one of the most important instruments of the steam engine, and has hitherto met with very little attention from scientific writers. It is, doubtless, the most simple, and perhaps the most efficient, contrivance, that can be devised to convert a reciprocating into a rotatory motion; and in this respect we cannot be surprised that it has not been superseded by any of the numerous inventions that have been proposed with the view of dispensing with it. We are compelled, however, at the same time, to admit that this beautiful simplicity is accompanied by corresponding inconveniencies, in the inequalities of motion, pressure, friction, and consequent wear. The mechanical defects of engines constructed on the rotatory principle appear to be of greater magnitude, and the disadvantages and difficulties that stand in the way of their application to the most important uses, are of a very formidable nature. This is much to be regretted, as we conceive a perfectly equable motion to be a great desideratum in the steam engine; and the only hope we can have of succeeding in obtaining it is in the exclusive employment of rotary action. On this head we may refer our readers to an instructive paper, entitled "On the Fallacies of the Roatry Steam Engine," by John Scott Russel, Esq., a gentleman to whom practical science is much indebted. One of the leading objects of this paper, which is printed in the Edinburgh New Philosophical Journal for Janurry, 1838, is to show that no loss of power is sustained by the intervention of the crank; but, in doing this, it should be remarked that the author has throughout this paper discussed only the particular case in which the power moving acts on the crank in parallel lines, or in which the connecting rod is supposed to be of infinite length, and that this necessarily reduces many of his statements into mere approximations, when the subject is generally considered. Mr. Russel has, however, handled the subject with considerable power, and his remarks are, perhaps, sufficiently precise for the object he had in view, viz., to dispel the delusion under which many practical men labor, with respect to the nature of the crank, that it is attended with a loss of nearly one-third of the power. It is well known that persons are to be found who have been the subjects of this delusion, as well as inventors who have been its victims, but we cannot concur with Mr. Russel, "that some eminent standard writers on the steam engine have advanced the same doctrines." Most writers who are accostomed to treat these matters scientifically have doubtless considered that no reasonable dispute could possibly be entertained, and have thought it unnecessary to make any declaration on the point in question. We may, however, be allowed to refer to one exception. At page 137 of "Hann & Dodd's Mechanics for Practical Men," the very question is taken up, and comprehensively disposed of in the following paragraph:—

"'In the crank, as applied in the steam engine, the effect which is produced is to the effect, were the force to act perpendicularly on the crank all the way round, as twice the diameter of a circle is to the circumference; in consequence of which, many practical men have considered that there is a corresponding loss of power by using a crank; without even considering that the piston, or moving power, only moves through twice the diameter of the crank's orbit, while the crank moves through its whole circumference. For here the same principle holds good, as in all other mechanical contrivances, viz., the power multiplied by the space which it passes over, is equal to the weight or resistance multiplied by the space which it passes over.'"

"These statements have since found their way into other mechanical works of more recent date; and it is certainly of some moment that practical men who have not the means of following out theoretical investigations of these subjects, should be thus guarded from an error by which many of them have been as widely misled. That no power is gained or lost by the use of the crank has already been established on dynamical principles at the commencement of this paper. We are not, however, to conclude that this principle is at all peculiar to the crank. It is well known to apply to every combination of the five elementary powers, and by the principle of virtual velocities it may easily be shown that it is an universal property of mechanical arrangement, *that with every possible mechanical combination, no power can be gained or lost, if we except the resistance occasioned by friction.*"

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

Permit me to make a few remarks in reply to Mr. W. R. C.'s communication, who says, that my "*theory*" appears to be founded on a mode of representing a given force by a surface, instead of, as usual, by a line.

Whoever will take the trouble to examine my communication with attention, will see, that no such error has been committed, which indeed would be too palpable to escape the notice of any one, who is at all versed in mathematics. It appears, that Mr. C. in his critique, was impressed with the same idea, which led him to the discovery of the grand error in Dr. Lardner's publication on Railway Constants.

There is a distinction between a *resting force*, (a dead pressure, or a power in a state of quiescence,) and a *moving force*, which is exerting itself. The *resting force* or *pressure* of the prime mover is the power, with which it is ready to act at any moment; the *moving force* or *motive power* is the *momentum* of the pressure, and equal to the product of the pressure into the space, through which it has moved. The simple dead pressure or its measure may be represented by a straight line, and also the space through which it has moved. The product of both, or the *momentum of the power*, or what is the same, *the amount of power expended*, is therefore to be represented by the area of the rectangle, the sides of which correspond to the pressure and the distance of its motion.

The term *momentum* is also used to express the product of a pressure into a leverage. I have made use of that term in both senses, because they are essentially the same.

Mr. C. says, further, (page 205,) "the crank pin has therefore moved 11·48 times further than the power, and if the force with which it has moved through this distance, be in the inverse ratio of the length of the arc *a* 1 to the line *a* 1″, the dynamical effects will be the same."

This is a demonstration on the principle of virtual velocities, *what is gained in space is lost in power*, and if this principle was as well applicable to rotary motions as to straight motions, the matter would be simple enough. But I contend, that the above principle is not directly applicable to the case in question, but that the change of a reciprocating straight motion into a rotary motion, is attended with a loss of power. If the crank pin was moving in straight lines, then the dynamical effects would be equal.

You will please to recollect, that the laws of rotary motion are as yet but imperfectly understood, and that those who applied the principles of straight motion, to rotary motion, as in the case of the crank, did so, without reflecting much on the matter, and because it had never been properly investigated.

The last remarks of Mr. C. with respect to the connecting rod are correct. This consideration, having no direct bearing on the question, was omitted by me. The connecting rod is supposed to be infinitely long, and the direction of the moving force therefore always parallel.

Yours very respectfully,

JOHN A. ROEBLING.

Harrisburg, Pa. April 8th, 1840.

For the American Railroad Journal and Mechanics' Magazine.

HASSARD AND CO.'S FRAME BRIDGES.

The frame bridges as erected on the Western, Norwich and Worcester and Housatonic railroads, are on the plan of Hassard & Co., their construction being somewhat different from any heretofore erected, we propose describing, as clearly as we can without reference to a drawing, some of the principal features wherein they differ from a plan for which the Engineer department have been long and greatly indebted to Col. S. H. Long.

The counter braces, as used in Col. Long's patent, are dispensed with. The truss frames are of large dimensions, giving broad and strong shoulders in the posts for the panel braces, and to prevent a too great strain upon these shoulders, arch braces are introduced bearing against the upper centre string, and running from between the posts of each panel, conveying the load directly to the abutments or piers, and thus relieving the panel braces. To prevent the upper inside shoulders of the posts from receiving the whole pressure which would be applied to them by the arch braces bearing against the upper centre string, the arch brace is shouldered into a deep bearing piece which runs between the posts under and against the upper string Through this bearing piece as it passes each post, a bolt is introduced, by which means, the upper inside shoulders of the posts are relieved, and the load conveyed in a measure direct from the posts to the arch braces. This mode of construction combines the system of panel bracing with arching, the arch braces serving to relieve and assist the panel braces and *vice versa* —each being without the other a perfect structure. Another great desideratum is that the support is not at all points equal, but the strength of the frames increase with the strain; this is effected by bolting the posts to each arch brace as it passes between them, and thus giving to each set of posts as they approach the abutments or piers an additional brace, and adding strength in the proportion it is required—supposing the number of panels should require six arch braces running to each bearing point, you then have by this mode of structure, for, say the third panel posts (in addition to the heel and toe shoulders for the panel braces) form bearings by bolts to the different arch braces, together with their own proper arch bearings against the upper centre string.

In addition to the structure as above described, with a view to relieve still further the shoulders in the second and third panel posts from the pressure of the panel braces (these points being more especially affected by the load and the reaction) short open braces are well secured by means of bolts and keys to the panel braces and are made to bear against a third shoulder in the posts.

The mode of footing the arch braces renders it easy to regulate their bearings by means of wedges—the strings of each truss frame project about three feet beyond the end panel posts over each abutment, about twelve or fifteen inches from their termination, two parts are erected side by side, and secured by the strings in the same manner as the panel posts; against these, on their inner side, and resting on the lower strings, is placed a hard wood block or casting, well secured, and formed with steps to receive the arch braces. On the outer side of these end posts at the right angle formed by them with the lower strings, are placed strong cast iron brackets to assist the end shoulders of the strings in receiving the thrust of the arch braces. Over the piers a sufficient space is left in the strings between the last panel posts of each span, to erect bearing or thrust posts and allow blocks or castings for the foot of the arch braces to be placed on each side of them.

Where the span is of great length and the elevation will admit, we perceive by a drawing, that instead of using one lower centre string, two are applied, making four lower strings to each truss, the object in framing thus is to apply the arch braces at a better angle, by passing them between the centre strings to a point in the abutment or piers below the seat of the bridge—the abutments and piers in such cases are built with an offset to receive a cast iron shoe, formed with steps for the ends of the braces. To guard effectually against any rupture at the splices in the lower strings where the strain may be very great, a double set of strings are applied to these break joints with each other, and thus prevent all possibility of separation.

For the American Railroad Journal and Mechanics' Magazine.

OFFICE OF THE NEW YORK AND ERIE RAILROAD CO.—Owego, April 15th, 1840.

GENTLEMEN—I herewith forward to you, *specifications* for the *materials and construction* of the Susquehannah division of the New York and Erie railroad, presuming that their publication in your valuable Journal, particularly that portion of the road that is to be constructed upon *piles*, would be acceptable to your readers generally.

This division, extending from ***Binghampton*** in Broome county, to ***Hornellsville*** in Stuben county, along the valleys of the *Susquehannah*, the *Chemung* and the *Canisteo* rivers, *one hundred and seventeen miles* in length, was put under contract February 10, 1840—to Messrs. Manrow, Higinbotham & Co.—to be completed by July 1st 1842.

The contractors are men of established reputation, and possessing a perfect knowledge of the manner of constructing a railroad upon piles, having been engaged as practical engineers, and superintendents upon the Syracuse and Utica railroad during its construction.

Over *one hundred miles* of this division will be constructed upon *white oak* piles, according to the accompanying specifications, at a cost of *fifty* *per cent.* less than the *original* estimates for a *graded* road. Sufficient *white oak* timber is now being cut, and delivered along the line of the road, in the counties of *Tioga, Chemung* and *Stuben*, to construct *thirty-six* miles of *pile* road. *Six* of *Cram's patent steam pile drivers*, from the shops of *Pond, Higham & Co.*, of Utica, will be put in active operation by the middle of May, each one of which, will drive *one mile* of pile road per month, making the *thirty-six* miles by November next. The cross-ties will be placed upon the piles as fast as they are driven, and the longitudinal rails and iron during the ensuing winter.

An abundant supply of suitable *white oak*, is found within a short distance of the road. It is purchased by the railroad company for *half stock*, at par, and *half cash*, at an average price of 2½ cents per lineal foot for *piles* and *cross ties*, and $12 per thousand feet, board measure, for the rail timber, delivered on the line, making the whole cost of timber less than $2,000 per mile. The entire cost of the *pile road* will not exceed $7,000 per mile, including an iron rail plate of *forty* tons to the mile, making one of the *cheapest* and most *permanent* roads that can possibly be constructed.

An examination of the *specifications*, will convince *all* of its *permanency*, and a knowledge of its advantages, will convert the *skeptical* to its practical *utility*. The superior advantages of a *piled road* (independent of *economy*) only requires to be understood to be fully appreciated by every unbiased mind.

If time permits, I may hereafter endeavor to show the relative merits of the two modes of construction, as practically tested, upon railroads now in successful operation in this country.

The maximum grade on the *Susquehannah division*, is thirty feet per mile, for short distances, on straight lines, and the minimum radii 1,910 ft. on *level* grades. *Two-thirds* of the whole curvature will exceed 6,000 ft. radii, and *five-eights* of the whole distance will be on tangent lines.

Yours respectfully, C. B. Stuart,

Chief Engineer Susquehannah division New York and Erie railroad.

The specifications referred to in the above communication will be found in another part of this number.

COMPARATIVE ADVANTAGES OF RAILWRYS AND CANALS.

We extract the following condensed views on this subject, presented more than ten years past, in Silliman's Journal, when railways were in their infancy. We understand they are from the pen of a distinguished Civil Engineer, now among the first in this State, Mr. E. F. Johnson. Had these views been listened to, the mania for canals, caught from our success with the Erie canal, would not have infected all parties. We should not have passed the laws for the construction of the Chenango canal, the enlargement of the Erie canal, the Black river and Genesee Valley canals—works that will entail on us a debt of fifty millions of dollars, without corresponding advantages, whilst on the branch canals, it is reasonable to assert, the public would now prefer railways.

1. "The resistance to be overcome on a level railway increases only at the same ratio with the speed, while on a canal all increase of speed is met by more than a quadruple ratio of resistance.

2. The facilities which railways afford for rapid rates of travel in the employment of steam. Rapidity of conveyance, in the intercourse of a country is of the first importance.

3. Canals must be made almost on a dead level, and the elevations must be overcome by expensive locks; whereas, railways may be so laid as to overcome an elevation of many feet to the mile.

4. Canals are often broken and rendered useless, till they receive extensive repairs and their locks frequently become defective and must be rebuilt at greater expense—railways are but little liable to interruptions of any kind.

5. Canals are often deficent in water in times of drought, while railways are in perfect order—railroads can be laid on summits, which afford little or no water for a canal.

6. Railways can be used at all seasons of the year, while canals in latitude 43 to 44, remain inoperative five to five and a half months in the year, and this too at the best season for disposing of agricultural products. This advantage alone, other things being equal, must give to railways an entire preference over canals. The experience on railways in England and in the United States is decisive on this point.

7. Canals are but imperfectly calculated to answer the wants of the travelling public—while railways afford the safest and best of all possible facilities for the purpose, and this too at a season of the year when our canals and rivers are closed, and when even our roads are next to impassible by the ordinary modes of conveyance.

8. Railways tend to drain the soil on which they are laid, while canals promote the increase of stagnant waters and unwholesome effluvia—a consideration of great magnitude.

9. Railways occasion less general hazard and loss of life than canals.

10. Railways occasion no obstruction in passing common roads, while canals require expensive and troublesome bridges.

11. Rivers are easily passed by railways on good bridges, canals require expensive aquaducts.

12. Railways afford more general accommodation to the country than canals, by enabling the occupants of farms to make outfits for market by branches.

13. The use of railways does not result in the deterioration of morals which usually attends the business of canals. A single person is sufficient to conduct a load on a railway, and his attention is necessarily engaged by the duties of his employment.

14. Much danger and loss is sustained on canals by *leakage of boats* and other casualties from which railroads are exempt. The business of the latter requires no inrurance.

15. The cost of a railway, is not more than half of that of a canal *through the same route.*" [In the instance of the enlargement of the Erie canal to 7 feet by 70 feet—a double track from Albany to Buffalo, will not cost one-fourth the sum necessary to enlarge the canal, to wit, $100,000 per mile. The railway will have four times the capacity of the canals, for general transportation at all seasons of the year.]

16. "Railways will in no case interfere with the right to the use of streams and water privileges—the reverse with canals.

17. Lines of railroad may in general be made more direct than canals, as in laying out the latter we are obliged to conform to the natural surface of the country."

In additton to the foregoing, it may be stated that,

The advantages of railways in a military point of view are of the first importance for cheap national defence. With steam frigates, for batteries in our harbors—aided by the prompt transit of troops of the United States, and the militia from the interior, the expense of large standing armies may be avoided.

In the event of war with England, the connection with Maine and the upper lakes by railways will save their cost in the transportation of munitions of war for defence. Railroads from Maine to New Orleans, and into the interior for the transit of the United States, mails are of the first consideration to commerce, and the defence of our sea-coast. They will be superior even to telegraphs. Troops can follow the signals, for the defence of any point attacked.

Experience, both in this country and Europe, has demonstrated the great superiority of railways. In New England, the Blackstone, Middlesex, and Farmington canals have been superseded by railways. The Delaware and Rariton canal is a failure, and a dead weight on the Camden and Amboy railroad. The Philadelphia and Baltimore railroad has taken the business from the Delaware and Chesapeak canal. The Baltimore and Ohio railroad is destined to supersede the Chesapeak and Ohio canal. After these facts, we would ask what is to become of the Chenango, the Black river and Genessee valley canals? The Erie canal, being on a thoroughfare desined to be the greatest in the world, *may* sustain itself. If the enlargement is continued to the size of seven feet by seventy, the counties on the tier of the Erie canal will get *money distributed in their region*, but the result will be to drive cheap transportation to the railroad, and by lake Ontario and the Welland canal to the upper lakes; and last, not least, prostrate the credit of the State.

J. E. B.

The road complete.—We are happy to state the entire route of the Wilmington and Raleigh railroad is completed. And passengers coming through on Sunday passed over it in the cars. We congratulate the public & the enterprising projectors on this happy consumation of a great work, and trust that it will prove as profitable as it is honorable to the Stockholders.—*Char. Mercury*, 10*th inst.*

Important Railway Discovery.—The Prussian State Gazette informs us that a M. Kalkenhimer has invented a new kind of carriage for railways, which will cost only 2500f. 100*l.* each, and which may be moved at the rate of six French leagues in an hour, without steam or horse-power. It states that a carriage containing 24 persons may be moved with the force of a single man.

☞ The price of freight on the Boston and Providence railroad, has been reduced from \$5 to \$3 per ton. The charge to passengers had been previously reduced from \$2 to \$1 50.

We learn also that the fare for passengers from Springfield to Boston is only \$2 50.

☞*Cheap Travel.*—The price of the fare on the railroad from Boston to Dedham, (distance ten miles,) was reduced, a week or two since, from 37½ cents to 25. Since the reduction, the weekly receipts of the road have nearly doubled.

Chesapeake and Ohio Canal.—On Saturday, the 4th instant, a public meeting was held at the Conrt-house in Hagerstown, which was attended by a large number of the citizens of Washington county of both politcal parties, the object of which, as stated by the chairman, Gen. O. H. Williams, was to take into consideration the propriety of calling an extra session of the Legislature of Maryland for the purpose, when convened, of making an additional appropriation for the completion of the Chesapeake and Ohio Canal to Cumberland. Mr. Thomas, President of the Canal Company, addressed the meeting, and, in the course of his remarks, as noticed in the Hagerstown Mail, stated that the present means of the Company were not more than sufficient to pay its debts, and that without further appropriation the work must stop—contended that a stoppage of the work, even for a time, would materially effect the credit of the State, and ruin many of her citizens. He showed the condition of the State finances, as connected with the canal, and urged with much zeal and earnestness the policy of making a further appropriation to the canal company at this time. H. H. Gaither, Esq. spoke in opposition, and was replied to by R. M. Tidball, Esq. in favor of an extra sesion and an immediate appropriation to the canal,

Resolutions were passed, setting forth the necessity of an appropriation and the propriety of an extra session at an early day for that purpose, and expressing the belief that an appropriation to the canal company would have been made at the last session if there had been a full attendance of the Senate when the canal question was acted on. A commitee of seven was appointed to communicate the resolutions to the Governor.

EIGHTH REPORT OF F. R. HASSLER, AS SUPERINTENDENT OF THE SURVEY OF THE COST OF THE UNITED STATES, AND OF THE CONSTRUCTION OF STANDARDS OF WEIGHTS AND MEASURES; RENDERING ACCOUNT OF THE WORKS OF 1839.

Upon the survey of the coast.

1. The proper organization and course of operation in a geodical work of such extent as the survey of the coast of the United States, is dictated by the nature of the country, and the relative position of its parts; presenting a long stretch of very unequal coast, with only such a breadth as the exigences of the work required; this dictated to begin at such an approximately central part of the country as would present the most facility and best prospects for large triangles, to serve as foundation of the work, and produce the greatest quantity of data for that purpose in the shortest time; presenting, also, within its limits, a locality for a base line of proportional length, and the necessary facility for its accurate measurement, from which the work might afterward spread in both directions of the country simultaneously, and alternately, as circumstances would dictate or allow.

2. Thence the work was begun in the neighborhood of New York sound, Long Island and its large sound, etc., which evidently present the requisites and qualifications above stated. The works of preceding years had filled up with the main and secondary triangulation, and the topographical, as well as the hydrographical detail, most part of the district from the Jersey shore of the Raritan and New York bay, till towards the east end of Long Island, the sound, and opposite islands, the shore of the main land of New York, Connecticut, till Black Point, etc.

3. The field works of this last season were in some measure a beginning of the stepping over from the eastern side of these works to the southwestern, to open on that side, also, the field for the topographical and hydrographical detail works through the southern parts of New Jersey, part of Pennsylvania, to the seashore of Jersey, along Barnegat Bay, and the Delaware.

4. All the survey of Long Island, as well the topographical, as the hydrographical part of its outer seashore on the south, and that of the sound to the north, had been completed the preceding years, till to Gardner's bay, of which a part of the sounding remained yet for this year.

5. The works of this year on the northern shore of the sound, include, as well the topographical, as the hydrographical surveys of Block Island, the numerous islands of Fisher's sound, and others, the shore of Connecticut, and Rhode Island, with their deep inland waters, from Black point, where the hydrographical works had ended last year, through the whole of Fisher's sound, so that the work reaches now on that side of the shores and waters of the eastern States.

6. The surveys on land were carried inland as far as the nature of the coast on one side, and the time on the other, dictated or allowed; always furnishing, to the hydrographical party, which is carried on parallel with the works on the shore, the fundamental points to ground their determinations of the points of sounding upon them; these works occupied one of the sounding parties, and a number of topographical parties.

7. The other sounding party finished the works in Gardener's bay; thence round Block Island, along the shores of the row of islands, turning up to the main, and a part of the main shore, in continuance of where the other party left off, from the side of Fisher's sound; a part of the same topographical parties furnishing the determining land points as always usual.

8. A second part of the work to be executed this year, in that eastern part of the survey, was the topography of the parts, between the country near the shore, surveyed with reference to the sounding more especially, and the limit of the main triangulation, farther in the interior; the former having always been accelerated in its progress, so as to assist constantly the hydrographers in their progress on the water, it could not be carried sufficiently deep, land inward, for all the wants of the survey in general, this part of the topographical works was therefore to be completed, and it required yet some secondary triangles to complete it, besides the plain table works. It appears, however, that the season will not serve long enough to prevent operation if it fall yet in next year's work. But this will not prevent the house works of maping, which are intended to be done the coming winter for that part of the country.

9. A work similar to the above, but of much smaller extent, was executed on the west side of the New York and Raritan bay through the county from the North river near the sloat on the west side of the Hudson river, corresponding opposite to Tarrytown, on the east side of it, which is the boundary point from which the work, which has just been mentioned, starts towards the east.

The western limit of this work following the Newark mountains, and the triangle points established upon them, until to their intersection with the Raritan river behind New Brunswick, and to the parts surveyed as shore line in that part of the country.

10. Thus the survey of the whole country from the New Jersey shore of the Raritan bay, Sandy Hook, and Shrewsbury, till to the waters of the eastern States is completed in topography and hydrography, grounded upon and included in, a great number of secondary triangles, which themselves are based upon the main triangulation.

Only over a small portion, at the east end, the primary triangulation does not yet reach, but the secondary triangulation is accurate enough, and near enough to the main triangles upon which they are grounded, to secure against all doubts upon sufficient accuracy for the detail operations of topography and hydrography. When the main triangulation will be again carried to that side of the work, it will soon cover it over. The whole of the works presents to the south in some measure a straight line, from which the work will proceed southerly through New Jersey and Pennsylvania.

11. Views for the guidance of the navigator approaching the shore as mentioned in the last report, have been made last summer by one of the assistants, on the whole extent of the outside coast of Long Island, and at such places of the eastern part of the sound, as were found properly the hydrographic parties, who had of course to lead the selection of these points; these are of two kinds, the one guiding, the other warning. The first are aspects of the shore from the most important points of a channel or entrance of a port, etc., by which the seaman is guided in his proper course in approaching. The second kinds are views taken from rocks, shoals, or other dangerous places in the approaches of the shore, which the view given shall warn him to avoid.

12. In extension of these principles, the views of every light house were taken double, first from the habitual ship channel at a distance at which vessels would habitually pass it, and second from the proximity, where the light house becomes entirely visible, and so near as to warn from nearer approaching unless special views of landing, etc.

The south shore of Long Island is well known for its dangers by the multiplicity of shipwrecks on it; therefore special direction was given to draw views from the habitual ship channel outside, at every short interval, or in some kind of moving panorama, by which the approaching seaman may reconnoitre the part to which he is near, and guide himself in his course by the views which he is thus shown that he shall meet in succession in his intended course.

13. From Sandy Hook southerly, the Jersey seashore, with Barnegat bay, and a certain breadth along the inner shore of the same, has also been surveyed, till down to the neighborhood of Egg Harbor river. This part of the shore is difficult of access, from the interior by triangulation, on account of the heavy wooded, but low hills which separate it from the other land of Jersey, so that it will become unavoidable to cut through the forests in various places, to get lines for triangles, joining this work to the interior parts in several places, in order to bind up with accuracy the long series of small operations, necessitated by the peculiar difficulties presented by the nature of the locality. The hydrographical part of the same locality was also intended to be begun, but as it could not be attended to this year, it will form the first work for sounding vessels next spring.

14. The extension of the secondary triangulation over New Jersey, between the Raritan bay, the Delaware and the seashore, for which the accurate first elements are given by the main triangulation, carried entirely to the same extent; and from the southern line, stated above, for all other works, was carried in advance of the main triangulation the most favorable points. This same operation has been continued this year more southerly, so as to lay out triangles for further extension westerly, to join the head of the Chesapeake, including in its course the northern monuments of the so called Mason and Dixon's line.

15. It is well known that the meridional parts of this Mason and Dixon's line has been applied to conclude upon the length of a degree of the meridian in that country and latitude, and that the result has been used, in former times, by European mathematicians, in their comparisons with the other measurements of degrees in different parts of the world, but gave so unsatisfactory results as to be always rejected. It will, therefore, be of interest in the course of the present survey, if ever possible to verify the meridional distance, by means of the triangulation for the coast survey, and the

latitudes of the two end points, either by the same, or by new astronomical observations.

16. The scientific account of the operation being recorded in the transactions of the London Philosophical Society, that part can be easily verified. But the monuments placed on the ground may, or may not, be found again in the old places, with the necessary accuracy to warrant proper confidence. In the archives of the State of Maryland such documents exist as may give a clew to designate the localities of them. Therefore there have been already some researches made upon the subject, and the verbal accounts of the persons living in the neighborhood may fully lead and decide upon the application of the diplomatic documents, that will be found to the locality when compared upon the spot. Whatever may be the result, this investigation is of scientific interest, and can, therefore, not be passed over uninquired or unverified in a work like the coast survey, passing over the same ground.

17. From some proper points below Philadelphia, there will be a branch of the triangulation carried on easterly towards the sea, to join the topographical works made along the seashore, Barnegat bay, etc., as stated above, and also southerly to Cape May and Cape Henlopen, at which point it will be proper to join again both these two series of triangles.

18. The place of Cape Henlopen light house must form a point of the main triangulation, though lying somewhat out of its shortest course, to bind up and compare with all accuracy, the results of the latitude and longitude determinations, made there on the occasion of the passage of Venus over to the sun in 1769; which is another scientific work, executed in that neighborhood in the last century, and a more interesting one than the preceding, it being generally considered as more accurately executed.

19. This summer the main triangulation has been carried on through Jersey, from the triangle points lying in the district of the works first enumerated, southerly to the neighborhood of Philadelphia; how far it may be possible to continue it south of it, must of course depend upon the weather, which at this time of the year is very uncertain. Over all this district the secondary triangulation must necessarily next year be carried more into details, and the topographical parties will also begin operations in it.

20. The main triangulation having been begun earlier this year than the former, more stations of it have been executed, and it will be brought as soon as possible, in following years, to the head of Chesapeake bay; the part of the country thereby obtained will then present again a systematic mass of work, connected so as to form the elements of another series of maps and data for publication, similar to the works now executed and above enumerated.

21. The results of the whole work in triangulation, topography, and hydrography, as far as obtained, the end of last year, were last spring collected together in one map, upon the scale $\frac{1}{100000}$, as already noticed in my last report as bugun; every separate sheet of work is there numbered, as it is in the register of the works, and its limits marked, so that any execution of maps, within the limits of the work, can be guided by this preliminary in some measure tangible register of the works; the same system is, of course, to be pursued in future.

22. It will be a special question to decide in each case of executing any map from the coast survey works, upon what scale it shall be executed, according to the different aims and purposes; this register map will in all cases give the means to form appropriate plans upon that subject, calculate the size and position of the whole map of the sheets, or any part of them.

23. During the coming winter the assistants will again be occupied as in the preceding ones, only the calculations being of a somewhat different nature, principally relating to the systematic junction into one body, of the results of the trigonometric operations that have been executed; all the calculations are always to be made three-fold; being now numerous, much of the time of the assistants will be used in it, and as well this as the reduction of some of the works to ultimate maps for final execution, will occasion to keep some of the assistants engaged in this work, instead of in the field work.

This arrangement is well appropriated to the work in its present stage, and, at the same time, agrees with the state of the balance remaining from the last appropriation, as it will postpone some of the expenses of the field equipments.

24. This will make ready for any final execution for drawing, etc., the whole extent of the coast and country adjacent, from the New Jersey shore to the end of Rhode Island shore, in the topographical and in the hydrographical parts.

This part of the coast, forming, in some measure, a whole work by itself, containing about three thousand square miles, will therefore be taken in hand immediately, for final execution upon two different scales, for the different purposes, to which they must naturally serve in future.

25. The map of the bay and port of New York, which has been especially mentioned last winter, as desired to be published, forms an essential part of this work, and will, of course, be attended to the first, with this view, for which arrangements are in progress.

26. A provision of the best quality of large drawing paper, appropriated to our work from the manufactory of Aunounay has just been announced as having arrived in New York for our use.

27. With the view to prepare for engraving maps, copper plates have been ordered in Vienna from Hungarian copper, on account of its best quality: these have just been announced as being under preparation, and that they may be expected in a few months: they will, therefore, certainly arrive before actual use will press for them.

28. In respect to the appropriation for the coast survey, to be proposed to Congress at the next session, I have only to state that it will be most economical for the best progress of the work, that Congress would please to appropriate $100,000, as I had taken the liberty to propose last year, because it will be necessary to begin incurring special and new expenses, for the arrangements and provisions required for executing final drawings, and begin to engrave. If the final appearance of the maps, when published, shall do justice to the trouble and expense incurred in the survey, the whole must came out of one systematic establishment, from which nothing should go out without the stamp of the establishment.

29. It is not proper, nor in fact possible, to separate these works from the drawings consequent upon the coast survey generally, because the works naturally interlock in one another, so that no distinct account can be kept, nor the works be detached from the assistants, who have worked at them in their origin; there should, therefore, be applied for the final drawing the necessary preliminary expenses of different kind of engravings, &c., such moneys of the appropriation total as may be needed, and the whole will enter into one mass of expenditure, like it is one system and map of work.

30. Except these establishments, and the expenses which must naturally be incurred in consequence thereof, there will be no change in the assistants employed, and the general arrangements and organization of the

work, so that it is expected the diminution of some of the field expenses, as mentioned above, will about cover the additions which the last two sections show as necessarily to be added in the present state of the work;—this presents a stepping over towards its full fruition at an epoch of its age shorter than I believe can be shown in other similar work.

(Continued from page 224.)

SPECIFICATIONS FOR THE MATERIALS AND THE CONSTRUCTION OF THAT PART OF THE NEW YORK AND ERIE RAILROAD WHICH IS TO BE BUILT ON PILES—THE SUSQUEHANNAH DIVISION.

Specification of the manner of clearing for pile road.

For a space of *twelve* feet on each side of the centre line, all trees, standing stumps and trunks exceeding 15 inches in diameter, are to be chopped off to a height not exceeding *one*-foot above the surface of the ground, and all trees, stumps, trunks and bushes, less than 15 inches diameter, are to be cut withing *six* inches of the surface of the ground.

The remaining portion of the company's land, on each side of the above mentioned space of *twenty-four* feet, are to be cleared by chopping all trees stumps, standing trunks, and bushes, to a height not exceeding *two and a half* feet from the surface of the ground. All the timber, wood, logs, brush, and decayed logs and rubbish, included in the above mentioned space of 24 feet, together with the wood, timber and brush on the remaining portions of the company's land, are to be secured and compactly piled, or stacked along the outward bounds of the company's land. The brush, limbs, and other timber and wood, as far as the engineer may deem advisable, is to be burned up and destroyed.

The timber for the piles and superstructure is to be as follows:

The *piles* are to be of *straight and sound* WHITE OAK. not less than *eight* feet in length, and not less than *ten* or more than *sixteen* inches in diameter at the butt. At least *one-half* of the piles are to measure *one foot* or over, at the *butt*, without the bark.

Said piles are to be delivered along the line of said railroad at such points and in such quantities as they shall be required for use, and as the engineer of such division shall direct, and shall be subject to his inspection. All piles which in his opinion are unfit for use, shall be rejected.

The *cross-ties* are to consist of *perfectly sound* WHITE OAK or CHESTNUT STICKS, not less than *nine*, nor more than *thirteen* inches in diameter at the small end, and *sawed* in lengths of *nine and one-half* feet. No stick shall be more than *three* inches larger at the *butt*, than at the *top* and *one-half* of the whole number, shall not be less than *eleven* inches in diameter at the *small end*. Each stick is to be cut from the *body* of the tree *below the limbs*, and is to be straight and free from loose knots or other defects. The said *ties* are to be delivered on the line of the said road, as directed by the engineer, in heaps of not less than *ten*, or more than *twenty-five* in each, and are to be inspected on or after delivery by the said engineer, who shall have power to reject all that are in his opinion unfit for use.

The RAIL TIMBER, is to consist of *perfectly sound*, square edged WHITE OAK timber, free from *wane and shakes*, sawed on *four sides* true and even so as to make a stick *precisely seven* by *eight* inches. The said timber is to be entirely free from *black* or *loose knots*, and delivered in lengths of *sixteen*, *twenty*, *twenty-four*, *twenty-eight* or *thirty-two feet*, exclusive of stub-shot, and *one-half* at least to consist of sticks *twenty feet long* or over.

Said timber is to be inspected on or after delivery, by the engineer of said division, who shall have full power to reject every stick which is in his opinion unfit to be used in said road.

It is also to be delivered and suitably piled along the line of said railroad, at such points as shall be directed, in piles of not less than 500 nor more the 1,000 lineal feet, each laid up true and even, to prevent the rails from springing or warping. The whole to be done in a workmanlike manner, and to the *entire satisfaction* of the said engineer.

The TIMBER for the SILLS, is to consist of *sound* WHITE OAK, PINE or HEMLOCK, free from *shakes* and *sawed* on *two sides*, so as to make a stick *six inches thick*, and not less than *twelve inches wide* exclusive of *wane* on the bottom or wide side; and no sill is to be less than *ten* inches, exclusive of *wane*, on the narrow side.

Said SILL TIMBER is to be delivered in lengths of 16, 20, 24, or 28 ft. and *one-half*, at least, is to be *twenty feet* long or over. The said timber is to be delivered along the line of said railroad, at such points, and in such quantities as the enginneer may direct, and is also to be subject to his inspection, and all sticks which are in his opinion unfit for use, shall be rejected.

The manner in which the pile road is to be constructed.—The piles.

The piles are to be driven perpendicular, four feet apart, *longitudinally*, and six feet apart *transversely*, from centre to centre. In all cases where the ground will permit it, each pile is to be driven at least five feet below the surface of the earth, and to be driven until it reaches a *solid bottom*, or a *point* where owing to the firmness of the earth, the pile cannot be driven by the hammers used in driving, more than two inches at one blow. In case the pile driven shall not be long enough to reach the solid bottom, or the point aforesaid, then it is to be sawed off, and another pile of the requisite length is to be connected with it, by a suitable pin placed in the heart or centre of each at the point, and then the two are to be driven, until the lower end of the second pile is at least five feet below the surface, and as much further as may be necessary, to reach the hard bottom or the point aforesaid.

After being driven to the point or depth required, each pile is to be sawed off at right angles with the pile, and on a line corresponding with the grade of the road, as indicated by the grade line designated by the engineer having charge of the work. In case each pile is not sawed off at right angles, and on the grade line as aforesaid, by the pile driving machine, the same shall be otherwise adjusted, so as to allow the cross tie a full bearing on the top of the pile. Upon the top or upper end of each pile after it is driven, a tenon is to be framed for the notch in the cross tie which tenon is to be *two* inches in height and *nine* in thickness, and of the same width of the cross tie, and to be so constructed that the cross tie will shelter the pile from rain and snow.

Cross Tie.

The lower side of each tie is to be framed to the top of the piles, by a notch cut across the same *nine* inches wide, and of a depth sufficient for the tenon on the top of the pile, and so adjusted that it shall have a bearing on the tenon of at least *nine* inches, and shall also protect the top of the pile from rain and snow. In the upper side of the tie suitable notches are to be cut, for the longitudinal rails, of sufficient width for a rail *seven* by *eight* inches in width and thickness, to be fastened by a wedge *eighteen* inches in length, *four* inches wide, and *one and a half* inches thick at the *large* end. The notch for the rail to be as deep as the thickness of the tie will permit, and still leave a neck of *four* inches in thickness, and the bearing of *nine* inches on the top of the pile. The *centre* of the tie is to be on a line with the *centre* of the track; and the distance to the outside shoulder of the tie, is to be *precisely three feet six inches* from the centre of the tie.

The outside shoulders of the ties are to be on a parallel line with the rail, and the inside shoulders are to be framed on an angle, to correspond with the shape of the wedge when driven to its place, so that the middle of the wedge shall be on a line with the centre of the tie and notch. Every alternate wedge is to be driven in a direction differing from the other, so that no *two* wedges or any *one* tie shall be driven in the same direction.—The ties are to be framed and fitted to the tops of the piles in a workmanlike manner, and firmly pinned to them by a white elm tree nail *one* foot in length, and *two* inches in diameter, being in form *eight square.* The tree nails are to be driven through the necks of the ties, at least *eight* inches, into an auger hole, *two* inches in diameter, in the top of the piles, which said tree nails are to be secured to the tops of the ties by proper wedges *two* inches in width and at least *one* inch in length.

The rails are to be fitted into the notches with precision, in a workmanlike manner, with tight joints, and firmly wedged with the wedges above described. The rails are to be champered off *one* inch from the inside line of the rails, on an *angle* of 45 degrees from the top line of said rails, in a workmanlike manner. Both rails are to be parallel to each other, and the proper distance from the centre line of the road. The iron bars are to be *three* inches in width, and *three-quarters* of an inch in thickness, and are to be spiked on to the above mentioned white oak rails firmly on a line with the champered edges of the rails, and laid true and even to a guage of precisely *six feet* in width, between the iron rails. And plates are to be fitted snugly into the rails *two-thirds* of their thickness at the joints of the iron bars. The space allowed between the ends of the bars for expansion is to be *one-quarter* of an inch. The spikes are to be fitted to the iron of the proper length, and driven in a workmanlike manner.

When the piles are driven in a strait line, so that each shall be under the rails and on the line, strong braces shall be framed firmly, into both the ties and piles, with shoulders of at least *two* inches, to support the bearing of the rails and ties.

Specification for that part of the road which is to be graded by excavations and embankments.

The timber is to be cut close to the ground, *forty feet* on each side of the centre line; from which space, all trees, saplings, bushes, and other vegetable matter shall be cut up, and together with logs, brush and wood of every description, shall be removed or destroyed. When excavation or embankment occurs, not exceeding *two* feet in depth or height, all trees, saplings and bushes, to be grubbed up, and together with all logs, brush, and wood of every description shall be removed or destroyed. Where spoil banks are to be placed, the timber to be cut down, and if required by said engineer, to be cleared off. In all cases the trees, saplings and bushes are to be cut near the ground, and cleared off to the distancd of *forty feet* each side of the centre line of said road. All *loose* or *vegetable* earth, shall be excavated and removed from the foundation of the embankment, for such width as may be directed by the engineer. The earth to be excavated and removed, and embankments raised as may be necessary to produce an uniform and regular surface, conforming to the inclination or level indicated by the levels and field notes of the said engineer. The excavations shall be *thirty-two* feet wide on the graduated line of the road, and a side drain of such slope and dimensions as may be directed by said engineer, shall be formed on each side of the road. The sides of the excavation and spoil banks to have a slope of *one and a half* feet horizontal to *one* foot vertical measure. The earth from the excavations shall be carried into the valleys or hollows, to form the embankments, as far as the said engineer may direct. The surplus earth shall be formed into spoil banks, with evenness and regularity and with as little injury to the adjoining levels as may be; and all trees, logs, stumps, roots and bushes, shall be turned up or disposed of with like precaution; nor shall any unnecessary injury be done to the owner or owners of the adjoining lands. The spoil banks shall be formed with a suitable descent to carry the water off from the road and the inside line of their base shall be back *ten* feet on each side from the outside line of excavation, as may be directed by said engineer, to form birms to lead the water from the road; the said birms to be excavated and formed to such level as may be directed by the said engineer, and when directed by the said engineer, drains shall be left through the spoil banks to carry off the water. All earth necessarily excavated in road ways or ditches, shall be estimated as excavation. When the earth to form embankments, cannot be obtained from the excavation, then it shall be taken from such place as the said engineer may direct. The sides of the embankments shall have a similar slope to that specified for excavation, which embankment shall be *fifteen feet* wide on the *top*. No stump, logs, or other perishable matter, shall be put in the embankment, and it shall be carried up level and uniform so as to settle as even and firmly as practicable. No public or private road which crosses the railroad shall be obstructed by excavation or otherwise, until direction shall be given by said engineer, to complete the work across said road or highway; nor shall any crops of grain, grass or vegetables, nor any dwelling house or other building, nor fence, be disturbed unless by the direction of said engineer. In any case where it may become necessary, for men or teams to pass any fence, gate or bars, in going to and from their work, care shall be taken to prevent any injury, that might occur to crops of grass or grain, on adjoining fields, by leaving fences, gates or bars open, or imperfectly closed. Any damages that may occur by such neglect, shall be determined by said engineer, and deducted from his estimate of the value of work done under this contract. The embankment for bridge landings, shall be of such dimensions and form as may be directed by the said engineer. The smaller class of culverts, squared drains, and sluice-ways, abutment walls, and piers, are to be laid in mortar, unless otherwise directed by the engineer, and are to be built of the usual sized building stone, in a substantial manner, faced and bound, with the corners firmly bedded, and in all respects are to conform to the directions of the engineer. All stone work to have plank foundations, unless otherwise directed. The timber sluice-ways are to be made by sinking a mud sill firmly and evenly to a depth of three feet below the surface, and framing in *five verticle posts* 12 by 12 inches square surmounted by a *cap-piece* 12 by 12 fastened on by mortice and tenon.—The rear of the abutments to be planked. *Seven* sound white oak string pieces 8 by 15, are then to be laid on the two bents, and covered with $2\frac{1}{2}$ inch hemlock plank, secured by tree nails.

Specification showing the manner of making the superstructure for the graded road.

The timber for the graded road is to be of the qualities and dimensions required by the specifications herein before stated. After the *road bed* is levelled off, as required by the specifications and contracts for grading, the sills are to be sunk in trenches to be dug *six inches* in depth, and of such widths as are required to bed the same evenly and firmly, with a full bearing for their whole lengths. At the *joints* of the *sills*, the trenches are to be so formed, as to admit a *short sill* or bearing plank, *of two inches thick one foot wide* and *two feet long*, under the sills. The *tops* of the bearing plank are to be on a *level* with the bottom of the trenches.

The plank and sills are to be pounded down and well settled, with heavy mauls or commanders, so as to be firmly and uniformly bedded with a full and perfect bearing on the bottom of the trenches; and their upper surfaces are to correspond with the level or grade pegs, given by the engineer. The earth that is taken out of the trenches is to be *filled around* the sills, and well rammed down to prevent the water from settling under them. The *bank* between the *sills* and the *outer edge*, is to be rounded off, to permit the water and snow to drain off readily from the sills.

The cross ties are to be hewn flat on their bottoms, their whole length, so as to give a *true* and *full bearing* of *nine* inches, longitudinally on the sills, and are to be *spiked on* firmly with six inch spikes, *four feet* from centre to centre. The *notches* of the *ties* are to be framed in the same manner as specified for the pine road; and the remainder of the superstructure is to be constructed in every respect in exact accordance with the specifications for the superstructure for pile road.

Specification for the bridges on the Susquehannah division, New York and Erie railroad.—Foundation.

The *superstructure* is to be supported, on *timber bents*, constructed by driving piles into the ground, in all cases, where the nature of the earth will permit, as specified below.

The bearing piles are to be of *straight and sound* WHITE OAK or WHITE ELM timber hewed *square*, free from *wane* and *loose* or *black knots* and of such dimensions as are stated in the bills of materials and plans for the several bridges, according to the length of spans for each. After being driven sufficiently deep, and in *every case* to the *hard or solid bottom*, the piles are to be *sawed off* at a proper elevation to receive the cap pieces, which are to be fastened on by mortice and tenon, secured by *two inch white elm tree nails*, well wedged at their head. Each *bent* is to consist of *two rows* of piles, driven in *straight lines four feet* from centre to centre, on a line corresponding with the current of the stream. *Each row* is to consist of *five* piles for single track, and *nine* piles for double track bridges. The said rows are to be of such distance apart, as are marked on the plans or directed by the engineer. *Piles* for the necessary *ice-breakers* and *guards* are to be driven as specified and shown on the plans and to the satisfaction of the engineer.

The cap pieces and braces are to be of the same quality of the piles, and of the dimensions stated in the bills of materials, and marked on the plans accompanying the same. They are to be framed and finished as shown on said plans, in a substantial and workmanlike manner. The sides of the bents are to be planked up from *one foot* below *low water mark* to the *top* of said bents with sound three inch *white oak* plank laid *edge to edge* and strongly *pinned* to the piles. When directed by the engineer, the bents are to be *filled* with suitable *cobble stone*, in such manner as he shall deem necessary for the more perfect support and security of the foundations.

Superstructure.—Carpentry.

1st. Each stretch or span of the bridge is to be composed of *two or three* vertical truss frames, formed of *white pine* with the exception of the *posts*

2nd. The truss frames are to be strengthened as shown upon the plan, by *bolts* and *straps* of iron, and supported by *braces* and *arches* placed either under the same or upon the the sides. The floor timbers are to be of *white pine*, placed transversely and either resting upon, or properly connected on the under side with the string timbers by bolts or straps of iron. The distance between the trusses is to be *sixteen feet* for each track, The floor timbers are to be *capped* or *covered* if required, with boards *one and a half inches thick*, from *four to six* inches wider than the timbers and *grooved* on the *under edges* to prevent the access of water from above.

3d. The *whole frame* to be composed of the *first qnality of square edged timber, perfectly sound, and free from black or loose knots, wind-shakes, worm holes and sap*, and to be *framed and braced*, according to the plans, in the most accurate and workmanlike manner, so as to secure the whole strength of the timber. Each *shoulder* and *joint* is to fit and bear with the utmost precision. The whole of the timber is to be sawed at least *six months* before being used in the work, and is to be suitably *piled under cover*, immediately after it is sawed to allow a free circulation of air through it, and prevent it from springing or warping.

Joinery.

1st. Each truss frame is to be protected from the weather, by a covering of *white pine inch boards*, placed vertically upon the *sides* and *ends*, and *matched* at the edges with a *tongue* and *groove*, so as entirely to exclude the water. Between the side covering and the timber, *furring pieces* are to be interposed *one and a quarter* inches thick. The covering is to be well and thoroughly nailed and secured to the frame.

2d. Each truss frame is to be *covered* or *caped* with a *two and* a *half* inch *white pine plank* projecting *two* inches over the siding with the *upper* surfaces bevelled so as to carry off the water. Under each projecting edge a *groove* is to be made, and a *moulding inserted* in the *angle* to prevent the access of the water.

3d. The flooring of the road way is to be composed of *sound, square edged pine or hemlock plank*, from *two* to *three* inches thick, as may be directed, well *spiked* or *pinned* to the floor timbers The flooring is not to come in contact with the siding, of the truss frames; the *space* intervening, to be such as the engineer may direct.

4th. The *coping* and *siding* to be composed of *sound, well seasoned stuff*, free from *large* or *decayed knots, worm holes wind shakes* or *sap*, to be *smoothly planed*, and put on in a faithful and workmanlike manner.

Iron.

The *bolts* and *straps* are to be formed of the *best quality* of *American wrought iron*. arranged in a manner and of a size specified in the bill of materials and plan, and as directed by the engineer. The *bolts* to be of *round inch iron*, (driven through 7-8 auger holes,) with *substantial square heads* and *nuts* 3-4 of an inch thick, and *two inches* square, and *washers* of 1-4 inch band iron, *three inches square*. The *bolts* are to be well secured at their ends, by a *screw plate* and *nut*. The screw is to be not less than *two* inches long, with a *clear and strong thread*. When required, the *string timbers* are to be *spliced* by means of *three splicing bars* to each joint. Each bar is to be *twelve* feet long, *three* inches wide, and 3-4 of an inch thick, with a *spur* on each end, *three* inches long and 3-4 of an inch in diameter at the base. The *holes* in the bars are to correspond in size and number with those marked on the plan. The bolts are to pass through the *splicing bars*, *string timbers*, and *splicing blocks*, and to be firmly secured at the ends. The bolts in the *ends* of each bar are to pass through the *posts* and to be secured as above. The bands or straps are be made of $2\frac{1}{2}$-$\frac{5}{8}$ iron, firmly *welded* or *screwed* together.

Painting.

The side and end coverings to the truss frames, to be thoroughly covered with *two good coats* of *best American white lead and oil paint.* The *coping*, *gallows frames*, and *outside braces*, are to be covered with *three* coats of the same kind, if not otherwise directed by the engineer. Previous to applying the paint, the *knots*, if any, are to be *well covered* with a *composition of red lead and litharge, bound with a size made of parchment or glue.*

The *road ways* of all the *bridges* to be *double* or *single* as occasion may require, and as directed by the engineer.

The work to be constructed in every respect according to the plan and bill of materials, to be furnished by the engineer, under whose supervision and inspection the same is to be erected, who will give such directions from time to time, during the progress of the work as shall appear to him necessary, to perfect the plan of the same, as contemplated by the preceding specifications,

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REPORT OF THE JOINT BOARD OF DIRECTORS, TO THE STOCKHOLDERS OF THE DELAWARE AND RARITAN CANAL, AND CAMDEN AND AMBOY RAILROAD AND TRANSPORTATION COMPANIES, ON THE COMPLETION OF THEIR WORKS.

(Continued from page 256.)

The business of the canal is now beginning to increase, and has received a new impetus from the arrangement last year made, to take the Schuylkill coal through it. For this purpose the companies have deemed it advisable to advance, on good security, for the construction of boats, and for developing the resources of the canal, the sum of one hundred and seventeen thousand dollars. The experiment has been eminently successful, and many individuals, stimulated and encouraged by the success of those, who under the auspices of the companies, have embarked in this business, have turned their attention to it, and a large number of boats are now being prepared, with decks, for the purpose of transporting coal, without transhipment, from the coal region in Schuylkill county, to New York. When these arrangements are finally completed, and the Philadelphia and Reading railroad is finished to the Delaware river, there is but little doubt that the canal will greatly increase the dividends. Add to all this, the increasing travelling of a growing country, which since the commencement of the railroad has been eleven per centum per annum, and the revival of business, and you may approximate to the real value of your investment. For ourselves, we hesitate not to say to you, that in our opinion, it is the safest and most profitable investment of money we know of, which opinion we now put on record, to be tested by experience. In conclusion, we notice, that whilst the cost of the works is six millions sixty-four thousand nine hundred and fifty-three dollars and forty-two cents, we divide only on twenty-nine thousand shares, or two millions nine hundred thousand dollars, the ballance having been borrowed at an average interest of six per cent ; which loan, forming a part of the cost of the works, will be paid by the State of New Jersey, at the expiration of the charter, as part of the consideration money, if she elects to take the works, and which loan, there is no doubt can at that time be liquidated by the receipts of the road for three years.

Although we cannot attempt to name all the individuals from whom we have obtained advice and assistance during the progress of our labors, still we may not overlook the important and invaluable aid we have received from one of the directors, (now absent,) Mr. John Potter, of New Jersey, formerly of South Carolina. To his enterprise, firmness, and public spirit, are the public, as well as ourselves, more indebted, perhaps, than to any other individual, for the successful issue of your affairs.

The directors and officers of these companies have devoted themselves to your concerns for ten years past; and although they have not thought it necessary or expedient heretofore, during the progress of the works, to trouble you with the details of their business, or to indulge idle curiosity, by constant inspection of their books, they do now, as a proper return for your unwavering confidence in them, lay before you every thing, from a snow plough to a steamboat

The accuracy with which the accounts and books of the company have been kept, by Mr. Edwin A. Stevens, Mr. John R. Thompson, and Mr. James Neilson, is manifest from the fact, that upwards of eleven millions of dollars have passed through their hands, and their accounts, after a full examination, balanced to a dollar.

In conclusion, the directors would state, that the arrangement made in June, 1836, with the Philadelphia and Trenton railroad company, by which the receipts of the companies were amalgamated, so as to divide on the shares of the companies, share and share alike, and to equalize the dividends has been attended with the most beneficial results. Whilst it has placed the stock of a company, in an adjoining State, upon an equality with your own, it has added much to your success and prosperity.

JAMES PARKER, *Chairman of the Joint Board.*

R. F. Stockton, Robert L. Stevens, Abraham Brown, John C. Stevens, W. M'Knight, J. Kaighn, G. D. Wall, B. Fish, J. S. Green, J. W. Mickle, J. Neilson, J. R. Thomson, E. A. Stevens, *Directors.*

A DESCRIPTION OF THE DELAWARE AND RARITAN CANAL, FROM ITS COMMENCEMENT TO ITS TERMINATION, WITH AN ACCOUNT OF THE PROPERTY OWNED BY THE COMPANY.

The works of the Delaware and Raritan canal company, commence opposite Bull's Island, at Black's Eddy, in the Delaware river, 22½ miles above the city of Trenton, and run thence along the river to Trenton, thence westwardly 6 miles, to the Delaware river at Bordentown; and from Trenton eastwardly 37 miles to the Raritan river at New Brunswick —the whole length being 65½ miles: uniting the tide waters of New York and Philadelphia; and, with an outlet lock in the Pennsylvania canal at Black's Eddy, will connect the Pennsylvania canal and the important works of the Lehigh Coal and Navigation company with New York.

From Bull's Island to Trenton, it is generally 60 feet wide and 6 feet deep. This portion of the canal was constructed to supply, with the aid of the river Raritan, the main canal between Bordentown and New Brunswick, with water, as well as for the purposes of navigation and trade.— The water is taken from the deep natural pool in the Delaware, of which Black's Eddy is a part, the bottom of the canal being below the lowest water surface ever known in that river. There has heretofore been a large surplus of water running over the waste weirs; nor can their ever be any deficiency while there is water in the Delaware and Raritan rivers. A guard bank, extending from Bull's Island to the first guard lock, is constructed about three-quarters of a mile below the head of the island, which forms a large, safe harbor for boats, rafts, &c.; it is more than 200 feet in width, and three-quarters of a mile in length. Through the guard bank there are two culverts; one for the passage of the water to the canal, the other for water power. The work is also constructed in such a manner as to admit of the water being taken out and used for water power, on the main shore side of the lock. From this point to Prall's creek, about three miles, the canal is made by constructing an embankment in the bed of the river, along and parallel to the shore from fifty to one hundred feet distant, raised two feet above top water line of the canal, and protected on both sides by a substantial slope wall, which will admit of the water passing over the bank during the floods. This arrangement has been found to answer the intended purpose, and has withstood the floods without receiving any injury. Across the mouth of Prall's creek there has been erected a dam of crib work, filled with stone, 200 feet in length which serves the double purpose of waste weir and dam for the creek. There is another guard lock at this place.

From this place to Trenton, about 19 miles, the canal generally passes along within a short distance from the river; but in some places the rocky bluffs made it necessary to construct high embankments in the bed of the river. In all such cases, the banks are protected with heavy slope walls, varying from $1\frac{1}{2}$ to 3 feet in thickness, and from 20 to 40 feet in height. About half a mile below Lambertsville is a lock of $10\frac{1}{2}$ feet lift, constructed of hammer-dressed masonry. Above this lock there is a large and spacious basin. The works at this place are likewise so arranged, that the water passing around the lock into the canal below, can be used for water power. From Bull's Island to this lock, nearly 8 miles, the bottom has a descent of two inches to the mile, and the top of the banks carried level; below this lock it has two inches to the mile.

The banks throughout the whole canal are made on a slope of two feet base to one rise, and generally lined either with coarse gravel or fragments of quarry stone. There are 14 culverts over the different streams over which this part of the canal passes, of from one to four arches, varying from six to twenty-five feet in span, and from 110 to 130 feet long. There are also a number of waste weirs, which are placed at proper distances to carry off any surplus water, which may accumulate from the drainage of the lands above. The bridges are all made to turn, so as to admit the passage of masted vessels. This portion of the canal joins the main branch, about one-fourth of a mile east of Trenton.

The main canal is 43 miles in length, 75 feet wide, and constructed for 9 feet depth of water; during the last season it has been 7 feet 4 inches. It commences at the Delaware river, near Bordentown, about 500 feet from where Crosswicks creek enters that river, and passes along the flats near the river shore, to Lamberton, thence in the rear of Lamberton, to the summit at Trenton, a distance of six miles, where it receives its water from the section above described.

Between Bordentown and Trenton there are seven locks, which overcome an elevation of 57 feet, made of cut-stone masonry, and laid in hydraulic cement, 110 feet long between the gates, and 24 feet wide; the whole length, from the head to the lower end of the wings, being 162 feet. Over the Assanpink creek, near Trenton, there is an eliptical arch of 36 feet, span 140 feet in length, and 16 feet in height, from the foundation.

From Trenton the canal takes an eastwardly direction, following the valley of the Assanpink, to Lawrence meadows; thence by a deep cut across Lawrence meadows into the valley of Stony Brook; thence down that valley, passing about a mile south of Princeton to Millstone river; thence across the Millstone on an aquaduct of 10 arches, and 100 feet in width of water way; thence along the east side of the Millstone to Kingston, about $13\frac{3}{4}$ miles. This portion of the canal is level, it being the summit; in its course it passes over several streams on arches from 6 to 12 feet span. The Shabbakunk creek has three arches, of 12 feet span each.—From Kingston the canal continues along on the east side of the Millstone valley; in some places it passes so near to the river as to require a slope wall to protect the embankment; but generally it passes along at the foot of a red shell bluff which bounds that valley on the east. At $13\frac{3}{4}$ miles, it intersects the Raritan river, where the bluff approaches so near as to re-require the canal to be made in the bed of the river by a high embankment, which runs along in the bed of the river to Bound Brook, about $2\frac{1}{2}$ miles, and which has been well protected by immense slope walls and loose stone lining; thence to Follett's farm $1\frac{3}{4}$ miles, it runs along in the flats. At this farm there is a dam built across the Raritan river, 8 feet high, and about 400 feet long, and connected to the high ground on the north side of the river by a guard bank raised above the highest flats. This dam was made to let in the river to assist in case of need in supplying the canal with water. From this point to New Brunswick, $4\frac{3}{4}$ miles, the canal has been constructed, for the most part by embankments in the bed of the river, protected by a slope wall and loose stone lining.

The basin at New Brunswick is formed by the construction of a pier in the river in front of the city, from 200 to 300 feet distant from the wharves, extending nearly a mile in length, and terminating at the steamboat wharf.

From Kingston to this place there are seven locks, overcoming an ascent of 58 feet, built of hewn granite, one at kingston, one at Griggstown, one at the mouth of the Millstone, one at Bound Brook, one at Follett's, one at the upper end of the New Brunswick basin,* and one at the outlet at New Brunswick, all of the same size as those on the other side of the summit, except the last, which is 30 feet wide, and 130 feet long between the gates, the whole length from the head to the lower end of the wings being 185 feet. There are besides several culverts over the different streams, from 6 to 20 feet space. All the mason work throughout the canal is laid in hydraulic cement. Waste weirs have been constructed throughout the line to carry off the surplus water, of which there has been a great deal during the last summer, although the business has been greater than at any previous time. The bridges are all made to turn, as before stated, for the purpose of passing masted vessels. At each bridge and lock there is a keeper's house. Basins of suitable size have been made at all the public landing places. Besides the banks before described there are guard banks about seven miles in length, constructed at an expense of $15,000 per mile.

* At this lock, the works have been so arranged as to be able to use the surplus water to drive machinery. At the ordinary summer height of the Raritan, the whole of its waters can be turned into the canal, and used here with a fall of fourteen feet.

A DESCRIPTION OF THE ROAD FORMATION, AND SUPERSTRUCTURE, TOGETHER WITH THE BUILDINGS AND FIXTURES OF THE CAMDEN AND AMBOY RAILROAD, AND ITS BRANCHES, FROM BORDENTOWN TO NEW BRUNSWICK, AND FROM TRENTON TO THE DELAWARE BRIDGE, AT BLOOMSBURY.

SECTION I.—*From South Amboy to Bordentown depot, distance thirty-five miles.*

This road was commenced to be graded in December, 1830. It is graded 15 feet in width, at the grade of the road; ditches 3 feet deep, 18 inches in width at the bottom, and 11 feet in width at the top, level of grade.—From Hightstown to Gravel Hill, a distance of five and a half miles, the road is graded 25 feet in width, for a double track of rails. The foundation of this road is formed by two continuous trenches, three feet in width, and one foot in depth, being filled with broken stone; over these trenches a roller, weighing three tons, was passed a number of times, until the whole was a solid mass.

On 26 miles 76½ chains, stone blocks, two feet square, 10 to 13 inches thick, were placed 3·2 feet apart, from centre to centre—embedded with small stone on the trenches; then settled with a heavy wooden driver, worked by horse power; two holes were then drilled into each stone block, (except at the junction blocks, which have four holes,) one inch in diameter, and five inches deep. Upon the stone blocks, locust chairs 14 inches long, 6 to 8 inches in width, and from 1 to 2 inches thick, are placed, and attached to the stone blocks, by tree nails driven into the holes of the stone blocks. The chairs were then dressed, to receive the edge rail, of the I from (invented by R. L. Stevens, Esq.,) 3½ inches high, 2⅛ inches on the upper running surface, and three and a half inches in width on its base, weighing 42 lbs. to the yard, is laid and fastened by spikes six inches long, with hooked heads, the ends of the bars resting upon wrought iron plates, or cast iron chairs, and are conneated together by an iron tongue five inches long, two inches wide, and five-eighths of an inch thick, with two rivets passing through the ends of the bars and tongues—oblong hole, to allow for expunctral contraction.

Seven miles and twenty-seven and a half chains are laid with cross sleepers, placed 2 feet 8 inches apart from centre to centre, of oak and chestnut, 8 feet long, 6 inches thick, and not less than 6 inches in width—embedded with small broken stone, upon the stone trenches, and consolidated with heavy hand pounders. The cross-sleepers were then dressed to receive the edge rail; to which they were fastened with hooked head spikes; wrough iron plates at the joints of the rail, and tongue fastened as before described.

Twenty-three chains of road, near South river, were laid with continuous granite sills, 12 by 14 inches, in lengths of 8 to 10 feet, on which a flat bar of iron two and a quarter inches wide, and seven-eighths of an inch thick, was attached. This part of the road was found, after experience of four years, to be expensive in its repairs, besides very rough and objectionable; so much so, that it has been replaced, in part, by taking off the flat rail, and substituting cross sleepers of locust, 7 feet long, and 6 inches square, transversely upon the stone sills, and placing the edge rail upon them; which have completely remedied the defects of this part of the road.

Whole distance of bridging is 2,179 feet, or 33 chains. The principal bridges, to wit, over South river, Rocky brook, at Hightstown and Crosswick's creek, have been partially renewed, upon a new plan; by which, it is believed, they will require but little repairs to the end of the charter.

It is done by covering the bridge in such a manner as to protect the superstructure from the action of the rain.

That part of the road laid with stone blocks, is of the most permanent character, and has required but a very small expenditure per mile annually, and it is believed it will continue, without renewal, to the end of the charter, with but small annual repairs. This opinion has been founded upon the fact, that at the end of the road, the passing over has been more than equal to that which, in all probability the main road will have undergone at the end of thirty years—as the engines, for eight years past, have necessarily to go from the water station to the wharf *three* times for every *one* they pass over the road; besides the running backwards and forward, to pump water into the boiler. Here the rails have not been renewed, and are still in good order.

The same applied to all the edge rail laid upon the road. The distance of 14 miles, from Bordentown depot to Hightstown, was so far completed on the 20th October, 1832, that a line of cars, drawn by horses, was placed upon it to convey passengers, and on the 17th December, 1832, the whole distance was used for the transportation of passengers and merchandise.

SECTION 2.—*From Bordentown Depot to Camden. Distance* 26 *miles* 10 *chains.*

The road bed is graded 17 feet in width—slopes of excavation and embankment, $1\frac{3}{4}$ feet base, to 1 foot perpendicular—ditches 3 feet deep, 2 feet wide at bottom, and $12\frac{1}{2}$ feet wide at top, or grade of road. The whole road bed was covered with 18 inches of sand or gravel, wherever loam or clay was found at the grade of the road. The object of this being to secure the road from the unequal action of the frost, and gave, in consequence a better foundation to lay the superstructure upon.

There are six turnouts. These portions of the line, a distance of 60 chains, are graded 27 feet wide, with the same slopes and ditches as before described.

A part of this line near Camden, was commenced to be graded in March 1831, and the remaining distance in April, 1833.

The superstructure for eight and a half chains, at Camden, is laid with stone blocks, 2 feet square, not less than 5 inches thick; 5 stone blocks are placed in the length of a rail 16 feet, for the foundation. Upon these are placed locust cross-sleepers, 8 feet long, and 6 inches square; upon which is fixed an edge rail, fastened by spikes, wrought iron plates under the joints of the rails, and tongues fastened as before described.

For 31 chains, red ceder piles, 7 feet long, from 7 to 9 inches diameter, are driven into the ground every 3·2 feet for the foundation; upon the ends of these piles is placed the edge rail, fastened on the head of the piles, with the same kind of spikes; the same connection at the joints of the rails, and the same kind of wrought iron plates as before described. Twenty-nine chains of roads are laid through the street at Burlington in the same manner as the last described. These parts of the road were laid in 1833, and have required but little repairing, are apparently perfectly sound, and likely to remain so. Seventy-two chains of road, near the Pensauken Creek, are laid with wood rail, and flat iron; foundation of plank $3\frac{1}{2}$ inches thick and 2 feet wide under each rail, continuous its whole length; cross sleepers of oak every 4 feet, with blocks 2 feet long, intervening; upon these sleepers and blocks, a wood rail, 6 inches square, of yellow pine, is placed; upon the wood rail, a flat bar of iron, $2\frac{1}{4}$ inches wide, and seven-eighths of an inch thick, is placed, fastened by spikes and screw bolts; the bolts passing through the ends of the iron bars and wood rail.

One mile sixty-five chains are laid with a foundation of plank, 3 1-2 in. thick, by 2 feet in width, under each rail, continued the whole distance; upon these plank, cross sleepers of red cedar, from the northern lakes, 8 feet long, 5 inches thick, and not less than 6 inches flat surface, are placed every 4 feet, and short blocks, 2 feet long, (of the same dimensions otherwise as the long sleepers,) between each space supporting the rail; upon these cross sleepers and blocks, an edge rail rests; with wrought iron plats at the joints, fastened by hooked spikes, and tongues at the ends as before described. This road was laid in 1833, and the red cedar cross sleepers appear perfectly sound.

Twenty-two miles and twenty-six and a half chains are laid in the same manner as that last described, except that the cross sleepers are of oak and chestnut, instead of cedar. This road was laid in 1833 and 1834.

Whole distance of bridging, is 1,188 feet, or 18 chains, of wood structure. Two of the principal bridges, to wit: one over Black's creek, 133 feet long, and one over the Rancocus creek, 497 feet long, have been renewed on the new plan, before alluded to in section 1.

A distance of 16 miles from Bordentown, below the Rancocus creek, was travelled upon in the winter of 1833, and the remaining distance, to Camden, in the spring of 1834.

Section 3.—*From Bordentown to lower depot near Trenton. Distance 6 miles.*

It was commenced in September, 1837, and passengers carried upon it in 1838. This road branches from the main line of the Camden and Amboy railroad, in the borough of Bordentown, at Prince street, following round the edge of the hill, and crossing the Crosswick's creek immediately above the mouth or entrance of the Delaware and Raritan canal; thence following the tow-path, on the right bank of the canal, to Trenton.

The superstructure of this part of the branch railroad is wood rail, and flat iron bar, except 12 chains at the commencement, which is of edge rail and cross sleepers, and 7 chains of edge rail on bridges.

The wood road, with flat iron, is laid by placing cross pieces, 3 inches thick, 9 inches wide, and 8 feet long, 8 feet apart; upon these are placed longitudinal pieces, 16 feet long, 5 inches thick, and 12 inches wide; being embedded in the earth; again upon the centre of these pieces, are placed oak, 3 by 4 inches, and 16 feet long, fastened by tree nails; upon which is put a flat bar of iron, two and a quarter inches wide, and five-eighths of an inch thick; these ends and joinings of the bars being secured by a small cast iron chair; the spikes for attaching the iron rails passing through the oak pieces into the longitudinal sill below.

One mile fifty-five and a half chains is constructed in the usual way, with shoes or mud sills, cross-sleepers and wood rail, with flat iron bar. The principal part of the timber used in the construction is of hemlock, which was saturated with lime and salt, or salted by means of one and a quarter inch holes being bored ten inches deep in the longitudinal sills, 18 inches apart; then filled with salt, and stopped with wood plugs.

There are two bridges upon this section: one over the street in Bordentown, 150 feet long, and one over the Crosswick's Creek, 323 feet long; both constructed upon the new plan before described.

Port Clinton Tunnel.—We are pleased to learn that the enterprising contractors have effected a junction between the east and west workings of the Tunnel at Port Clinton. This is indeed most acceptable inteligence, and we are gratified with the zeal of the company and contractors, in spite of hard times, to complete this magnificient work. That portion of the Tunnel under the charge of Mr. Neville required much skill in its management, and it has been happily effected with but few and slight accidents to the labours; and we view its completion as a harbinger of the successful termination of the entire route, the opening of which is so closely interwoven with the future welfare of our region.—*Miner's Journal.*

We understand that the contractors will commence laying down the rails on the road early in may, and that the work will be finished for use from Reading to Port Clinton early in October, and to Pottsville in the course of December.

STEAM BOAT FIRE ENGINE

An experiment was made day before yesterday, with a newly invented Fire Engine, just completed by Mr. Creed, and intended for the use of steam boats, and other purposes where it can be stationary. The main principle is the same as that of any fire engine, or force-pump, but the adaptation and application are new. It is arranged so as to stand in a very small compass upon the deck, where it is to be cased over and secure from damage. It can be connected with the engine, and worked by it, with tremendous effect, whenever circumstances will allow; but if fire is around the engine, as is generally the case, the fire engine may be instantly put in order to work by hand power. In five seconds after the discovery of a fire, water may be poured out from this engine to any part of a boat, at the rate of *four hundred* gallons per minute, if operated by *sixteen* men. Nor is this all—should a boat strike a snag or sawyer, or be otherwise injured so as to leak, this engine will pump out and throw over the water at the rate above named; which, in our river navigation, would enable almost any boat to run ashore, before it could sink. Such are the purposes and advantages of this invention, and the little machine, being so placed as not to be in danger from fire itself will afford ample security to any steamboat against any disaster from that cause. A boat may be nearly drowned in five minutes, so that no fire could prove dangerous.

At this exhibition, No. 12, with its powerful company, were present. Creed's engine drew the water about 10 feet, and played into No. 12, at an ascent of about 3 ft; No. 12, was fully and strongly manned, with plenty of fresh hands to supply the places of those who found it convenient to drop off the brakes. They played with open hose, and had tough work to prevent being over-run, though they had double the number of men, and no water to lift. Playing through thirty feet of hose and fire pipes, Creed's Engine would if well manned, over-run any two engines in the city. No. 12, is said to be the most powerful engine in the city, and none has a better company—they did not like to acknowledge beat, but seemed to be pleased with this improvement as a capital thing for the uses intended. It will certainly draw and throw for a short distance an enormous quantity of water; and on one trial with hose and two pipes, one an inch and the other seven-eights in diameter, it threw two streams to a good height and upon the roofs of the buildings on the opposite side of the street. No. 12, being calculated for throwing to a distance, could of course play further and higher.

The various trials were made with apparent gratification to the Engineers of the Fire Department, and to the other spectators, as well as to the satisfaction of Mr. Creed; and we are satisfied, that for security to boats, both against fire and leakage, it is one of the best things we have seen. Its value lies in its power, simplicity, and the readiness with which it can be worked, either by the steam engine or by the persons on board.—*Boston paper.*

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 10, Vol. IV. New Series.	MAY 15, 1840.	**Whole No. 358. Vol. X.**

It becomes our painful duty to announce to our readers, the death of the *Chevalier de Gerstner,* the distinguished Engineer, who has spent more than a year in this country, and in that time, obtained the good will and esteem of all who knew him.

The object of this gentleman in visiting our country, was to obtain the most exact information in regard to our railroads. He himself, had constructed the first railroad in Russia, had been one of the earliest advocates of the system, and had done much to promote it on the continent. From time to time, he had visited all of the public railroads in Europe, and with the information and experience thus acquired, he was prepared to make the most profitable application of his sojourn with us.

When the Chev. de Gerstner came into this country, our prospects in regard to Internal Improvement, were considered, and the friends of the system were almost derided for their adherence to that which in our legislative halls was pronounced as little better than a curse upon the nation, and which in our own and foreign markets, was considered as a bubble ready to burst.

At this stage of affairs, the most unpromising, it was to be expected that the unprejudiced opinion of an intelligent foreign Engineer, formed from a deliberate examination of our railroads, would have great authority. The result of the investigation of the Chev. de Gerstner, and his friend and assistant, Mr. Klein, are already before our readers, and their influence we conceive has already shown itself.

Independent of the loss to society of an amiable and accomplished gentleman, the Profession has lost much in the possessor of the greatest amount of precise information in regard to our railroads, ever collected by any individual. It is to be hoped, however, that Mr. Klein will be able to make such arrangements as shall conduce to the most profitable employment of the immense mass of information, in the collection of which he has taken so active a part.

We are reluctantly compelled to omit an important article, furnished by the politeness of *John M. Fessenden, Esq.*, for which he is entitled to our best thanks. Owing to an illness of our engraver, we have not yet been able to obtain the cuts. We hope, however, in the next number to furnish it to our readers.

For the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN :—In one of the last numbers of your Journal there appeared an article, questioning the statements, and casting some reflections on the judgment and opinions of Professor Renwick, in his account of the steamboats of the United States.

We are always pleased to see any statements which may appear incorrect, commented on, and their inaccuracies pointed out, provided it be done in a proper spirit, and facts sufficiently strong are brought forward to refute them.

But, unfortunately for the writer of the above article, the assertions he makes cannot all be substantiated by facts, and we are compelled to make the following remarks, more from a desire of preventing any error in the public mind in regard to the present mode of constructing engines in this country, than from any fear that the reputation of the Professor would be injured by that article, though backed by an Engineer having such a practised eye, and extensive information as Mr. Ward asserts that he possesses.

At the same time, we cannot but express our wonder that the writer, urged on by his vehement desire to "do the State some service," has not before this time pointed out these errors, and thus prevented the construction of several new vessels on the principles advocated by Professor Renwick, in his article in Tredgold.

These have all been built since that article appeared in this country, which was more than a year ago, and we therefore are obliged to question the conduct of the writer, for not endeavoring before this, to prevent a method of construction, which he says is so highly dangerous to the safety of the public.

We do not consider the first three objections of sufficient importance to allow us to take up the time and space necessary for their proper discussion, and must therefore pass them without remark, and leave them, for what we consider the more important charges.

On the third page, the writer has gratuitously furnished the public with a table of his own, for the purpose of proving that the consumption of fuel in the American engines, which use steam of a high tension, is far greater in proportion to their power, than it is in those of English manufacture, which use steam of a far lower pressure.

The things in this table which are stated as facts, are not only contradicted by every valuable work on the steam engine and by practical experiment, but by the authority of the English, and the words of the great perfector of the engine, Watt.

In the first place, to show the gentleman that he knows nothing of the English method of calculating the power of an engine, and that therefore he is wrong in his comparison of powers, we refer him, and all your readers, to page 146 of Stephenson's Civil Engineering of North America.

The author of this work, an Engineer of some standing, there calculates the power of the Rochester to be equal to 748 horses, which is more than four times as great as Mr. Ward states it to be; and the power of the Great Western, when working at her usual rate, if tried by the same method, will be found to be about 450 horse. The ratio of consumption of fuel, then, instead of being in favor of the English, inclines not a little to the American engines.

Another proof of the economy of using steam of a high tension expansively, may be found in a description of the Cornish engines, on page 117 of vol. I, and page 49 in vol. II, of the Transactions of the Civil Engineers of Great Britain, to which we refer the writer. It will there appear that the Cornish engines have done more work than any others in England, with a given quantity of fuel, also that they use steam of a pressure of from 40 to 50 pounds, and work expansively; and on page 127 of vol. I, in the same work, he will find the words of Watt, himself, brought forward in proof of our statements.

Having thus given the gentleman a few facts, from the works of English Engineers, we furnish the following further proofs of the inaccuracy of his statements, which from the arrogant and unmeasured manner in which he expresses himself, he seems to think are so generally known to be correct.

These are to be found in the fact, that all the American steamboats of the latest and best construction, use steam of a high tension. Of these, besides those whose names he has so kindly furnished in his table, we may mention the Independence, Pasaic, and Raritan, all of which were constructed under the superintendence of Robert L. Stevens, Esq., an engineer who holds, deservedly, a high rank in the profession; and most, if not all, of our first Engineers, have adopted the same practice.

We may also state that the Russian steam ship now constructing, is to be furnished with tubular boilers and to use steam expansively, which methods have been preferred on account of their superior economy and lightness, by the engineers of that country now in this city, who may certainly be quoted as impartial judges.

We are now brought to the final charge, and the one on which the writer seems to have expended the whole virulence of his critical wrath, namely the danger which he says arises from the use of steam of a pressure of 30 or 40 pounds in steamboats, which in his opinion, "has already cost the lives of many hundreds, and if persisted in, will require the yearly sacrifice of, perhaps, hundreds more."

In this last sentence, the writer, with more modesty than appears usual to him, has, fortunately for his reputation, qualified his assertion, by saying, "of, perhaps, hundreds more," leading us to believe that he is himself, in doubt of its correctness.

That this assertion is no longer a matter of opinion, will be seen from a memorial of the owners of our principal steamboat lines, in relation to the new steamboat law. From a table, on page 10 of this memorial which is grounded on pretty strong facts, and drawn up by Mr. Redfield, an Engineer of eminence, and which is approved of by James A. Stevens, James Cuningham, and several others, the following statements are deduced to show the comparative safety of the high and low pressure systems on the Hudson river and other waters near New York.

Mr. Redfield states, "I have separated the business of the fifteen years which it (the table,) comprises, into three several kinds, of five years each, commencing with 1824, early in which year, the navigation in this State, which had been previously controlled by the associates of Fulton and Livingston, was thrown opon to all competitors."

"On comparing the results of these several periods, the ratio of steam accidents for the first and third periods, as compared with the probable number of trips made, has decreased from 1 in 20,317 for the first period, to 1 in 317,105, for the third or latest period, showing a diminution in the ratio of accidents, in the average period of 10 years, equal to *about* 84 *per cent.* The average of lives lost from these accidents during the same periods, has also decreased, from 1 in 126,211, to 1 in 1,985,787; equal to a diminution in the ratio of personal hazard in this short period, of 84 *per cent.* The ratio of hazards in proportion of distance, is also reduced, almost 90 per cent."

By a reference to Mr. Redfield's table, it will be found, that the average pressure of steam during the first period was about 7 lbs. to the square inch, and during the third, 18 lbs. to the square inch, or more than a two-fold increase of pressure; yet notwithstanding this, that the accidents and loss of life, have diminished about 84 per cent., showing clearly that the mere pressure of steam is among the least important causes of danger.

We may add, that we have no written account, nor have we heard of any accident ever occurring in Cornwall, while it is well known, as may be seen by reference to Captain Pringle's report, made to the house of Commons, May 31st, 1839, that the accidents which have occurred to the English steamers which use low pressure engines, have been very numerous.

Professor Renwick has in no place stated, that explosions were not caused by the violent action of steam, suddenly generated, but that the *mere* pressure of steam determined by the load on the safety valve, is not to be feared; and that where the pressure is suddenly highly augmented through carelessness or accidentally, a boiler made for an expansive engine, is more likely to remain uninjured than a low pressure one, on account of the superior strength necessarily given to it—neither could he be expected to enter at large, into the causes of explosion in a paper like the present, but only give a brief view of his ideas on the subject, as he is evidently no writing an account of the method of constructing and using boilers, but of the practice of American Engineers.

AN ENGINEER.

COMMON ROADS.

The subject of common roads, the first improvement of a new country, has not received that attention which the subject strictly demands. The object of all internal improvements should be the convenience of a travelling public, and the particular accommodotion of a few must in a measure be sacrificed for the many; that is, the greater benefits will result from the real accommodation of the public at large, although a few individuals may suffer some little inconvenience by it. All the works of improvement in a State or country are in a great measure dependent on the judicious location and grading of the common roads adjacent to, and leading from such improvements; from the fact that all the freight or passengers have first to be transported over a common road before they can be conveyed on a railroad or canal. Hence if a railroad has superior advantages from its easy gradients, a common road will certainly have advantages by easy gradients and circuitous routes, over those that are located on the tops of the highest hills to accommodate one or two individuals, by passing through their farms without regard to hills or valleys, which will cause great undulations in the surface of the roads.

Every person who travels over a road injudiciously located, is taxed for the ignorance of the highway commissioners. Persons holding that office in almost every town, are not qualified to calculate force and resistances, or the firiction of carriages on common roads. Hence the calculation of the resistances does not enter into the account for locating common roads thro' a hilly country. Now the fact is, that most of the great thoroughfares in the shape of common roads in this State traverse very hilly countries, and if there had been some little instrumental examination made, and a calculation of the force necessary to draw a given load, taken into consideration, the character of common roads in the State of New York would have been materially altered.

The changing of a route when it is once located and graded, is seldom resorted to, but at a sacrifice of time and money; for the cost of making two roads, and those but poorly constructed, would doubly benefit the public if it was all expended on a road carefully located. That we have greater difficulties to encounter in the construction of roads through the different parts of the State than other portions of the United States is denied.—Some of the eastern States are more mountainous than the State of New York, yet their roads are much less undulating, and the highest elevations are overcome with the greatest ease, so that their stages travel from eight to twelve miles per hour; while ours, on most of the important routes, are compelled to drag along at the slow rate of from two to four miles per hour. In the location of common roads, and finally all kinds of improvements, intended for the conveyance of freight and passengers; the ease of the moter should be duly considered, because it is the actual saving of property in such moter.

The experiments made by Mr. Telford on the draught of carriages on different kinds of roads, prove that the force of traction on the best of roads necessary to draw the weight of one ton is as follows:*

1st. On a well made pavement,	33	pounds
2nd. On an old broken stone surface,	65	"
3d. On a gravel road,	147	"
4th. Broken stone upon a rough pavement foundation,	46	"
5th. Broken stone surface upon a bottoming of concrete,—formed of Parker's cement,	46	"
The mean of which is	77	"

Which is more than eight times the traction of a railroad, and this estimate in both cases is made for the resistance on a level plane. Now the best common roads in the State of New York, are not better constructed, if they are as well built as the gravel road on which Mr. Telford made his experiments.

Taking, then, 147 lbs. as the traction of common roads in this State, which on an inclination of four feet in one hundred, gives a resistance of 256 lbs. necessary to give motion to a weight of one ton, and on an acclivity of twenty feet in one hundred, one ton would require a force of 595 lbs. to cause motion, which, including the carriage, will require a force of about 900 lbs.

Common roads should never exceed an acclivity of four feet in one hundred, ($\frac{4}{100}$) which can be the maximum grade, without materially increasing the expense of construction and which will enable loaded trains to pass over the road with ease, and overcome at the same time an ascent of more than two hundred feet per mile. Many roads are located with an inclination of some thirty or forty feet in a hundred, in which cases the force becomes nearly equal to the load.

It is not my object in the present commnnication to define any particular method of legislation, by which the remedy for this evil may be found, but merely to show that the present management, location and construction of common roads are not based upon the most strict principles of economy.

S. L. W.

Dunkirk, March 31*st*, 1840.

* Report of the Holyhead road commissioners.

Western Railroad.—*Reduction of prices.*—A pamphlet of 50 pages, recently issued at Boston, entitled "Proceedings of the Annual Meeting of the Western railroad Corporation," touches some topics of interest to this city, particularly the reduction of the rates of freight and travelling on said road, and the object of said reduction. The fare between Springfield and Boston, is now only $2,50 for passengers—being a distance of about 100 miles. The object of this, and of the corresponding reduction of freight, is, of course, to " conciliate," as they express it, the trade of the Connecticut Valley towards Boston; (*alias* away from New York) and of this result they appear to be sanguine. As the matter stands *now*, or did lately, they show, that a country trader who goes with a ton of produce from Springfield to New York, instead of going to Boston, and returns with a ton of goods, although he travels 130 miles farther, saves six dollars on the way. This great disparity is itself the result of comparatively *low rates*. It is the effect of Steamboat navigation; for, 20 years ago, the Committee say, the trade of the Valley was chiefly with Boston, whereas four-fifths of it are now with New York. And as the one change has been effected by reduction, so, they argue, must be the other. What Steamboats effected *then*, the railraod must effect *now*. Putting the rates at $2,50 for passengers and $3,75 the ton of merchandize on the route above mentioned, will accomplish it, they say. It will " *control the travel and buisness of the great valley;*" and they are satisfied that a train of cars, carrying 200 passengers, and a train of freight-cars having at least 60 tons of merchandize, may be propelled from Boston to Springfield for less than $100 each, inclusive of supervision, motive power, wear and tear of the cars, engine and road, and all incidental expenses, making an outlay of 50 cents for each passenger, and but $1⅔ for each ton of merchandize. All their officers and agents concur in this; and so it is now settled.

The committee appear to have considered this step a very important one; and though unanimous about it at last, they fully weighed a vast mass of evidence, bearing on the point of moderate charges. The history of all the foreign roads was laid before them. In the case of the Belgian, it was found that *they* have cost over $41,000 per mile, or $5,000 per mile more than the Western. That the entire expense of sending a train over them is $15-100, or at least 5 cents per mile more than the cost upon the Western; but the average charge for passengers has been only 11-10 cent per mile, equal to a charge of $1,08 between Springfield and Boston; and yet these roads, at this charge, have afforded an ample income, paying a fair interest upon the outlay. In 1838 the receipts between Antwerp and Ostend, 159 miles, were as follows: 17,503 passengers, first class at 2⅓ cents per mile each, who paid $13,171 18; 215,893 passengers, second class at 2 cents per mile each, who paid $133,475 38; 604,935 passengers, third class at 1⅓ cent per mile each, who paid $196,451 07; 1,343,354 passengers, fourth class at 8 mills per mile each, who paid $206,680 00. Average number to each train 143; actual expense of carrying each passenger 73-100 per mile, or a little less than ¾ of a cent per mile.

The American roads are next referred to. The Salem road, for example, carries 6000 passengers a week, a distance of 13⅓ miles, and across a ferry equal in distance to four miles more of railroad, for the moderate charge of half a dollar each; and now the number of passengers upon it is more than double that originally estimated. This is ascribed to reduction, the rate being but half the stage-fare; and again, still later, between Salem Marblehead (5 miles) a few months since, a single coach usually conveyed the passengers, who rarely exceeded a dozen per day, at a charge of 25 cents per passage; but since the locomotive was set in motion, the number at 12½ cents has been as high as 200 a day. Extending these observations, the committee proceed to notice the vast increase of passengers in steamboats, upon the coast of Maine, the North River and the Sound, since the reduction of charges; the astonishing numbers that pass between Boston, Nahant, Roxbury, Charleston, and Cambridge, since the establishment of cheap steamboats and omnibuses; the striking results which have attended the reduction of postages, of the price of tickets for concerts and theatres, the cost of luxuries, the extension of commerce, at low rates of premium; the wide and increasing circulation of the penny press; the wonderful growth of the ice trade, which under the system of low charges, has so expanded, that it adds annually 30,000 tons to the exports of Boston, and supplies at least 100 sail of ships with cargoes; and more particularly to the great increase of the revenue of the New York canals, and gain in the aggregate receipts of these canals, which has attended three successive reductions of the tolls. These facts are doubtless to the point. They are such as have influenced the owners of the Atlantic steamers and the lines, still more lately, in similar reductions. The same philosophy appears in the new rates of the Norwich route. It appears in all quarters; in fact, it is the order of the age. The Worcester company are only a little earlier, and so much the wiser, than some of their old fashioned and narrow minded cotemporaries. A little we say, for even the Providence company have struck their flag at last. And so must all the rest do sooner or later. They must reduce. To this effect, the facts, as well as the reasoning, are very strong. We notice, that in consequence of rumours heretofore respecting an experiment tried on the Worcester road, the committee come out with a statement, the amount of which is, that in December 1836, they raised their fare (to Worcester) from $1,50 to $2, and again reduced it to the original price in May 1839. To remove mistakes as to the real result,they cite the return of the number of passengers on the Worcester railroad, for four successive years as follows:—

1836	Rate,	$1½	No. of passengers,	78,088
1837	"	2	"	61,666
1838	"	2	"	56,016
1839	"	1½ two thirds of the year,		75,230

On the whole, the road, in spite of hard times and every thing else, has been going ahead. It has always been at least a six per cent. stock. From the *Western* road still more is expected, running into a new region of Massachusetts, as it does, whose exports and imports are about 150,000 tons a year, and to connect with the Hudson and its commerce of a million of tons the year. Thus, by the section already finished, the committe expect to conciliate a business equal to 50,000 tons of goods and at least 60,000 passengers per annum, to be derived entirely from the resources of the railroad East of the Connecticut, and increasing at a rate not less than 10 per cent. a year; and then much stress is laid on the time when "this great avenue of commerce shall consumate its union with the canals and railways of New York," becoming part of a line from Boston to Buffalo, or connecting with the ocean steam packets the steamers of the lakes and the canals of the west, and entering into a continuous route from England to Cincinnati, Louisville and St. Louis, "as well as the most direct, expeditious, cheap, and least fatiguing route between those great marts of commerc."

The committee do not forget to hint that the produce of the West finds its *best* market at Boston, and of course would *like* to go there; while the great Boston Yankees find their most extensive markets also at the West.

They mention, moreover, the facts that at least 15,000 persons weekly ascend and descend the Hudson; that at least 30 packets and transient vessels ply between Boston and Albany, besides vast numbers which bear the produce of the West from New York; that more than 100,000 barrels of flour are annually boated up the Connecticut above Springfield; "that in the hills of Berkshire the Western railroad intersects quarries of lime and marble, which will supply the valley of Connecticut and the entire country bodering on the road; that as soon as this great artery of the State is finished, and the sections between it and Buffalo are complete, a passengers may pass almost without fatigue in eleven hours from Boston to Albany in thirty hours from Boston to Buffalo, in six hours more to Erie, in six hours thence to Cleaveland, and in two days and a half from Boston to Detroit.

EIGHTH REPORT OF F. R. HASSLER, AS SUPERINTENDENT OF THE SURVEY OF THE COAST OF THE UNITED STATES, AND OF THE CONSTRUCTION OF STANDARDS OF WEIGHTS AND MEASURES; RENDERING ACCOUNT OF THE WORKS OF 1839.

(Continued from page 275.)

Upon the construction of the standards of weight and measures.

1. Since my last report upon these works, the full sets of weights for all the custom houses have been delivered and destributed according to their destination.

2. Weights had been prepared to become, when standarded, the heavy ounce weights for the mints, to be grounded upon the sets of ounce weights till to the one hundred onnce weight, which were delivered to the mint in Philadelphia, early in 1838, as has been reported upon in proper time. The mint having, in the meantime, constructed more accurate balances, desired for the sake of acceleration, to receive these weights in that unfinished state, and adjust them in their own establishment. This being granted by the treasury department, the whole of the sets, with their packing boxes, etc., complete, were delivered to the director of the mint at Philadelphia, and also the beam of an unfinished brass balance, of large size, which had been begun, and which they were in need of, to assist in the adjustment of the weights delivered.

3. The principal attention in the way of adjustment of standards this year, was put upon the numerous yards ready for it, a task which it is impossible to make hasty, and which requires in all cases continued and very fatiguing application; many thousands of microscopic observations are required for it. The specialities of these minuted parts of the work belong rather to an ultimate full account of all the means and methods employed in the execution of the whole task of the establishment of the standards which it will then be proper to publish, and distribute on government account, like a similar account of the works of Mr. Bessel, of Konigsberg, for the establishment of a standard length measure, has been published lately by the government of Prussia.

4. The feeling lever apparatus, which Professor Bessel has directed to be made for this establishment, at Berlin, he has lately announced to me as being nearly ready, so that it may perhaps yet arrive before the final delivery of the yards. This would afford the opportunity of establishing some comparisons by two methods, by the microscopes, and by the lever, which would be the more desirable, as the latter is intended to remain in the establishment for future use in comparisons.

5. A number of yards sufficient to furnish all the States are ready; but it is not proper to deliver them as yet, as it will tend to more accurate coincidence, to combine more numerous comparisons, under a variety of temperatures, and with different means. Besides the original standard scale of eighty-two inches, described in the report, upon the comparison of the weights and measures of the custom houses, various other sets of microscopic arrangements were constructed, and constantly employed, whereby always a number of comparisons are carried on at the same time.

6. The form of the yards is that which has been formerly already mentioned, as best adapted for the preservation of their accuracy; the yards being cut to a length, in about the half breadth of a strong brass bar, and

fitting between the butting pieces at both ends of a similar bar of equal thickness, which it fills exactly, so that when joined they form one piece, and nothing can ever touch the ends, which determine the exact length: this arrangement presents evidently two different means of ascertaining the length of the yard to the nicest; but it should be used only when it is desired to give the length of other yards that are intended *to form again standards.* For the transfer of the yard for common purposes, there is a special decimally divided length of a yard traced upon the outer piece of the yard, or matrix, between two parallel lines. A tracing arrangement is given with it, by which means, the yard being left undisturbed in its proper place, in the box fitted for it, a bar of metal, or wood, for which a location is made parallel to the yard, can be laid off and subdivided without in any way injuring the original; the use of this will be described in a statement to be added, as instructions at the delivery of the yards. My assistant worked at a considerable number of these divisions, until interupted by sickness.

7. Of the liquid capacity measures the full number is finished, until to their adjustment, which requires their being weighed filled with distilled water, at the temperature of the maximum density of water, which is a most tedious and minute, therefore not very quick operation.

For the use in it a special balance has been constructed. Their actual adjustment will begin immediately after that of the yards, when the arrangements which it requires will be completed. Handles of a peculiar construction, to take off and put on, are constructed for their proper manipulation, in use, without changing in the weighing.

8. As it is necessary to close the tops of the vases exactly at the proper height, to contain a determined weight of distilled water, at a given temperature, in a given cubic space of a brass vessel, it is necessary that this vessel be *exactly* covered, no air bubbles admitted in it, and no overflowing; to effect that, glass plates are required, exactly plane. of proper thickness, ground, unpolished on the side which touches the liquid, and of the size of each vessel's top; only large plate glass factories can procure these good; to construct them expressly would have necessitated a great establishment, different in its kind from all that is now established, therefore these plates have been ordered at the manufactory of plate glass of St. Gaubin, where they can be made with ease; which has established arrangements for such works, and can execute them at short notice, and with proper accuracy; they will perhaps cost a great deal less than in any other way.

9. The half bushels require a manner of casting, different from that of the other parts of the works, which takes also more time and special cares; it has been in full operation as much as possible; but this casting cannot be made in our establishment at all seasons of the year with equal success, and will, therefore, suffer temporary interruptions; during which other castings are executed. Some of these half bushels have also been turned; but it is evident that in the proper order of the work, there could not yet be any attempt toward their adjustment. The glass plates, that shall serve to cover them, have been ordered, together with those for the capacity measures for liquids for all of them; the proper size has been given to the factory for guide.

10. Thus it appears that the different tasks of the establishment for standard weights and measures have advanced properly, each in that proportion which the kind and the quality of the work they require, indicate naturally as the time required for their execution. The weights being already fully executed and delivered, except the ounce weights for the States, have made known in the country what is to be expected from the establishment,

and have, I believe, given general satisfation, which I doubt not every part of the works will give, whenever it appears before the public.

F. R. Hassler.

Station of Willow Grove, Pennsylvania, November, 16, 1839.

ON THE MODE OF PROCURING FAC-SIMILE COPIES OF MEDALS, ETC.—BY THE AGENCY OF VOLTAIC ELECTRICITY.

Sir—You request a condensed account of my voltaic process of working in copper. I shall endeavor to give you one, premising, I shall divest it as much as possible of electro-chemical detail, that it may be rendered quite intelligible to those unacquainted with that science.

It has been long known that one metal will precipitate another from its solution. As one instance, if we take a solution of the sulphate of copper, the blue vitrol of commerce, and dip the blade of a penknife in it, in a few seconds it becomes coated with pure metallic copper. We have here an instance of simple electro-chemical action, and I may say, the type of all the experiments I have lately published on the subject. Subsequently, it has been found that copper itself possesses this quality, by acting on *its own* solutions, and to a much greater extent than in the first instance, but under a somewhat different condition.

If we take a clean copper wire and dip it into a solution of the sulphate of copper, on taking it out, we find no perceptible difference is made on its surface. If we now take the copper wire, or slip of that metal, and solder to one of its ends a piece of zinc, and bend the two metals so combined into the shape of the letter U, and again place the copper end in the cupreous solution, and the zinc end in a very weak solution of salt and water—if allowed to remain some time, it will be found the copper end has received a thin coating of solid copper. In this instance, as in most others connected with continued galvanic arrangement, it is a *sine qua non*, that the two fluids must *not* be allowed to intermingle, yet must be *in* connection with each other.

To effect this, various expedients have been resorted to, with more or less success; but to give a simple illustration of how this may be effected, in order to attain the result mentioned above, take a piece of *stout* brown paper, and bend it into the form of a piece of tube about three inches long and perhaps an inch in diameter. This may be conveniently done, by bending the paper round a phial to make it assume the desired form; let the edges of the paper overlay, and fasten them together with a bit of sealing wax. A paper tube is thus obtatined, open at both ends, but one end must be closed; this may be done simply, by cutting a piece of card into the shape of the bottom end, but a little larger, and fastening it on with sealing wax, just as we would take an impression of a seal, by covering the disc of card with the wax, and while soft dip the end of the paper tube into it; when set, we shall thus obtain a vessel capable, to a certain extent, of containing a fluid, yet from its porous texture, this fluid would be in connection with any other fluid that might surround it on the other side.

Having obtained such a tube, we three parts fill it with salt and water, or better still, glauber salt and water, which is a sulphate of soda. We then take a common drinking tumbler, containing a quantity of sulphate of copper in solution, and take the paper tube containing the saline solution, and immerse it in the tumbler, taking care that both fluids shall attain the same level. If we now take the bent slip of copper and zinc, and place the copper end of it in the cupreous solution, and the zinc end in the saline solution, contained in the paper tube, and let this remain at rest for a few hours, (if in a warm situation so much the better,) it will be found on removing the combined pieces of metal, that the copper end has obtained a solid covering of pure copper. I have here described an elementary voltaic battery, and the most extensive one ever constructed, is only a combination of such simple arrangement connected together by copper wires.

In this arrangement the inside of the paper tube, containing the saline solution, is termed the positive cell—the outside one—the tumbler containing the cupreous solution—is termed the negative cell. The zinc end of the combined metals, is termed the positive electrode—the copper end—the negative electrode. With a modification of this very simple apparatus, all the experiments of this process may be readily performed. I have judged the above explanation necessary, as many persons have imagined the apparatus when constructed, was in some way or other connected to a galvanic battery.

By performing the above experiment, we acquire a clear idea of voltaic arrangement, while the eye becomes acquainted with the phenomena produced.

Were I required to produce an exact fac-simile of a medal in copper, I should proceed as follows:—Suppose it were equal in size to half-a-crown—I should procure a piece of glass tube (a short gas glass of the largest diameter does best) and then take a piece of flat glass and oil its surface slightly—this done, I place one end of the tube on the oiled glass, and pour into it some fluid plaster of paris, to the depth of one-half or five-eighths of an inch; when this sets, the oiled glass will slip easily off, and a porous bottom will thus be given to the tube, which in all cases should be of equal or superior diameter to the medal required to be copied. This and a common sized drinking tumbler, comprehends nearly all the apparatus required.

I should now procure two pieces of pretty thick sheet lead, and with a plane, smooth one of the surfaces of each piece in the manner wood is planed. I then take the medal to be copied, and place it between the bright surfaces of the pieces of lead, and place the whole under a press. Should the medal not be very large, a copying press will be found sufficient, but when larger, a more powerful one is requisite. In either case the object to be acted on must be under the centre of pressure.

When removed from the press, a most exact mould of each side of the medal will thus be obtained. I now take a piece of copper wire, varying in length according to the size of the apparatus—in the present instance, from 12 to 16 inches may be used. To one of its ends, I solder a piece of zinc, rounded, and sufficiently large to go into the gas glass. To the other end I solder* one of the leaden molds. I have now what is termed a "galvanic pair," the leaden mould constituting the negative electrode, and the zinc the positive one.

The wire is now bent in such a form, that the lead and the zinc will be opposed to each other—the opposed surfaces being distant about one and a half inches. To effect this, bend the wire into a right angle, at its junction with the lead, and place the lead in a horizontal position, at the bottom of the tumbler, the impressed side being uppermost. The gas glass, with its plaster bottom, must now be placed exactly over the lead mould.† The wire must again be bent in the shape of the letter U, in order that the zinc end may go into the gas glass, and *touch*, or nearly so, its plaster bottom. This like the lead, mnst lay horizontally, on the bottom of the interior cell.

* The wire should be soldered to the blank side of the lead.

† In order that the gas glass may not *rest* on the plate to be deposited on, I suspend it by a wooden collar, which rests on the outside vessel, and keeps the bottom of the inside one, at a quarter of an inch distant from the plate.

To conveniently effect this, the end of the wire should be soldered to the centre of the zinc disc.

These arrangements being neatly effected, I now pour a hot saturated solution of sulphate of copper into the tumbler, being in connection with the lead. A few undissolved crystals may be added with advantage. I next pour a hot solution of glauber salt into the gas glass, in connection with the zinc, taking care it does not exceed the level of the fluid in the outside cell. This latter solution must not be saturated, but only a few crystals of the salt put in the water. This may now be allowed to remain for a day or two, until the blue color of the cupreous solution is assuming a pale green; then add a few crystals of the salt of copper.-- Should a very thick deposition of copper be required, it is well to renew the solutions entirely, as the acid that is set free, materially interferes with the success of the process.

This process may be quickened in a very great degree, by the application of heat, and the metal so deposited, is of a much superior character to that deposited under a common temperature. The apparatus I have described, may be kept at a temperature of from 120° to 160°, by being placed at the side of a fire, and a deposition got in a few hours.

When it is judged the requisite thickness is deposited, I proceed to get the copper so deposited, off the mould as follows: Previous to immersing the lead into the solution, I generally varnish the back and edges of the mould, to prevent deposition on any other portion of its surface than that opposed to the zinc.

On removing it from the apparatus, I file the edges of the copper until they are flush or parallel with the lead. I then heat the copper side by holding it over the fire, and suddenly plunge it in cold water. On examination it will be found some portion is loosened from the lead, when, by inserting the edge of a knife, the plate of copper will come readily off, bearieg a *most exact* impress of the original.

I have thus far described how to proceed, in the progress of taking a single medal; but it will at once be perceived, that the same instructions apply to a sheet containing an indefinite number by only enlarging the apparatus. By exactly the same process here described, I have succeeded in obtaining exact copies of engraved wood blocks and copper plates. I have also succeeded in stereotyping in copper, some elaborate ornamental printing, equal in area to a large octavo page.

I have used lead for most of my latter experiments, instead of copper— as that metal percipitates copper, when in connection with zinc, and it is much easier got off the mould, in consequence of the different degrees of expansibility possessed by the two metal, on the application of heat. The time occupied by the whole process is also materially abridged. I have not yet had an opportunity of trying the "fusible metal," that melts at a temperature of 212° F. It must also be borne in mind, that as far as our knowledge extends, it is an electro-chemical law, that a *metallic* surface must be present, before we are able to precipitate a metal from its solution.

Want of space compels me to omit several minutiæ, that my experience has suggested, but enough has been said to illustrate the princple, and I may add, it is susceptible of infinite variation.

I have every reason to believe it might be found advantageous to type founders, for the matrix from which they cast type, as copper precipitates very readily, on a surface of type metal.

In conclusion I may add—I have no personal intention of turning this process to pecuniary advantage—should it be capable of being so applied, but should at all times feel happy in communicating my experience of the matter to those desirous of applying it in the arts.

My own expectations have been fully realised, as it has been a means of illustrating a hitherto unsolved geological problem, in connection with some peculiar views I hold on the subject.

THOMAS SPENCER.

Liverpool, Dec. 14th.

Internal Improvements.—Yesterday the two houses passed the bills in aid of the New York and Erie, Hudson and Berkshire, Auburn and Rochester, and Long Island railroads. They had previously passed the appropriations for the enlargement of the Erie canal, and for the prosecution of the Black river and Genesee Valley canals. The appropriations, so far are, as follows:—

Erie Canal enlargement*	2,500,000
Genesee Valley Canal	500,000
Black River Canal	250,000
N.Y. and Erie Railroad†	400,000
Hudson and Berkshire Railroad	150,000
Auburn and Rochester Railroad	200,000
Long Island Railroad	100,000
	$4,100,000

In addition, the bill appropriating $100,000 in aid of the Harlem railroad has passed the Senate, and the bills in aid of the Tonewanda railroad and for the purchase of the Oneida Lake Canal and feeder, the former $100,000 and the latter $50,000, have passed the Assembly.

MEMORIAL OF SUNDRY PROPRIETORS AND MANAGERS OF AMERICAN STEAM VESSELS, ON THE IMPOLICY AND INJUSTICE OF CERTAIN ENACTMENTS CONTAINED IN THE LAW RELATING TO STEAMBOATS ASKING TO BE RESTORED TO THE RIGHTS AND PRIVILEGES WHICH BELONG TO OTHER CITIZENS ENGAGED IN NAVIGATION.

To the Honorable the Senate, and House of Representatiaes of the United States, in Congress assembled:

The memorial of the undersigned, proprietors, managers and agents of american steam vessels, respectfully showeth:

That for several years, your memorialists have been actively engaged in steam navigation: and that, in thus employing a power which is universally known and acknowledged to be hazardous in its nature and use they claim to have afforded and maintained a degree of security, in the transportation of persons and property, which has not been equalled by any other known means of transport or navigation. This important fact, so contrary to public apprehension, we trust will appear from the annexed documents, and also from any just and accurate comparison of the average losses and casualties by steam, with the average losses and casualties which occur in other modes of navigation or transport.

For these results, which are on the whole so favorable, the public are not indebted to incentives furnished by pecuniary rewards; for your memorialists believe, that no interests involving such vast investments of capital, have generally been less productive. Nor is the present degree of

* An appropriation of $500,000 early in the session.
† For this year, and an indefinite sum for the future.

security due to any interference of the government with the mechanical arrangements and prudential management of our steam vessels, or to the enforcement of novel and severe principles of legislation; but has been owing to the inventive and discriminating powers, prudent foresight, and persevering spirit, of those who are engaged in this important branch of national enterprise.

This spirit of national enterprise, producing results which have generally been more and more favorable to the security and advantage of the public, has continued in full activity to the present hour; with a firm reliance, on the part of those engaged, upon the guardianship and protection which is due from the government of this vast country to an interest which is inseparably connected with it principal business relations and public resources, and which is destined to advance our country to the highest point of prosperity and power.

Your memorialists further represent, that certain enactments of peculiar novelty and severity, found in the act of Congress of July, 1838, are calculated to bear harshly and oppressively upon the owners of steam vessels and thus to affect injuriously this important branch of our navigation.—These enactments, instead of furnishing encouragement for a just and generous rivalry, in bringing steam vessels and their machinery to the highest possible state of security and perfection, have unfortunately, in the view of your memorialists, a direct tendency to deter men of prudence, capacity and property from further connection with this business; who are unwilling to submit to implied reproach and degradation, to unwarranted hazards, and to the loss of rights and privileges which are guaranteed to all other persons engaged in a lawful calling. Your memorialists refer more especially, to the clause which deprives them of the universal legal protection common to every civilized country, by unjustly construing, in the event of any serious disaster to life and property, the presumption of innocence into *prima facie* evidence of guilt; and they respectfully request of your honorable body, that a provision, which is so much at variance with their fundamental rights and privileges as American citizens, may be repealed.

It is with painful regret that your memorialists have noticed an attempt to procure a broader and more mischievous application of this unjust principle, by means of proposed additions to this law; and they respectfully ask of Congress to be protected from such proposed aggravations of the already severe and relentless doctrines of the common law as it now governs the responsibilities of common carriers; and which, if enacted, must tend to destroy every just inducement for longer continuance in a business which is subjected to such unprecedented liabilities to loss and ruin.—These extraordinary hazards and liabilites, it should be noticed, will not pertain to our competitors under a foreign flag; and our citizens may thus be virtually excluded from navigating the ocean by steam. Your memorialists would further remark, that if with the best knowledge possessed by this or any other country, this species of navigation be deemed too hazardous for the public safety, they deem it more just and honorable to submit to its entire prohibition.

Your memorialists believe that few opinions are more erroneous than that which ascribes to the provisions of the existing law a generally increased safety for persons and property carried in steamboats. This may appear from the many accidents or disasters of a serious character which have taken place during the short period in which this law has been in force. The number of these accidents on the western waters during the last year is stated to have been forty; which may serve to convince Congress that the appropriate remedies for these disesters are not furnished by this law; and can be found only in the increasing practical knowledge and skill of those persons who are engaged in the construction and management of steam vessels.

Your memorialists do not seek to escape from any just responsibilites in conducting this important business. On the contrary, they feel bound to furnish every reasonable guarantee for safety to life and property which human foresight and prudence may be able to afford; and it is for the purpose of furnishing these guarantees in the most direct and practical manner, that they further respectfully but earnestly request, that Congress will call to the aid of its committees, to whose protection this important branch of navigation has been intrusted, the information and experience of some of the individuals whose lives have been devoted to its improvement and practice from its earliest origin in this country:—in order that practical knowledge may form the basis of legislation upon a subject which affects more or less directly the interests and business of, probably, a great majority of the American people.

All which is respectfully submitted.

New York, February 22, 1840.

MEMORIALISTS.	STEAM VESSELS OR LINES REPRESENTED.
A. N. Hoffman, James A. Stevens, Robert Dunlop, Jonas C. Heartt, Richard P. Hart, Daniel Drew,	North river line; steamboats Albany, De Witt Clinton, Swallow, Erie, Champlain, John Mason, Columbus, Union, General Jackson, R. L. Stevens, J. C. Heartt, Rochester, Utica and Saratoga; about 5,500 tons; navigating about 250,000 miles annually.
W. C. Redfield, A. Van Santvoord, Isaac Newton, Henry Green & Co., Pope Catlin, Horace Stocking, Joy & Monteith, Charles S. Olmsted,	Steamboats Swiftsure, Constitution, Commerce, Illinois, Sandusky, Mt. Pleasant, O. Ellsworth, U. States, H. Eckford New London, J. Fairlie and John Jay, with 54 steam freighting vessels; aggregate, 13,000 tons; navigating an aggregate of about 330,000 miles annually.
David Crawford,	Steamboat Washington, Newburgh line.
Benjamin Carpenter,	" James Madison, "
Jackson Oakley,	" Superior, "
Thomas Powell,	" Highlander, "
M. Sandford, Charles H. Northam, S. B. Stone,	Steamboats Splendid, New York, Bunker Hill, Charter Oak —1,580 tons; New Haven and Hartford lines; navigating about 60,000 miles annually.
William W. Coit,	Steamboat Norwich; Norwich line.
Thaddeus Phelps, Nevins & Townsend, Richard S. Williams, James G. King, C. H. Russell, Wm. Comstock,	Steamboat Massachusetts, Narraganset, Rhode Island, Providence and Mohegan; 2,700 tons; navigating about 120,000 miles annually.
James Cunningham,	Steamboat Huntress, North America and Thorne.

With many others not printed.

Appendix A.

No. 1.

The following communication was made by request to the commissioners appointed by the English government for conducting an inquiry into the causes of steamboat accidents and the practical means of preventing their recurrence.

To Capt. J. W. Pringle, R. E.

Sir—Having received through a valued friend, a copy of the circular issued by the lords commissioners of the board of trade, which authorises an inquiry through the agency of yourself and Mr. Parke "into the nature and causes of the accidents which have occurred in steam vessels, and whether any measures can be taken in order to prevent the recurrence of such accidents," accompanied also by a request for my views on this subject I will cheerfully respond to the inquiry in such manner as is suggested by my own experience and observation.*

The accidents comprised in this inquiry may be classed under the following heads:

I. Accidents by shipwreck.
II. Accidents by collision.
III. Accidents by fire.
IV. Accidents by explosions, or by the injurious escape of steam.

The following suggestions on these several topics are offered for your consideration.

I. The liability of steam vsssels to shipwreck or loss at sea by stress of weather, may chiefly depend on the following causes or considerations:

1. The ability to avoid being stranded or cast on a lee shore, as in the case of the Rothsay castle, the Killarney and the Forfarshire steam vessels must depend mainly upon the power which can be commanded for encountering successfully the winds, tides and seas, and for keeping the vessel manageable or under the control of the pilot or navigator.

This power must depend: 1. On the general rate and efficiency of the engine: 2. On the ratio of velocity, or in common sea laaguage, *purchase* between the piston and the paddles:† 3. On the strength of the boiler, and its security from inundation; The boiler if near the bottom of the vessel, being liable to have its fires extinguished by any accidental accession of water in the hold.

2. The liability of the hull of a steam vessel to receive injury from stress of weather, when clear of the land, as in the cases of the English steamer Royal Tar, in the Bay of Biscay, and the American steamboat Home, on the coast of North Carolina, appears to depend greatly on the mode of construction which may have been adopted. Steamers require a greater proportionate length than is given to other vessels, and being oftener kept up to the wind and sea, they are more liable than other vessels to suffer from straining. The best remedy which is suggested for this evil, consists in a change in the system of naval construction. In the present system, reliance is mainly had upon spikes, bolts or tree nails driven traversly, and aided also, in some cases, by longitudinal bolts, bedded in the vessel's frame; but no effectual measures have been taken to transfer the laboring strain which falls latterally upon the fastenings and their bearings,

* This communication did not reach England till after the puplication by Parliament of the report made to the government by Capt. Pringle and Mr. Parke.

† The advantages of an increased ratio of velocity in the piston are far more important in stress of weather than in the ordinary circumstances of navigation.

to the timbers and planking or the mass of woody fibre. Hence, when a heavy stress is thrown upon the fastenings, their bearing surfaces in the wood are found to yield, and even the fastenings themselves become subject to flexure. Thus the planks are moved, the seams are loosened, and water is admitted, to the immediate hazard and damage of the vessel, and causing also a premature decay.

I propose as a remedy for this evil, that the frames of the vessel, (if closely built,) be so moulded as to project alternately inward and outward, to the extent of say three-fourths of an inch beyond the general surface, so as to form alternate projections and depressions on both the interior and exterior surfaces of the framing. Each plank should be of somewhat more than the usual thickness, and is first to be fitted to its place, and its bearing surface then cut out in such manner as to receive the projections of the framing in the closest manner; the several butts being scarfed so as to lock the continuous planks together by means of one of the projecting frames. After laying three or four planks in this manner, the next one is to preserve its full thickness throughout, and is to be let into an opening which is nicely cut to the depth of the projections of the frame, so as to interlock against the lateral or calking strain to which the planks and timbers are exposed; and these modifications of the interlocking process are to be repeated throughout the planking, except, perhaps, in some parts near the extremities of the vessel where the strain is less, and the greater bending of the planks may render the overlocking part of the process too inconvenient.

On this plan, the strain upon the fastenings is chiefly longitudinal, and they perform little other duty than that of holding the several parts of the structure in close contact; while the great strain which results from the weight and throw of the vessel and her cargo by the power of the sea, is brought to bear upon the general mass of woody fibre which is used in construction, and which is competent to sustain it without the least injury; while, in the usual system of construction, perhaps more than two-thirds of the wood employed is quite unavailable for the support of the vessel against heavy straining at sea; and contributes also by its weight to the strain upon the fastenings.*

II. *Accidents from collision.*—These, it is believed, are mostly owing to the want of a simple and well digested system of regulations for the government of vessels which are steering in opposite directions, especially in the night season, or in thick weather. Various plans have been recommended in Europe and America, but I know of none that I think equal to the system established on the waters of New York; where, with perhaps the most active night navigation in the world, accidents by collision have now become quite rare.

It is important for each pilot or navigator of a steam vessel to be able to understand the course or courses which are steered and will continue to be taken by the vessels which he may meet. For this knowledge we must chiefly rely upon a judicious system of lights and upon the reasonable presumption that no steam vessel will vary from its usual and proper course without good cause.

Owing to their sharpness and great length, steam vessels are not adapted to turning and dodging in their course; for any such practice is highly dangerous, and should never be attempted. If a slight variation of the

* In this plan of construction it is not intended to dispense with the auxiliary aid of a system of diagonal braces and riders, which should also be interlocked with the vessel's side. But diagonals will be if little benefit if secured only by the common lateral fastenings.

course be judged insufficient for avoiding collision, the proper alternative is to stop instantly and work the engine aback.

In this quarter, when steamers are likely to *meet* each other on opposite courses, each keeps sufficiently to the right to avoid collision, as required by law; but this rule does not require the steersman to change from one side of an approaching vessel to the other, for this would not unfrequently end in confusion and accident. In the night time, the course of other steamers is ascertained by means of the two signal lights, at the bow and stern, which each steam vessels carries.

The forward lights are placed outside the bow, on each side of the stem and inclosed, except in front, so as not to interfere with the view of the pilot or steersman, while the stern lights are hoisted upon the flag-staff at the taffrail, some 40 or 50 feet above the deck. The comparative *distance* of these or other lights cannot always be well determined, but the *low* light is known to be at the bow, and the *high* light at the stern, and according to the angle or distance at which the low light is subtended to the right or left of the high one, is the course of the approaching steamer with entire certainty determined; and the probable changes to be expected in her course, if any, are known by her position in the channel way and her probable destination. Thus, nearly all sources of uncertainty and confusion are avoided, by means which are at once both simple and effectual.

I have seen it recommended to place lights of different colors on the paddle covers; but this can only serve to distinguish steamers amid a multitude of other lights and in a very crowded navigation. Nor should lights ever be carried in such a position as by their glare or reflection will embarrass the night view of the steersman; and by exposing as few lights as possible, a great source of confusion is avoided. I also hold it as assential, that a steam vessel should be steered from the highest portion of her central or forward body, by means of a wheel and tiller ropes, and that in narrow waters or a crowded channel the *cun* of the vessel should be assumed only by an officer or pilot standing at the wheel, who *feels* the helm while he has also the advantage of an unobstructed view.

You will find annexed, a copy of the principal sections of the steamboat law of the State of New York, marked [A.]* This statute is not recommended on account of its penal enactments, which being probably designed to allay popular apprehensions, have been chiefly fortuitous, and are mainly inoperative; but as exhibiting our practical system for the avoidance of collisions, which has very properly found place among its provisions.

III. *Accidents by fire.*—This being a subject to which the common observation and attention of mankind are largely directed, it appears hardly necessary to discuss it on the present occasion. In addition to other securities, good forcing pumps with air chambers and hose, having the essential qualities of a fire engine, should always be provided, both near the boilers and furnaces and in situations above deck which will be always accessible, in case of being driven from the former by accidents of fire or steam.

IV. *Accidents by explosions, or injurious escape of steam.*—This is doubtless the chief topic which claims our consideration on the present occasion.

As regards the means which are now chiefly relied on as affording security from steam explosions, such as careful and intelligent management,

* This law may be found in the Revised Statutes of New York.

the providing of good safety valves, gauge taps, glass water guages, pressure thermometers, mercurial pressure guages, and the like, I am not aware that anything new and useful can now be offered; and am convinced that if due attention to these, could have insured entire safety, it would have been already attained. But an attentive consideration of the various accidents which have occurred within the circle of my observation, and of those also which have come to my knowledge through the publications of the day, has led me to the following conclusions:—*First*, that accidents, more or less serious, must be expected sometimes to attend the use of the steam engine, as well as all other efforts or combinations of human skill, and that the interests and safety of the public are not best promoted by resorting to a system of onerous and penal legislation in regulating its use. *Second*, that a very great proportion of the steam accidents which have occurred on both sides of the Atlantic, have been owing chiefly to defects in the general system of construction, and not, as has been very generally supposed, to the want of cautionary apparatus, or the gross neglect of those who were intrusted with the executive duties.

The last conclusion, though at variance with opinions which are extensively entertained, may also be sustained by a careful examination of the degree of strength which is afforded by the weakest portions of common steam boilers, as compared with the maximum pressure and incidental hazards to which they are liable. This want of a sufficient disparity between the maximum of force and the minimum of resistance, will appear still more obvious by extending the conparison to other structures or effective laboring machines of like metal, where, in all important cases, it is believed, a much greater proportionate strength is usually found than pertains to steam boilers of the ordinary construction.

But however this may be, it appears certain that in this quarter, the accidents to steam boilers have been nearly in proportion to their deficiency in comparative strength. This point deserves, however, a more complete elucidation than can be attempted at this time, and I therefore refer to a communication to the Hon. Secretary of the Treasury of the United States on the general subject, which I prepared a few months since in compliance with a resolution of inquiry which was passed by Congress; a copy of the same is hereto annexed, marked [B.]*

It is obvious that there are few uses to which metals are applied, which demand so much attention to strength and security, as in the manufacture of steam boilers. These should be so constructed as to be guarded, on this point, against all contingencies of use which are likely to occur.

If an examination of the English and American steam vessels should show a degree of deficiency on this point, the cause may be readily found in the influence of habit, of prevailing opinions and of previous examples, which have had their origin in an early stage of the art; and also in considerations of practical convenience and facility of manufacture. That the warnings resulting from the various disasters which have occurred, have failed to some extent in their preventive effects, is probably because the theoretical opinion has been honestly and seduously cherished, that these accidents have occurred only through the culpable carelessness and neglect of those in immediate charge of the boilers; and the evil is thus in some degree rendered permanent.

That the safety of steam boilers from explosions does not necessarily depend upon working with so low a pressure as five or seven pounds to the square inch, and that a reasonable increase in the proportionate strength of the boilers in steam vessels would remove all immediate hazard, and

* For a revised copy of this communication see Appendix [B.]

nearly end the catalogue of these disasters, is rendered apparent by the facts which relate to this branch of navigation as it has been carried on in various directions from the city and port of New York. Here, where steam navigation was first successfully established, and where it has probably attained its highest degree of efficiency, we might have expected that accidents and disasters would, not unfrequently, attend the use of a power at once so novel and energetic. The accidents and fatalities which have here occurred, as well as their probable proportion to the pressure of steam, the number of boats employed or trips made, the number of miles navigated, and the number of passengers which from time to time have been exposed, may be seen in the annexed table.

This table, so far as relates to the service performed on the different routes and the number of persons exposed, is made up approximately, by estimates founded on my general acquaintance with our steam navigation; but is believed to be sufficiently correct for general purposes. I have separated the business of the fifteen years which it comprises, into three several periods of five years each; commencing with 1824; early in which year the navigation in this State, which had previously been controlled by the associates of Fulton and Livingston, was thrown open to public competitors.

It appears from the average results of this table, that during even the first period of five years after the navigation was thrown open to public competition, the ratio of steam accidents was only equal to one, for more than 20,000 trips or passages; and that the average loss of life is only equal to one, for more than 126,000 passengers exposed. Thus, at the fair outset of this noble enterprise, a degree of safety was attained for the passenger, such as may well challenge comparison with any artificial means of transit or locomotion that have ever been resorted to by the human race.

It appears further, on comparing the results for these several periods, that the ratio of steam accidents for the first and third periods, as compared with the probable number of trips made, has decreased from one in 20,317 for the first period, to one in 317,105 for the third or latest period; showing a diminution of the ratio of accidents in the average period of ten years equal to *about* 84 *per cent.* The ratio of lives lost from these accidents during the same period, has also decreased from one in 126,211 to one in 1,985,787; equal also to a diminution in the ratio of personal hazard, in this short period, of 84 *per cent.*

It appears also from this table, that during the first of these periods, the average number of miles navigated by all our steamboats, to each explosion which occurred, was equal to 235,646; a distance equal to many times the circumference of our globe, and about equal to that from the earth to the moon. But even this ratio has been rendered tenfold more favorable in the short average period of ten years, being for the latest five years, 2,733,725 miles navigated for each explosion; or more than eleven times the distance from the earth to the moon; and reducing the ratio of hazards in proportion to distance, *almost* 90 *per cent.**

[* The results of a like examination extended to the whole Atlantic tide waters, and the great lakes, it is believed, would be no less favorable. But it will doubtless be supposed, that on our western rivers the ratio of accidents and hazard by steam explosions must have been far greater. This is probably true, in a degree; owing to the ultra and improvident system of high pressure construction which there prevails. But let the inquiry be strictly made, upon the above principles of analysis, and it may serve to show how uncertain a test of the real hazard is found in public prejudice, or individual apprehesion. The constructors and managers of western engines and steamboats owe it to themselves, to their profession and the public, to make this inquiry; so that the faults, or the safety of their favorite system of engineering may fully appear. If a scheme of penal enactments shall there be found necessary and available for the protection of human life, which I cannot readily believe, let it be confined to those waters which are above the flow of the tide; or, which I deem better and more efficient practice, let their present system be either modified or discontinued.]

A Tabular Estimate of the amount of Steam Navigation connected with the Port of New York, the number of passengers carried, and the steam accidents, together with the average and comparative hazards which have attended the same, for two successive periods of 5 years each, beginning with 1824 and ending with 1833.

ROUTES FROM NEW YORK.	length of route, miles	First period, from 1824 to 1828, both inclusive. Probable number of passages per year.	Probable number of passengers and crew exposed on each trip.	Estimated number of trips made in the five years.	Aggregate miles navigated in the five years.	Estimated number of persons exposed in the several trips during the five years.	number of accidents.	Number of lives lost.	Ratio of accidents to whole No. of trips.	ratio of loss to whole No. of exposures.	Estimated average pressure of steam used in 1825.	Second period, from 1829 to 1833, both inclusive. Probable number of passages per year.	Probable number of passengers and crew exposed on each trip.	Estimated number of trips made in the five years.	Aggregate miles navigated in the five years.	Estimated number of persons exposed in the several trips during the five years.	number of accidents.	Number of lives lost.	Ratio of accidents to whole No. of trips.	ratio of loss to whole No. of exposures.	Average pressure of steam in this period.
Albany and Troy,	150	1,850	120	9,250	1,387,500	1,110,000	1a	3	$\frac{1}{9250}$	$\frac{1}{370000}$	7 lbs. to the squ're inch.	2,294	150	11,470	1,720,500	1,720,500	2h	18	$\frac{1}{5735}$	$\frac{1}{95583}$	14 lbs. to the squ're inch.
Hudson and Catskill,	120											160	80	800	96,000	64,000					
Kingston and Rhinebeck,	90											160	40	800	72,000	32,000					
Poughkeepsie,	75											160	40	800	60,000	32,000					
Newburgh, Fishkill, etc.	60	320	80	1,600	96,000	128,000						400	80	2,000	120,000	160,000					
Peekskill and Sing Sing,	40	320	60	1,600	64,000	96,000	1b	1	$\frac{1}{1600}$	$\frac{1}{96000}$		500	70	2,500	100,000	175,000	1i	15	$\frac{1}{2500}$	$\frac{1}{11666}$	
Haverstraw and Tappan,	35											240	40	1,200	42,000	48,000					
Fort Lee,	8																				
Jersey city and Hoboken,	1·2	16,600	12	83,000	103,750	996,000	1c	2	$\frac{1}{83000}$	$\frac{1}{498000}$		30,000	14	150,000	187,500	2,100,000					
Elizabethtown, Amboy, & New Brunswick,	40	1,120	80	5,600	224,000	448,000	3d	20	$\frac{1}{1866}$	$\frac{1}{22400}$		1,600	100	8,000	320,000	800,000					
Staten Island,	6	1,120	40	5,600	33,600	224,000						1,600	45	8,000	48,000	360,000					
Newark,	22											1,120	60	5,600	123,200	336,000					
Middletown Point, etc.	18											120	40	600	10,800	24,000					
Shrewsb'y, Rockaway, etc.	22	120	40	600	13,200	24,000						120	40	600	13,200	24,000					
Brooklyn, Williamsburgh,	1-2	25,000	10	125,000	62,500	1,250,000						45,000	12	225,000	112,500	2,700,000					
Charleston, S. C.	700											24	60	120	84,000	7,200					
Flushing Bay, etc.	12	700	30	3,500	42,000	105,000						800	35	4,000	48,000	140,000					
New Rochelle, etc.	20																				
Sawpits, Norwalk, and Bridgeport,	55	480	60	2,400	132,000	144,000						600	80	3,000	165,000	240,000					
New Haven,	74	360	40	1,800	133,200	72,000	1e		$\frac{1}{1800}$			500	50	2,500	185,000	125,000	1j	9	$\frac{1}{2500}$	$\frac{1}{13888}$	
Connecticut river,	160	210	60	1,050	168,000	63,000	1f	3	$\frac{1}{1050}$	$\frac{1}{21000}$		360	80	1,800	288,000	144,000	1k	20	$\frac{1}{1800}$	$\frac{1}{7200}$	
New London and Norwich	135	160	50	800	108,000	40,000						160	60	800	108,000	48,000					
Stonington,	135																				
Bhode Island,	200	240	60	1,200	240,000	72,000						300	80	1,500	300,000	120,000					
Unlocated boats, (say)*	25	160	30	800	20,000	24,000	4g	9	$\frac{1}{200}$	$\frac{1}{2666}$		100	40	500	12,500	20,000					
Totals and average results,		48,760		243,800	2,827,750	4,796,000	12	38	$\frac{1}{20317}$	$\frac{1}{126211}$	7 lbs.	86,318		431,590	4,216,200	9,419,700	5	62	$\frac{1}{16318}$	$\frac{1}{151931}$	14 lbs.

A Tabular Estimate of the amount of Steam Navigation connected with the Port of New York, the number of passengers carried, and the steam accidents, together with the average anh comparative hazards which have attended the same, for five years, beginning with 1834 *and ending with* 1838.

ROUTES FROM NEW YORK.	length of route, miles	Probable number of passages or trips per year.	Probable number of passengers and crew exposed on each trip.	Estimated number of passages or trips made in five years.	Aggregate miles navigated in the five years.	Estimated number of persons exposed in the several passages during five years.	number of accidents.	Number of lives lost.	Ratio of accidents to whole number of trips.	Ratio of loss to the whole number of exposures.	Aggregate pressure of steam in 1839.
	Third period, from 1834 to 1838, both inclusive.										
Albany and Troy,	150	2,738	200	13,690	2,053,500	2,738,000	1 l	2	1/13690	1/1369000	18 lbs. to the sq. in.
Hudson and Catskill,	120	240	100	1,200	144,000	120, "					
Kingston and Rhinebeck,	90	320	60	1,600	144,000	96, "					
Poughkeepsie,	75	160	80	800	60,000	64, "					
Newburgh, Fishkill, etc.	60	480	80	2,400	144,000	192, "					
Peekskill and Sing Sing,	40	660	80	3,300	132,000	264, "					
Haverstraw and Tappan,	35	240	60	1,200	42,000	72, "					
Fort Lee,	8	800	40	4,000	32,000	160, "					
Jersey city and Hoboken,	1-2	40,000	16	200,000	250,000	3,200, "					
Elizabethtown, Amboy, & New Brunswick,	40	1,800	130	9,000	360,000	1,170, "					
Staten Island,	6	2,240	50	11,200	67,200	560, "					
Newark,	22	1,120	80	5,600	123,200	448, "					
Middletown Point, etc.	18	160	50	800	14,400	40, "					
Shrewsb'y, Rockaway, etc.	22	160	50	800	17,600	40, "					
Brooklyn, Williamsburgh,	1-2	72,000	15	360,000	180,000	5,400, "					
Charleston, S. C.	700	48	80	240	168, "	19,200	1 s	6	1/240	1/3200	
Flushing bay, etc.	12	800	40	4,600	48, "	160,000					
New Rochelle, etc.	20	360	50	1,800	36, "	90, "					
Sawpits, Norwalk and Bridgeport.	55	500	100	2,500	137,500	250, "					
New Haven,	74	600	60	3,250	222,000	180, "					
Connecticut river,	160	450	100	2,500	360, "	225, "					
New London & Norwich,	135	220	70	1,100	148,500	77, "					
Stonington,	135	1y.480	70	480	64,800	33,600					
Rhode Island,	200	500	100	2,500	500,000	250,000					
Unloaded boats, (say)*	25	150	50	750	18,750	37,500					
		127,226		634,210	5,467,450	15,886,300	2	8	1/317105	1/1985787	18 lbs.

* The miscellaneous business is doubtless greatly underrated.

a Constitution.
b Franklin.
c Jersey.
d Etna, (high pressure,) Bellona, Legislator.
e Hudson.
f Oliver Ellsworth.
g Fidelity, Patent, Caroline, ——.
Average number of miles navigated to each explosion, 235,646

h Ch. J. Marshall; Ohio.
i General Jackson.
j United States.
k New England.
Average number of miles navigated to each explosion, 843,240
l Novelty, high pressure, 1837.
s William Gibbons, January, 1836.
Average miles to each explosion, 2,733,725

[N. B. Accidents other than by steam were not included in the above Table; only one of a fatal character being recollected, which happened at sea. The calamitous loss of the Lexington, at a more recent period, will doubtless inspire additional caution in all future navigation. In reference to the comparative and increasing safety of steam navigation, which may be deduced from the above Table, it is proper to notice, that a large portion of the above consists of a regular and unremitted *night navigation*, which is carried on in every variety of weather.]

This remarkable diminution of accidents and hazard, it may be seen, has taken place in the very period in which the average working pressure of steam has been more than doubled. It has also been attained solely by professional skill and experience, and without any aid from legislative interference; for the law of Congress on this subject was not in force till near the close of the year 1838. Had such a system of legeslation been at first adopted, there are sound reasons for concluding that it would not have prevented disasters, but might have greatly retarded the rapid advance in safety, as well as improvement, which has been so happily attained.*

It must not be supposed, however, that the average pressure of steam now used on the New York steamboats can be generally increased without incurring material hazard. The thickness which is found most suitable for boiler metal and the practical and economical limits of form and size, are such as should prevent us from allowing a maximum pressure exceeding one and a half or two atmospheres above the common boiling point, for condensing engines; with an addition of about one atmosphere for high pressure engines, which are worked without a condenser and air pump. To these limits, *if an adequate system of boiler construction be adopted* the pressure may with safety be carried, as is done in locomotive engines, in the use of which, owing to a better system of construction, fatal accidents have been less frequent, perhaps, than with low pressure marine engines.

I annex also a copy of the law of the United States, entitled, "An Act to provide for the better security of the lives of passengers on board of vessels propelled in whole or in part by steam."

It may be proper to remark, that the passage of this law was unexpected to the owners of steam vessels, and that it appears to have been considered by Congress itself as a premature measure, as may be inferred from the resolutions for instituting an inquiry on this subject which were passed at the same period.

* [January, 1840. On the 13th of the present month, the steamboat Lexington took fire on Long Island Sound and was destroyed. By this frightful disaster 124 lives were lost, and only four persons escaped. The loss of this vessel was, perhaps, owing to the combustible nature of the materials in which the fire broke out, the want of immediate and concerted action to arrest its fatal progress, and the panic which appears to have prevailed on board. To these circumstances, and especially to the latter, is ascribed the extraordinary destruction of life; all the boats having been lowered and lost while the engine was running at full speed.

The loss of a large amount of property by the owners and managers of the Legington, and the destruction of thirty-nine valuable lives of persons in the service, might have shown that no reasonable motive or provision was likely to have been wanting to secure safety for all on board, whatever may have been the momentary errors or indiscretions of the crew or passengers. Those who have labored to inflame the public against these unfortunate men may well be reminded, that it is now thirty years since the public have enjoyed the use of passenger vessels impelled by fire and steam, and that during this period not less than *thirty millions of persons* have been transported from time to time, in the various steamboats which have to run to and from the City of New York, and that these steamboats probably navigated a distance equal to *fifteen millions of miles*, and that in all this prolonged and varied exposure, *never before has a single life been lost by the burning of a steamboat.* This fact alone, to the unprejudiced, speaks volumes in favor of the general care and skill of the parties who have been concerned in this species of navigation.]

More recently a bill has been reported to the Senate of the United States, near the close of the last session, designed as a substitute for the existing law.

This bill it will be perceived, embodies nearly all the precautionary measures which have been suggested in various quarters for preventing steamboat accidents, and for enforcing these prescriptive measures, an onerous and complex system of penalties is provided in the bill; the owners managers and officers of steamboats being apparently viewed, as in the present law, as a class having feelings and interests which are adverse to the safety and welfare of the community. Of the great error of this newly assumed principle in legislation, or of the practical value of such a system of enactments, it is not my purpose further to inquire; these being questions which relate solely to American legislation. Nor is the slightest disrespect intended to the views of the honorable and highly intelligent Senator who reported this bill; who doubtless considered it to be his duty thus to prepare for more mature consideration, the various projects for securing safety, which had been urged upon his attention.

I have long been convinced, however, that governments should not attempt to become responsible for the prevention of accidents to the boilers or machinery of steam vessels, any more than for the errors and failures of any other machines or fabrics; and that the remedies for these accidents must be sought elsewhere than in legislative enactments, which should relate only to matters which may partake of the character of conventional regulations, for the general convenience and safety of navigation. The most available and useful legislative provision for these accidents, I conceive to be that which shall provide in every case of explosion or injury by steam, for a thorough investigation of all the fact and circumstances which may tend to throw any degree of light upon either the immediate or the remote causes of the disaster; and this inquiry, I think, should be instituted solely for public benefit in the promotion of correct knowledge; and be conducted at public expense.

With my best wishes for the success of the important inquiry in which your are engaged, I subscribe myself, dear sir,

Your most obedient servant, WM. C. REDFIELD.

(To be continued.)

REPORT OF THE JOINT BOARD OF DIRECTORS, TO THE STOCKHOLDERS OF THE DELAWARE AND RARITAN CANAL, AND CAMDEN AND AMBOY RAILROAD AND TRANSPORTATION COMPANIES, ON THE COMPLETION OF THEIR WORKS.

(Continued from page 281.)

SECTION 4.—*From the Lower Depot near Trenton to New Brunswick. The length of this is 24 miles 1 chain.*

It was commenced to be graded in June, 1838, and the rails were laid and passengers passed over the road, in full operation, on January 1st, 1839.

It follows the tow-path of the right bank of the Delaware and Raritan Canal, to a point near Kingston, a distance of 13 miles 20 chains; thence up the valley of Heathcote's Brook, to its summit, between it and Lawrence's Brook, on what is called the Long Bridge Farm; thence down Lawrence's Brook to Dean's mill dam, near George's road; thence in a straight line, in the direction of New Brunswick, to its intersection with the New Jersey railroad, about three and a half miles from the railroad bridge over the Raritan River, at New Brunswick.

The formation of the road is as follows: In excavation, the road is constructed 14 feet in width; slopes one and half foot base to one foot perpendicular height; ditches three feet deep, two feet wide at the bottom, eleven feet wide on the grade of the road. Embankments are fifteen feet wide on grade of road; slopes the same as in excavation; ditches always three feet below the grade of the road. Wherever there were sods, on the line of the road to be excavated, they were placed on the slopes of the embankments, to protect them from washing.

Superstructure.

A distance of 16 miles on different parts of the line, it is as follows: stone blocks two feet square, and not less than five inches thick, for the foundation, at the joints of the rails; cross sleepers of locust, eight feet long, and six inches square, resting upon them, with a cast iron chair, weighing twelve and a half pounds, resting upon the locust, for the purpose of receiving the iron edge rail, (which rails are of the same pattern as that already described, except that it weighs forty-seven and a half pounds per yard), which is fitted in the chair, by cutting the lower edge or base of the rail an eighth of an inch on each side; between the joints of the rails, (the rails being sixteen feet in length), are laid from ten to eleven cross sleepers of oak and chestnut, seven feet long, four and a half inches thick, and not less than six inches flat surface, rest immediately upon the surface of the ground, the rail resting on these sleepers, making so many bearings, fastened by hook-headed spikes, five to seven inches long, each weighing a third of a pound; the joints of the rails connected as before described in section 1.

In consequence of the ground not having settled sufficiently, the remaining distance of eight miles one chain, was laid without the stone blocks at the joints, but with locust cross sleepers at the joints of the rails, and intervening cross sleepers, the same as those with stone blocks, at the joints; except twenty chains that has cross sleepers, with white pine plank, four and a half inches thick, twelve inches wide, and sixteen feet long, laying upon them, in line of the road; upon these plank are placed the edge rail, spiked and secured as before described. It was laid in this manner, in consequence of its having been laid with wood rail, and flat iron bar, in the first instance, for want of edge rail.

There is also a distance of thirty chains laid with iron, similar to the New Jersey railroad, with cast iron chairs.

There is but one bridge on this section, over the Millstone River. It is of wood, sixty feet long, with stone abutments, constructed upon the new plan, as described in section 1.

SECTION 5.—*Extends from Trenton to Delaware Bridge. Distance 1 mile 30 chains.*

This road was originally laid with flat iron, two and a quarter inches by five-eights of an inch thick, wood rail, of yellow pine, six by six inches, cross sleepers of oak, and shoes or mud sills of plank, three inches thick, and twelve inches wide, laid in the usual manner.

For seventy-six chains, the flat rail has been taken off, and replaced with cross sleepers and edge rail. Cross sleepers, of locust, eight feet long, six inches square, are placed at the joints of the rails; oak and chestnut sleepers, the same dimensions as on section 4, laid four feet apart, and short blocks of wood between them, with cast iron chairs, spikes and fastenings, as before descrided.

There remains thirty-four chains of wood rail and flat iron, laid as bove.

Distance of road from depot at Trenton, is thirty chains, to the depot at the canal lock; thence to the Delaware bridge, one mile.

LOCOMOTIVES, CARS, STOCK, ETC.

17 locomtives; 64 passenger cars; 7 baggage cars; 64 transportation cars for merchandize; 24 dirt cars, etc., for use on road.

Steamboats on the Delaware river.

Steamboat "New Philadelphia;" "Burlington;" "Philadelphia."

Steamboats between New Brunswick, South Amboy and New York.

Steamboat "Independence;" "Swan;" "Trenton;" New York;"—"Thistle."

Account of the Receipts of the Delaware and Raritan Canal Co. *Dr.*

To cost of the Delaware and Raritan canal per J. R. Thomson's (Sec.) statement,	$2,829,797 36
Bills paid and not included in the above statement,	14,307 67
Balance due for advances to Camden and Amboy railroad, and transportation company,	18,203 86
Notes of hand unpaid,	1,910 00
Cash on hand,	12,334 47
	$2,876,643 36

Cr.

By capital stock paid in,	$1,496,000 00
By cash from loans,	1,279,278 88
By loans paid interest, and for real estate per loan account,	45,627 92
By rents from water power,	5,185 15
By balance of running account.	50,551 41
	$2,876,643 36

JAS. NEILSON, *Treasurer.*

Abstract of the cost of the Delaware and Raritan Canal.

Canal Sections, Embankments, Excavations, Waste Weirs, &c.,	$1,354,372 50
Locks,	285,256 28
Culverts,	160,853 52
Bridges,	88,971 82
Fences,	26,387 04
Peir and Harbour at New Brunswick,	22,016 50
Wharfing,	8,379 99
Dredging Machine and Dredging at Bordentown, Bull's Island, and improving Raritan River, in addition to the sums received on this account from the United States,	26,841 88
Timber,	132,509 69
Cement,	93,240 45
Real Estate,	271,000 66
Damages,	33,989 80
Engineer Department,	84,496 19
Legal Expenses,	15,299 91
Office Expenses,	1,653 14
Contingent Expenses,	35,573 42
Salaries to the time of completion,	38,526 35

Barges,	319 23
Smith Shop,	1,427 77
Interest to the time of completion,	100,529 07
Towing Establishment, Horses, Harness, &c.,	9,876 39
Loan Expenses, 1st English Loan,	15,460 00
Railroad Iron, balance,	3,936 05
Due by Contractors,	1,506 77
	$2,829,797 36

JOHN R. THOMSON. *Sect.*

Dividend account of the Delaware and Raritan Canal. *Dr.*

To current expenses per J. R. Thomson's (Sec.) account,	$210,344 42
To cash paid E. A. Stevens on dividend account,	46,000, 00
To ballance to construction account,	50,551 41
	$306,895 83

Cr.

By tolls to Dec. 1, 1839,	$306,895 83

JAS. NEILSON, *Treasurer.*

Joint account of receipts and expenditures of the Delaware and Raritan canal, and Camden and Amboy railroad and transportation Cos. *Dr.*

To instalments from stockholders,	$2,996,000 00
To receipts from loans including temporary loan of $14,640 42,	2,848,469 44
To borrowed from the dividend of Camden and Amboy railroad and transportation Co. for the construction of the road,	$131,071 29
To rents received by do.	5,322 16
To sundries received by do.,	1,543 54
To balance per construction account of C. & A. R. R. & T. Co.,	170,025 79
To rents from water power from the D. &. R. Canal Co.	5,185 15
To balance of dividend account from do.,	50,551 41
	$6,208,168 78

Cr.

By cost of construction of the Camden and Amboy railroad and branch road per statement,	$3,220,848 39
By cost of Delaware and Raritan canal,	$2,829,797 36
By bills paid and not included in the above,	14,307 67
By notes of hand unpaid,	1,910 00
By cash on hand,	12,334 47
By cash advanced for building boats and increasing the transportation of coal through the canal,	117,000 00
By loan expenses in England,	11,970,89
	$6,208,168 78

JOHN R. THOMPSON, *Sec. Joint Board.*

Abstract of the annual receipts and expenditures of the Delaware and Raritan canal from 1834 *to* 1839 *inclusive.*

TOTAL RECEIPTS.			TOTAL EXPENDITURES.		
1834	$11,604	19	1834 }	$40,242	74
1835	47,141	92	1835 }		
1836	54,801	22	1836	34,764	89
1837	67,194	26	1837	27,079	21
1838	73,507	24	1838	46,007	72
1839	74,843	52	1839	44,698	48
			December,	8,550	38
	329,092	35			
Deduct allowances made on coal, merchant's line, &c., per order,	22,196	50		210,344	42
			Balance to dividend account,	50,551	41
	$306,806	85	Paid on account of dividends.	46,000	00

JOHN R. THOMPSON, *Sec.*

Summary of Cost of the Camden and Amboy Railroad, Branch Road and Appendages.

Grading,	$379,721	76	Locomotives,	$123,840	67
Engineering,	94,294	77	Iron,	10,372	08
Wharfing,	55,644	55	Locust,	13,447	70
Stock and tools,	48,955	05	Printing,	1,679	32
Incidental Exp's,	32,384	90	Interest,	104,242	64
Timber,	121,153	65	Wood Rails,	7,310	57
Stone,	37,314	14	Steamboats,	420,153	57
Office Expenses,	1,058	20	Property in trust to pay debts,	8,543	04
Real Estate,	371,769	68	Canal passage barges	1,832	28
Culverts,	17,112	91	Sleepers,	35,170	60
Salaries,	26,858	22	Fencing,	2,245	35
Damages,	4,579	71	Salting Timber,	6,352	61
Carpenters,	5,482	85	Stable Expenses,	36	89
Legal Expenses,	6,701	51	Phil. & Tr. Railroad,	46,569	54
Masonry,	14,768	36	Stone Rails,	3,457	59
Smithery,	10,067	08	Taxes,	209	09
Bridges,	78,459	37	Pine Wood,	75	12
Broken Stone,	103,372	64	Coal Lands,	25,000	00
Iron Rails,	517,907	62			
Gravelling,	22,223	44		$3,222,204	84
Trenching,	27 998	14	Deduct credits,	1,347	87
Stone Blocks,	111,524	73			
Laying Rails,	155,346	46		$3,220,857	02
Cars,	140,742	88			
Ditching,	26,232	61			

E. A. STEVENS.

ON THE PREVENTION OF ACCIDENTS, BY FIRE, ON BOARD OF STEAMBOATS. BY ITHAMAR A. BEARD, CIVIL ENGINEER.

Much has been writen and published on the prevention of accidents on board of steamboats by the bursting of boilers or the collapsing of flues; and I fear much more will be required to prevent all accidents and fatal catastrophes in boats, which, in too many instances I believe, to arise from a want of due caution on the part of those whose business it is to guard the lives and property of the public, confided to their skill and watchful care.

Besides the ordinary class of accidents, there is another class of which we have on record several accounts within a few years, and one very recently, of a still more awful and distressing nature. I have reference to the burning of a boat at sea, where the passengers and crew have no alternative, but must either burn or drown.

I do not recollect having read any efficient mode proposed for extinguishing fire on board a boat, nor any other theory recomended than the ordinary mode with buckets and a fire engine.

Believing that there is always ready at hand and available, with proper fixtures, in every steamboat, an agent much more efficient than water and an ordinary engine to extinguish fire, I deem it a duty to make the suggestion, that others who may be disposed, and have better means than I can command, may try experiments upon it, and test the utility of the theory.

From the few imperfect experiments my means have permited, I am of opinion, that steam is far preferable to water to extinguish fire. For steam can be made to enter every apartment, birth, and crevice, even where water could not possibly be thrown, and being lighter than air it keeps the space filled instead of falling to the bottom as water would do, and can be as effective on the under side of a ceiling, deck, or floor as it would be on the top, and even more so.

The first that I ever noticed of the effect of steam upon flame was several years since, by carrying a lighted lamp into a room in a dye-house that was filled with steam, and the light was instantly extinguished.

Again, when the steam was issuing from the nose of a teakettle, I have taken a bright coal of fire and held it in the steam, and the fire was quenched in as short a time as if it had been immersed in water, and as effectually through the coal.

Now if the theory be true (which, I confess, needs further experiment and stronger proof) a comparatively trifling expense may furnish every steamboat with certain and available means of readily extinguishing a fire, if it should take in the woodwork of the boat, or in the freight, either on or under deck.

I would propose the following mode of operation. Let a pipe, say a gas pipe, or any other that shall be of strength sufficient to bear the pressure of the steam, be connected with the boiler, either directly or indirectly, at pleasure, and be carried to every apartment in the boat. And in as many places as may be thought expedient, insert stopcocks of such construction that they can be readily and easily opened at any time and by any person:

In case of a fire in any apartment the occupants would of course leave the apartment as soon as possible, and when the apartment should be vacated, let the stopcocks be opened, and force in as much steam as would be practicable. Under deck, and in a close apartment, it would have a double advantage over water, for it would, in a great measure, exclude the air from feeding the flame, at the same time it produced an effect by its moisture, but the greatest effect would undoubtedly be produced by the excluding of the air.

In addition to the foregoing, I would attach pipes and carry them on each side of the engine, fore and aft, upon the deck some thirty or forty feet, and at the terminations, I would affix "gooseneck joints," and to these attach several lengths of pipe in joints of six or eight feet, and then another "gooseneck" and to this attach a directing and discharging pipe of about the same length as the other joints, all the connections to be made with screw joints, or couplings.

The two goosenecks would enable the man having charge of the pipe to convey and use the steam on any part of the deck, with nearly as great facility as water would be conveyed and used with a hose: and, if necessary, any number of goosenecks may be used.

To enable the men to handle and use the pipes without burning their hands, let some two or three feet of each joint of pipe be incased in, or near the middle, with a tin or sheet brass cylinder (brass is preferable,) one inch, more or less, at pleasure, greater than the steam pipes, and fill the space between the two pipes with pulverized charcoal, pipe clay, or soapstone dust, and outside of the exterior cylinder wind on some two or three thicknesses of woolen cloth, and this will fully protect the hands of the men in moving and directing the pipes.

It is thought that this mode of extinguishing a fire in a boat may be more effective than a fire engine, and may always be available at the moment it may be needed, whereas, with a fire engine, there must always be a delay, and frequently, perhaps generally, much difficulty in supplying it with water and in getting it into action, and more difficulty, in the terror and confusion in getting hands to work it; and these unavoidable difficulties, it is presumed, would, in most instances, let the fire get such headway that no power on earth could arrest its progress; and inevitable destruction is the consequence.

In any situation, a single bucket of water when a fire first takes, is of more effect than an ocean after the building is envoloped in flames. And on board a boat, especially, it is necessary to stop the progress of a fire immediately and with the least possible delay, for if the wind did not blow, the motion of the boat would produce a current of air sufficient to kindle a fire rapidly.

In general it would be favorable, in a case of a fire, to run the boat directly before the wind, and this would, in a measure, neutralize its effect; but circumstances might alter the case in this respect.

As too much precaution, to preserve and render life and property safe, cannot be used, whether philantrophic motives, or those arising from self interest on the part of steamboat owners, be consulted, every boat should be well and constantly furnished with every possible means of safety or escape in case of accidents of any kind.

For one such catastrophe as that of the Lexington, is enough to deter thousands who would otherwise patronize steamboats with perfect confidence, from risking their lives and property on board a boat, for years. And unless some sure measures can be adopted and put in general use to render safety more certain to the public than has been the case, in very many instances, every year since steam got into general use as a motive power; this mode of conveyance and travelling ought to be totally abandoned.

But it is thought, by not a few, that most of the accidents are chargeable, in a very great degree, to neglect of duty and proper precaution, and to the want of preventive means on the part of those who own, as well as of those whose business it is to manage steamboats, and that it is fully practicable to render them as safe as any other mode of travelling.

I am not fully confident that there is any value in my hints respecting extinguishing fire by steam; but trust the reader will not impugn my motives even if he shall feel inclined to reject my theory as worthless.

If it have no other value than to draw from other and more ingenious minds some further and better views on the subject that may ultimately lead to the adoption of better modes to ensure safety, I shall feel fully compensated and highly gratified.—*Journal Franklin Institute.*

Improved railway track.—A patent has been recently issued for improvements in the manner of constructing the tracks of railroads, invented by JAMES HERRON, Esq., Civil Engineer, a gentleman of much practical experience in the particular department of buisiness to which the invention appertains. The defects of the existing modes of construction are too apparent to need insisting upon; the early and very injurious production of both horizontal and lateral undulations not only interferes materially with the tractive power of the locomotive, but is the pregnant cause of a large proportion of the accidents incident to this mode of conveyance. The perpetual necessity for, and the heavy cost of, repairs are also evils of no small magnitude. The improved mode of construction devised by Mr. Herron is intended, among other things, to give a stability to the road which the plans now in use do not afford, and to render the structure of more easy repair, without any increase, and it is believed with a diminution, of the first cost. In the proposed system, the string-pieces which support the iron rails are not to rest in notches made in cross-ties, but are to be connected together by means of plank, firmly secured on their under sides, and extending obliquely from one string-piece to the other, in such a manner as to constitute lateral and diagonal braces, and to prevent all danger of their spreading. These tie-plank are to rest upon the road, which is to be evenly graded for this purpose. The proposed manner of connecting the string-pieces with each other, and with the iron rails and other parts of the track, is intended, and well calculated, to give to the whole a degree of firmness which shall enable any and every part of it to constitute a bridge, over which the locomotive and its train would securely pass, although a considerable portion of the supporting ground might be washed away.

It will be obvious that track thus constructed, as it bears evenly and equally upon every portion of the graded road, will have little or no tendency to settle, except by the settling of the road itself, such as takes place in newly-made embankments, and that it may be raised to its proper level with a facility not offerd by any other mode of structure.

The specification of this patent is of great length, and embraccs many devices for securely uniting the frame work of timber, and likewise the iron rails, so as to combine firmness with the requisite degree of elasticity, all of which display the handiwork of one familiar with the business under consideration; and, although they may be said, in several instances, to be untried projects, they are still projects well worth trying, as they must answer the intended purpose perfectly well, even should they not be found so superior to the methods previously in use, as it is believed they will.

The writer of this article has just been informed that it has been determined to give a fair trial to the plan, along a mile or two of road, at a very early day. He has no other interest in the matter than that felt by every citizen who glories in the onward progress of his country. The present moment, it is true, is a most unfavorable one for the trial of new projects; but the existing state of things cannot long endure. The native energy, elasticity, and resources of our favored land will, at an early day, enable us to resume the most important of our public works. Our means of intercommunication must and will be extended; and, in the mean time, it is desirable that we should ascertain and determine the best mode of procedure.

The laying of a mile or two of track upon Mr. Herron's plan would, in one particular, accomplish this object to a certain extent, as, after the lapse of a few months, its relative value would be satisfactorily ascertained.—*National Inteligence.*

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

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[Communicated.]

PRESERVATION OF TIMBER.—We understand that Dr. EARLE's method of preserving Timber (the merits of which are so well attested,) is being extensively employed under authority of the War Department.

We insert with pleasure, the following communication of Mr. Ward, as it enables us to remove a misapprehension, existing in the mind of that gentleman, which is certainly calculated to do us and others, injustice. At the same time we are glad to find that Mr. W. has taken our remarks in good part.

Our sole object, is to elicit truth, and to avoid error—we shall therefore insert the communication, and append such remarks as we consider necessary.

To the Editors of the American Railroad Journal and Mechanic' Msagazine.

GENTLEMEN:—The first May number of your Journal, contains some remarks upon a letter of mine, published in a previous number; in which I made some comments upon Professor Renwick's paper "on the steamboats of the United States of America:" and I fear I am doing you injustice by treating these remarks as your own, but I see no way of avoiding that, as you have endorsed them "editorial." To some of these, I wish to make a brief reply. I pass over what is said about "warmth of manner," and "sweeping assertion, not borne out by practice," and proceed to your remark "to render this table complete, we should have the average velocity of the vessels—the number of strokes per minute, and the area of the immersed portion of the transverse section. We should then be able to form some idea of the proportion of the engines to the vessel, and of the amount of power expended in obtaining high velocities. Without these elements, the comparison to be fair, should only be between vessels having the same size, and moving at the same rate. We should then be better able to oppose 'facts and theory.'" Now, with regard to the table, I must beg you to examine it again, and I think you will find it was only designed to show the rate of consumption of fuel in different engines, to procure a given amount of power—a matter which has no connection whatever with the size, or form, or velocity of the vessels containing the engines, and which could have been done just as well if each engine had been employed at a different kind of work. If to produce the power of one horse in one engine, it requires three times the amount of fuel that it does to produce the same amount of power in another engine, no change of size or form or speed of the vessel containing them, could affect the rate of consumption. And if you will attentively examine the table, you will find the amount of fuel required to produce a given amount of power, in each of the engines named, is clearly set down.

You have next made some remarks upon the practice of working steam expansively, and quoted some opinions in its favor. On this subject, I have only to say, that so far from denying its advantages, I said nothing about it in my former letter, and am decidedly in favor of the practice, on account of its economy. But I take the liberty to add, that *all* its advantages may be obtained without resorting to the dangerous pressure of 57 lbs. per square inch, or even venturing into its neighborhood.

Your criticism upon the inference that Prof. Renwick supposed something else than the "mere pressure of steam," is generally the cause of explosions I am obliged to let pass, for the reason that I am entirely unable to understand them. In your concluding paragraph, you say, "the testimony of almost all practical and well informed men is, that the *mere* use of steam of 40 or 50 pounds pressure per square inch, as in locomotive boilers, etc., is not the *cause* of danger; and that the use of such pressures in boilers of competent strength, skilfully managed, is less dangerous, if not more economical, than a low pressure, depended upon as safe, merely because it is a low pressure." With regard to this, I have to remark, that if nearly thirty years attentive study of the steam engine, and no inconsiderable practice in the building and management of it during that time, entitles any one to be called a practical man, I have some claim to that appellation. And during the time I have been connected with the steam engine, I heve been acquainted with no inconsiderable number of practical men in this country and abroad, and nineteen twentieths of all that I have known, have been clearly of opinion that "the mere pressure of steam," is abundantly sufficient, to cause the explosion of steam boilers, however well they may be made, or however skilfully and carefully the engines attached to them, may be managed.

I am, gentlemen, your obt. servt.

JOHN D. WARD.

Novelty Works, 15*th May*, 1840.

In the first place, we wish to disabuse Mr. Ward of an error, into which he has fallen in regard to the authorship of the remarks here commented upon. In his communication, it will be perceived that an insinuation is thrown out that we have "endorsed as editorial," that which has been written by another, either wholly or in part.

We now most unequivocally assert, that the remarks in question were written by the editor without any consultation, advice, or instigation from any person, that they were the result of his own convictions upon first reading the communication of Mr. Ward, and were seen by no one, save by his partner, the printer of the Journal, until printed.

We may likewise state, that the remarks by "an Engineer," in the last number of the Journal, (not yet published, when the above communication was received,) were written before our own notice could have been seen by the writer—before we had either seen him or spoken with him on the subject, and we were ourselves surprised with the coincidence of our views—in several instances having turned to the same authority, in confirmation of our respective opinions.

This much being premised we proceed to notice the several objections taken to our criticisms. In the first instance, it will be seen, that the difficulty lies in the different value given to the estimated horse power. What we mean to assert is this, that the horse power estimated from the size of the cylinders, etc., is not in all cases the expression for the real and effective power of the engine, and that particularly where high velocities are aimed at, the consumption of fuel is far beyond that of the engine working at the highest useful velocity. In other words, and to illustrate our meaning the better, we mean to say, that of two boats precisely equal in all respects, the one obtaining the highest possible speed, will burn more fuel, in travelling a given distance, than the one travelling at a certain rate beneath that of the first. Is it not a well known fact, that in racing at the top of their speed, our steamboats consume more fuel than when going the same distance at their ordinary velocity?

We had considered this fact to be universally conceded, and it was to this we referred, when pointing out what to us seemed a deficiency in Mr. Ward's table. We conceive that a fair comparison cannot be made between the estimated horse power of the Great Western, etc., working at the most economical velocity, and that of our North river boats, working beyond the most economical velocity, and burning cords of wood to gain an extra mile per hour.

If authority in this case is needed, we refer to the experiments of Pambour, in which an engine working its maximum at a fixed pressure, (or nearly so,) uniformly decreased its velocity in inverse proportion to the increase of load, caused by a greater amount of ascent in the road. Pambour also adds a caution, that the velocity, among other things, be taken into account, in estimating the horse power of locomotive or any other sort of engines. In view of this very case, Mr. Stephenson estimates the horse power of one of the very boats named in the table in question, so high as to give quite a different result in the economy of fuel. (See the article in the last number of the Journal.)

It will therefore be granted, that if this is a correct view of the matter, the speed size and form of the vessels, are, one or all of them necessary elements in such a table. And that this is a correct view, we can hardly conceive will be questioned by any one.

In the next place Mr. W. admits the economy of working steam expansively, and disclaims any intention of doubting it, but adds, "that *all* its advantages may be obtained without resorting to the dangerous pressure of 57 pounds per square inch, or even venturing into the neighborhood." It will be found, by a careful examination of the authorities brought forward in our remarks, that the best effect, in point of economy, was found to result from using steam, certainly not far from a pressure of 57 pounds, if not in its immediate neighborhood. It is unnecessary to particularize, but it will be found that the pressure named varies from 45 or thereabouts, to 50 or more lbs. per square inch. The very nature of the laws of steam will point out the greatest economy to be derived from the use of steam of high pressure, the limit, of course to be dependent upon the strength of the boiler.

It appears that our criticism of the writer's misinterpretation of the word "mere," as used by Prof. Renwick, were unintelligible. We must confess that we did not render the matter more clear, by attempting to explain what was clearly self-evident. We meant to say, that the word mere was wrongly translated, and by a substitution of other words than those used in the passage quoted, to show that such interpretation, involved an absurdity.

As to the opinions of practical and well informed men, we have only to say, that we quoted such authority as we could find—papers sanctioned by the Institution of Civil Engineers—the appendix to a memorial signed by nearly all the gentlemen concerned in steaming on our waters. This, however, is matter of opinion, and every one has a right to his own; we wish, however, such a consideration of the facts in question, as shall bring about, at least an approximation of opinion, and we feel convinced that there must be some misapprehension in the mind of the writer of the foregoing communication, which has led him into an untenable position.

As we have said before, our sole object, is to get at the truth, and we have therefore devoted more time to the explanation of our remarks, in the hope that misapprehension may be removed, and the subject in dispute narrowed down to the true point in question.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

Gentlemen:—I observe that three of your correspondents, have lately assumed positions respecting the crank, that if proved, would annihilate the whole theory of mechanics, and lead directly to a perpetual motion.

The first gentleman, vol. x, page 161, argues that when the power acts in parallel lines, 0·2146 of the power is lost by the use of the crank.

The second, vol. x, page 205, shows by a numerical calculation that this is not exactly correct, but that when we use a connecting rod "there is necessarily some loss, to obviate which, the connecting rod is made as long as possible."

The third, vol. x, page 241, says, that "the force in passing from its primitive direction, to its final direction in the tangent to the rotary circle of the crank must evidently lose two proportions," etc.

Now, there can be no *expense* where there is no motion. We may raise a weight by any of the mechanical agents, and the weight multiplied by its velocity, will at all times equal the power applied, multiplied by its velocity.

When the active power ceases, there is no more *expense* of power, however great may be the inert force that is required to retain the weight in its position.

Thus, in the crank, and in the combination of the crank and connecting rod, there is an inert resistance required of the guides and of the centre of the crank motion; but as these remain fixed, with respect to the rest of the machine, they cause no *expense* of power, but merely enable the power to be diverted from its original direction to that in the direction of the tangent. Consequently, the whole expense, (except friction) is caused by the direct resistance of the pin, multiplied by the distance through which it acts. This being the total effect, if it be less than the power expended, we may gain by reversing the action, and converting a circular into a rectilinear motion, and consequently construct a perpetual motion.

But since this "*reductio ad absurdum*" rests upon the basis, that a perpetual motion is a mechanical impossibility. And since this assumption may be denied, and the solution therefore rendered unsatisfactory, we will take a positive demonstration.

In the first case, where the power acts in parallel lines, we have precisely the condition of gravity causing the descent of a heavy body on a curved inclined plane. Here it has been generally conceded that no power is lost. But since this has also been disputed, we take another more conclusive mode of investigation.

Let P=the original power, f=the force in the direction of the tangent, V=the velocity of P when v=the velocity of f, and c=the angle included between the crank and the direction of P.

Take the first case where the power acts parallel.

$$P : f :: \text{Rad} : \sin.\ c.$$
$$V : v :: \sin.\ c : \text{Rad}.$$

$P\,V = f\,v$. But $P\,V$ is the expense of power, and $f\,v$ the effect, therefore we see that there is no loss.

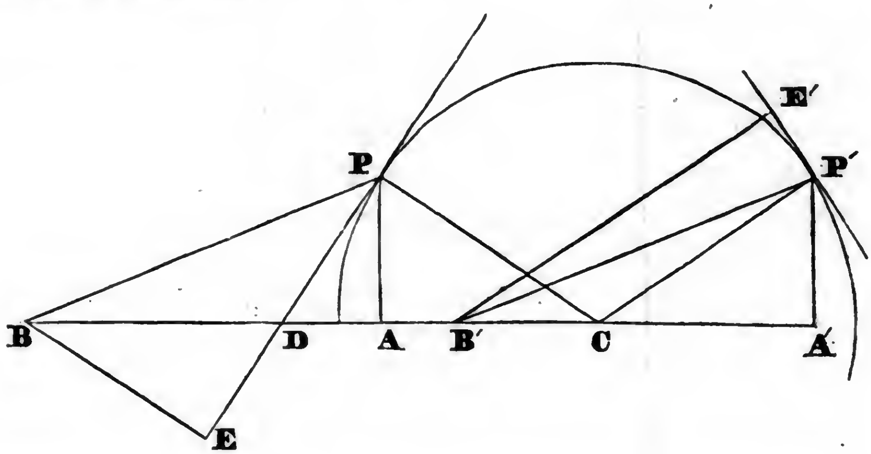
Again, with the connecting rod as usually applied. Let d= the angle of departure of the rod from the line of the original direction of the power, p=the force in the direction of the rod. Then, by the resolution of forces, we get $p = P \times \sec.\ d$=the force in the direction of the rod, and by resolving p, we get a force=P acting on the pin parallel to the original direction.

Since, then, it is both equal and parallel, we find that the rod merely transfers the power from the coupling box to the crank pin, without loss, and we may there compound or resolve it in the same manner as if immediately applied at the pin; in which case, we have already seen that there is no loss of power. Therefore, there is no loss of power, either from the circular motion of the crank, or the diagonal action of the connecting rod.

Having thus reviewed the remarks of these gentlemen, I will present for their investigation the following formula, to suit all conditions of crank and connecting rod.

$$f = \mathrm{P} \times \text{sec. } d \times \text{sin. } (c \pm d)$$

The positive sign belongs to the 1st and 4th, and the negative sign, to the 2d and 3d quadrants.



Demonstration.—Let C be the centre of the crank, P the position of the pin, and B the position of the coupling box. P E a tangent to the circle described by the pin, touching at P, and crossing B C the line of the direction of the power, at D. B E perpendicular to P E, and P A perpendicular to B C. (The pin P being in the first or fourth quadrant.) Then if B A represent the power, B P will represent the force in the direction of the rod, and B P being resolved, gives E P in the direction of the tangent $=f$. Therefore, the power B A produces the force E P.

P C and B E are both at right angles to P E, and therefore parallel to each other, consequently

$$\mathrm{DBE} = \mathrm{PCA} = c,\ \mathrm{BPE} = \mathrm{DBE} + \mathrm{DBP} = c + d,$$

calling B A radius, we have B P=secant d, consequently, the force B P= P $\times$ secant d.

When B P=radius, then E P$=f=$sin $(c+d)$ therefore,

$$\text{Rad. : P} \times \text{sec. } d :: \text{sin. } (c+d) : f = \mathrm{P} \times \text{sec. } d \times \text{sin. } (c+d).$$

We have, thus, the first part of our formula, or that part for the first and fourth quadrants.

For the opposite semi-circle, use the same letters accented, to signify the same relative points.

Then, because E′ B′ and C P′ are parallel, the angle E′ B′ A′=P′ C A′, therefore E′ B′ P′=P′ C A′—P′ B′ A′= $(c-d)$.

Then as in the former case, calling $B' A'$=radius, we get $B' P'$=secant d, and when $B' P'$=radius then $E' P' = f = \sin. (c-d)$. Therefore,

$$\text{Rad.} : P \times \sec. d :: \sin. (c-d) : f = P \times \sec. d \times \sin. (c-d).$$

This gives us the second part of our formula, or that for the semi-circle opposite the power, and by combining the two, we get,

$$f = P \times \sec. d \times \sin. (c \pm d). \quad \text{Q. E. D.}$$

Carollary I.—If the length of the connecting rod be infinitely great, the power acts in parallel lines, the angle d becomes 0, and consequently when c is the same in each quadrant, f is also the same, and therefore each quadrant receives an equal amount of force.

Corollary II.—When the length of the rod is infinitely great, then f becomes a maximum when sin. c becomes a maximum=sin. 90°=radius =1, we have then $f = P \times 1 \times 1 = P$.

Corollary III.—When the length of the connecting rod is a maximum, equal the length of the crank, then $c=d$, and the formula becomes $f = P \times \sec. c \times \sin. (c \pm c)$. Hence, in the second semi-circle $f = P \times \sec. c \times \sin. 0 = 0$. Therefore no power is communicated during the second semi-circle, and consequently the intensity of the force during the revolution through the first semi-circle, is doubled by the connecting rod, and at the same time the piston moves through the diameter of the crank motion.

Corollary IV.—The longer the connecting rod the more uniform will be the force, for the longer the rod the less the angle d, and consequently the less the force subtracted from the second semi-circle, and added to the first.

Corollary V.—Since the effect is equal to the expense of power, we have under all these conditions $v = \frac{V P}{f}$.

Friction.—In all these cases, we have supposed a perfect machine, working without friction, and found that we neither lose power by the circular motion of the crank, nor yet by the diagonal action of the connecting rod. But when we introduce friction, the question assumes quite a different appearance, and we here discover the reason why the connecting rod should be made as long as the machine will admit, for the purpose of reducing the *loss* of power by friction. B A being the direction and intensity of the power, A P is the force with which the coupling box rubs against the guide. When the power acts in parallel lines, this loss does not occur, but when the rod is short it becomes very serious. A P being the tangent to the angle d, if the rod be a minimum the friction will become almost infinite as the box approaches the centre. Besides, during one revolution, this friction acts through twice the diameter of the crank circle, while the friction on the pin when the power is parallel, is not only less, but acts only through the circumference of the pin.

Again, the force B P being the secant of d, is always greater, than B A the radius, except at the dead points, and increases to infinity or nearly so, when the rod is a minimum.

Hence we find that on the score of friction, it is highly important to make the connecting rod long, and in most cases it is equally important to increase the length, in order that the mechanical force may be as uniform as possible, although theoretically no power is lost.

To reduce these infinitesimals to positive and definite numbers, may afford employment for the industrious, but they will be of no practical utility. The proper mode of ascertaining the loss from friction, is that pursued by De Pambour; to subject the engine to direct experiment.

One of the gentlemen whose words I have quoted, refers to the defects in De Pambours formula, and shows that a uniform loss from the crank, will not remove the difficulty.

I will add, that if we reject the formula and take the experiments, we will find in them, a proof that there is no loss from the crank.

This practical demonstration, is too long and intricate for the present article, for I have found, that after reducing the most difficult part of the investigation to a tabular form, and combining several operations, there still remains upwards of thirty distinct calculations, before we can predict the pressure in the boiler, and the amount of fuel, to effect a given velocity, with a given load, under the ordinary circumstances of high speed.

Of this we shall have more hereafter.

Yours, respectfully,

B. Aycrigg, *C. E.*

New York, June, 1840.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

Engineer's Camp, Line of the Central Railroad of Georgia, *April*, 1840.

Gentlemen:—The frequent accidents occurring to cotton trains on railroads, from fire, has led me to bestow some little thought on a method for remedying the evil. The plan that I shall suggest, will at least have the advantage of simplicity, which is too often lost sight of.

Various descriptions of cars have been used for the purpose of carrying cotton, some close, and some open, with a canvass covering for the cotton. The latter being thought by many persons, superior to the former, from the readiness with which the fire is detected and extinguished. But as this description of car does not answer as well for other kinds of freight, and I very much question whether they are as safe for cotton, it is not probable they will be extensively used. The kind commonly in use, is the, so called, close cars; but unfortunately they have generally but a poor title to the name—however tight they may have been originally made, by tinning, tongueing and groving, and buttoning; the motion soon working the joints loose.

To open the door of the cars occasionally, while in motion, for the purpose of examining, would, it is evident, lead to the very result intended to be avoided, even if it were convenient. The object, then, is to communicate with the interior of the cars, without leaving open any space for the fire to enter at. That fire does not spread rapidly when communicated to cotton in bales, is a well known fact. An instance lately came under my observation, where the cars ran half an hour after the cotton was on fire, in one of them (having been smelt by a passenger) without any serious result; a single bucket of water being sufficient to extinguish it. Therefore, if discovered at an early stage, it can be easily controlled; and the plan which I shall propose, will, I think, lead to an almost instant detection of it; and long before the smoke would find its way through the cracks, and diffuse itself through the atmosphere, so as to be detected in that way, in too many instances it having been discovered too late to prevent a conflagration.

The plan is, to have a hole through the top of each car, say one inch in diameter. To this hole is to be fitted a valve, attached to the end of a spring beneath the roof of the car; the spring may be a flat straight piece of steel, say nine inches long, and the valve may be of cork or wood, attached to the spring by a screw, with a large flat head, if the former, passing through into the spring. The valve should be so made as to come flush up, when closed, with the top of the roof, to keep water out of the hole; it should be made tapering, and also the hole, so as to make the motion easy, and to insure the valve setting tight. Next there is to be a tin tube, say about four feet long, the diameter a little larger than that of the hole. A single tube will answer for a whole train. This tube is to be placed over the valve in each car, from time to time—having a point projecting about an inch to throw the valve open—and if there is any smoke in the car at the time, its levity will cause it to rise instantly through the tube, when it will be detected by the *smell*. One of the hands that necessarily go with the cars, for the purpose of oiling, etc., can attend to this duty when the cars are under way, so that the *expense* may almost be set down at *nothing*.

It might be well to have the roofs of the cars made to project a little, so as to facilitate stepping from one to the other.

Yours, truly,

F. P. H. Assistant Engineer.

For the American Railroad Journal, and Mechanics' Magazine.

IRON VESSELS.

Though this age is often condemned for a too great desire of innovations and experiments, not only in morals, but in arts, yet it will be found upon examination, that *upon* this desire rests its claim, and its right, to be called "the age of improvement." Though this mania for patents, and rage for new applications of the mechanical powers, bring with them, much that is to be lamented, and much that is crude and unphilosophical, and though they tend to multiply the number of those mechanical sciolists, who regard nature and her laws of little importance in the construction of machines, and think that long continued courses of experiments, without reference to *fixed mechanical principles*, will supply a deficiency of knowledge, yet with this evil there is *some good*, with this superficiality there is some deep science, and though there are thousands of ignorant smatterers, the age has nevertheless, produced an Arkwright, a Watt, and a Smeaton.

No art which ministers to the convenience and comfort of man, is more indebted to scientific discovery and scientific improvement, than the art of navigation. When we turn our eyes to the ancients and see that weakness and imperfection of their vessels, which compelled them to creep timidly and carefully along the coast of an inland sea, to which they were almost entirely confined, and then look at the art in our day, and see the beautiful model of the packet "walking the waters like a thing of life,"—the solidity of the frigate, defying the wind and the waves—and still more wonderful, the ocean steamers "shooting backward and forward between great continents, like shuttles weaving the world into one great web," we may well be proud of our age, and with reason boast of that superiority in the mechanic arts, which has almost enabled man to make the "winds and the waves" a subjugated part of his domain.

With these trite remarks, we come to a consideration of our subject. The use of iron in the construction of vessels is comparatively a modern invention, dating back not more than eight or ten years. Little has been written upon the subject, but not a little has been *accomplished.* Already iron steamers are used on the Niger, the Ganges, and the coast of Great Britain and France, and one has crossed the Atlantic. Two centuries ago man *might* have believed that vessels could be propelled by steam, but he would have found it difficult to believe that *iron* would be the material of which they would be constructed. He would have supposed that only the *Prophet's* miraculous power, could make iron to swim.

The construction of iron vessels has been almost entirely confined to Great Britain; and *there* even now, the expense of building a vessel of the same tonnage of wood, is but little less than that of building of iron. Owing, however, to the novelty of the invention, and perhaps to the prejudice which favors long established usages, and rejects innovation, it has not *yet* come into very general use; still we are of opinion that *very soon* in England and France, and *eventually* throughout the civilized world, it will supercede the use of wood. Before we proceed to show the advantages accruing from the use of iron as a material for the building of vessels, we shall remove the chief, and indeed only objection against it, by saying that from experiments accurate and conclusive, it has been ascertained that if iron be kept well covered with tar, it will suffer no injury from the corrosive power of sea-water. At a small expense, this can be done, and thus the only cause which can produce decay in the vessel, is removed.

The numerous advantages which have appeared, even in the short time since the first trial was made, are sufficient to convince the unprejudiced mind, of the advantage of the use of iron vessels.

First.—The vessel may be divided into a number of compartments, each of which is "water tight," and should the vessel sustain an injury in one or more of them, the remainder would possess buoyancy sufficient to keep it afloat. This is a desideratum which cannot be obtained in the case of vessels built of wood, and if there were nothing but this fact to recommend iron to general use, it would be an argument strong enough and convincing enough.

Secondly.—Paradoxical as it may appear, it is nevertheless true that an iron vessel is lighter by nearly one half, and consequently draws much less water, than a wooden one of the same dimensions. On the Niger and other rivers they are used where other vessels of the same size could not be, and for shoal navigation are undoubtedly superior to all others.

Thirdly.—In the torid zone subjected alternately to the burning heat of the mid day sun, and the heavy night damps and rains of such climates, a vessel constructed of wood soon decays, or else from expansion and contraction of its parts soon become unseaworthy; but iron is subjected to no such decay and no such expansion from the *climate.*

Fourthly.—Iron vessels may be built stronger and tighter than wooden ones—they are secure from fire which so often destroys the *steamer*—the devouring element has no power over *them* and the "leak at sea," which fills every heart with terror and dismay is not to be dreaded.

Lastly.—An iron vessel may be constructed and taken in pieces and conveyed to any part of the globe, and again put together, at a very little expense, compared with one of wood. Several years ago, one was built at Manchester—sailed up the Rhine as far as was practicable—was then taken in pieces and conveyed to Lake Zurich in Switzerland, at a less expense than it could be constructed for *there.*

In case of a war on our inland seas, a fleet might be constructed at a national foundry, secure from all attacks from the enemy, and conveyed to the seat of war at a very small expense.

Such, imperfectly sketched, are some of the advantages, attendant upon the use of iron vessels. Should we succeed in calling the attention of scientific engineers to the subject, we shall be amply satisfied. We believe that at some future day, iron will be the *sole* material in the construction of navies. In Europe, already the scarcity of timber is felt, coal has long taken the place of wood; and man finding the *outward* resources of the earth failing, has discovered still richer and more abundant *internal* treasures. In our own country, too, we shall experience the same thing. Our forests are daily disappearing before the industry of the backwoodsman; we are daily compelled to seek for new materials and new complications of mechanical power to minister to our comfort and our luxuries, and the time is not far distant, when *here*, as in the Old World, our resources must be obtained from the bowels of the earth.

To the Editors of the American Railroad Journal, and Mechanics' Magazine.

GENTLEMEN—A severe illness, which left my eyes for several weeks in a state which required me to make the least possible use of them, prevented my conplying at an earlier date with the request of "*an early friend to railroads,*" in your Journal of November last, that I would furnish the drawings and description of the chair and rail which I have introduced on the Eastern railroad from Boston to Portsmouth N. Hampshire

I have now the pleasure of forwarding a drawing which presents plans and sections of the joint and centre chairs, together with the rail, key and dowel, as above requested. The chief improvement upon the old chair and rail, and the T rail, is in the greater elevation, (some three or four inches) at which it places the top of the rail; the height of chair and rail being 7½ inches, and as the sleepers or ties are covered with about three inches of gravel in the centre, and two inches under the rail, the top is five or six inches above the covering. This elevation I have found to relieve the road from all interruption in three-fourths of the snow storms which have occurred the two winters' experience which we have had with it, and it is obtained without greatly increasing upon the weight of the old chair, chiefly by having the centre chairs about two-thirds the width of the joint chair, instead of having all of the same width as formerly;—and by cutting off the inner end of the chair, and lengthening that which is to be placed outwards, to make the angle of leverage even less than with the old chair. They weigh about 23 and 17 lbs. each, giving, with six to each rail of 18 feet in length, an average of less than 18 lbs., the old chair weighing generally about 16 lbs. The rails weigh 46 lbs. to the yard, and have dowels which fit tightly at the joints, and are secured in the chairs by a single key which is bent or clenched after it is driven.—With this arrangement, and having the distance between the joint sleeper and the one next to it, a foot less than the other distances, an unusual degree of firmness is secured at the joints. Although we have experienced no inconvenience from any longitudinal movement of the rails, yet I have had check holes formed in every third or fourth rail, into which a check of five-eighths iron, two inches in length may be inserted to bear against the adjoining chair and prevent such a movement. With regard to the key which this rail requires, I have found, after several years experience, that where the sleepers are of wood, from the elasticity which it gives to the track, they do not come out, except to a very trifling extent, and are not at all objectionable. Compared with the T rail, which is very generally in use, this chair rail possesses great advantages, particularly where snow and ice, and indeed any obstacles are to be encountered. It permits a freer drainage of the track; it is much firmer, the angles of leverage being less, and the supporting base greater than with the T rail, and of course admits of greater speed without injury to the track. It allows the sleepers to be well covered, which very much improves the appearance of the road and increases also its firmness. It is more readily removed for repairs, &c., and without injury to the sleepers, as in removing the T rail. It is more easily and perfectly manufactured, and its cost is not greater.

The T rail, which is generally laid like the other with ties about every three feet, will support a greater weight without deflection, but having found this chair rail fully sufficient as to strength, running engines of from nine to about twelve tons weight, mostly at a speed of 25 to 30 miles, and more the hour upon it, I deem this additional strength superfluous.

J. M. F.

Fig. 1.

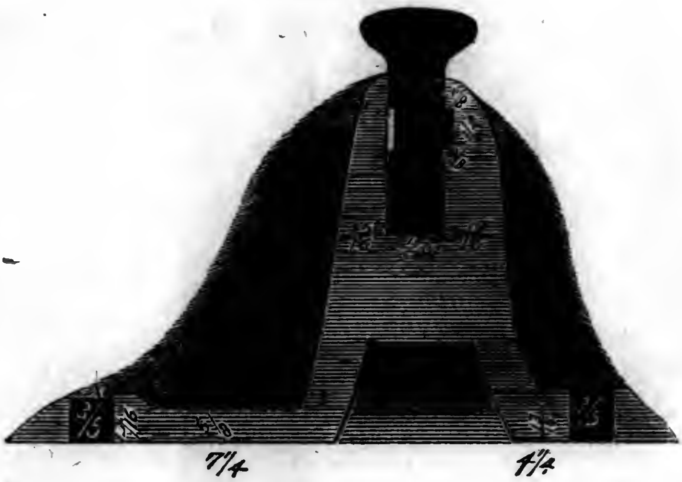


Fig. 2.

Fig. 3.

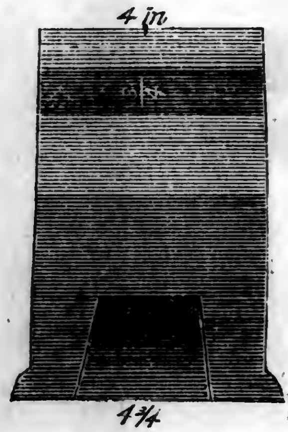


Fig. 4.

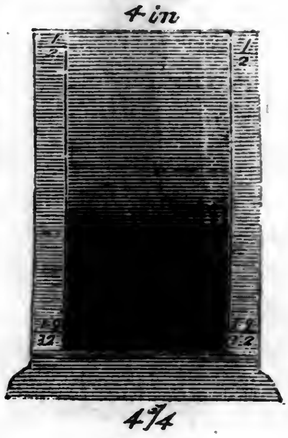


Fig. 5.

Fig. 6.

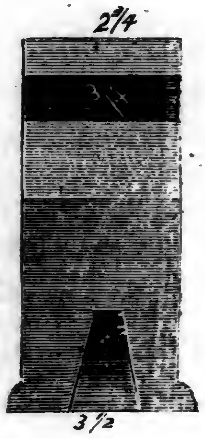


Fig. 7.

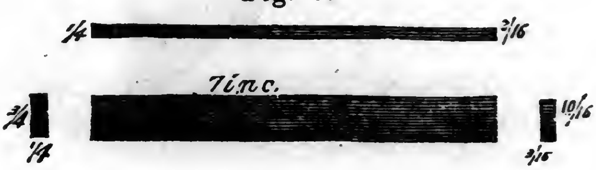


Fig. 8.

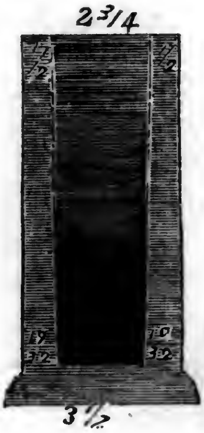


Fig. 9.

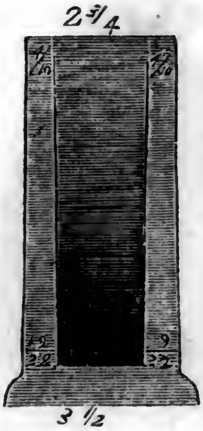


Fig. 10.

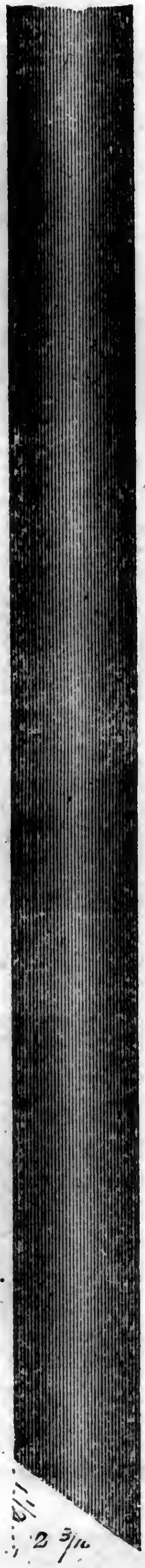


Fig. 11.

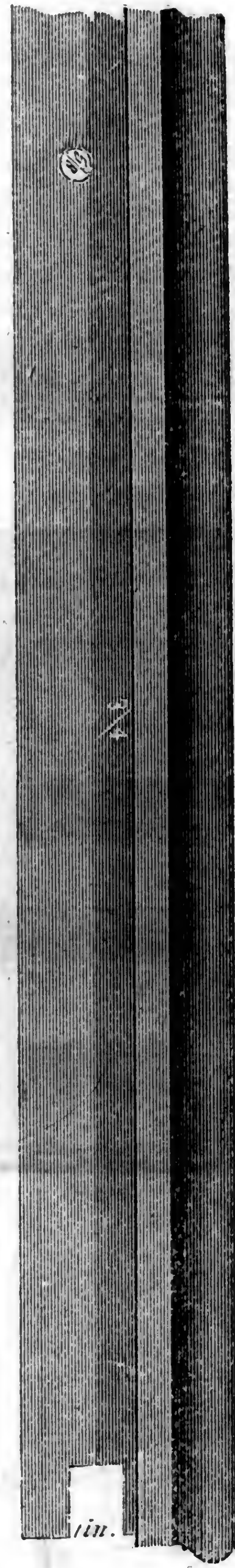


Fig. 12.

Fig. 13.

Explanation of the Cuts.

Fig. 1. Side section of joint chair.

" 2. Plan of joint chair.

" 3. End section of joint chair.

" 4. Elevation of short end of joint chair.

" 5. Elevation of long end of joint chair.

" 6. End section of centre chair.

" 7. Top and side view of wedge.

" 8. Elevation of short end of centre chair.

" 9. Elevation of long end of centre chair.

" 10. Top view of rail.

" 11. Elevation of rail.

" 12. End view of rail.

" 13. Elevation and end of dowel.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN:—I was somewhat surprised, to find in your number published on the 15th inst, a paper signed "*An Engineer*," the writer of which appears to have been highly offended at the liberty taken by myself with Professor Renwick's account of the steamboats of the United States; and he takes the opportunity to read me a very edifying homily upon "a proper spirit, and facts sufficiently strong." These are undoubtedly necessary in properly discussing any subject, and where one of the parties engaged is nearly, or quite destitute of both, the other must supply the deficiency, if any good results from the discussion. To this paper I feel bound to make some reply: but as I have no other object, in doing so, than to place the matters in question in their true light, I shall avoid any remarks not having a direct bearing upon them. I am bound, first of all, however, to plead guilty to the "Engineer's" charge of delay.

But, as he appears quite displeased with my remarks, now they have appeared, I am somewhat surprised that I am charged with criminal neglect, in not sending them forth at an earlier day. In extenuation of the fault, I beg leave to say, that I am not so fortunate as to obtain every English work immediately on its publication, and also, that at the time of receiving this, (which was several months since,) a serious accident, rendered me unable, even to read, much less write comments upon any portion of it. The next thing which "an Engineer" complains of, is the table showing the consumption of fuel by different engines, and says, "the things in this table which are stated as facts, are not only contradicted by every valuable work on the steam engine and by practical experiment, but by the authority of the English, and by the words of the great perfector of the engine, Watt." He then proceeds to show that I know nothing of the English method of calculating the power of a steam engine, and prove it, by refering to "page 146 of Stephenson's Civil Engineering in North America." The figures which are quoted, are certainly set down in the book, but if "an Engineer" has not forgotten all his arithmetic, and will read the calculation over again, he will see that 748 is a typographical error; and all that is said of the Great Western, by Stephenson, is that her engines "*are* said to be 450 horse power." Will "an Engineer" please to make use of the formula which he will find at the same page, and calculate for himself, the power of the Great Western. The result will vary very widely from 450. And here I beg leave to refer the writer to *one* English work of *some* value, in which he will find a part of the details of an experiment, and some opinions which do not exactly contradict my own. In "Tredgold on the steam engine and steam navigation," page 365, vol. I, in an account of the steam packet "Ruby," it is said, "the safety valves are arranged upon the plan invented and used by Messrs. Boulton and Watt, a long time since, and now generally adopted by the Engineers of London. They are so arranged that no one on board can possibly have access to them; the engine man can at pleasure open them and let the steam escape, but he has no means by which he can keep them down, beyond the weight placed upon them by the engine maker, which weight is, as before stated 3½ pounds on the inch; and it is a curious fact, that this boat has attained the great speed named, with this small pressure, while in a variety of instances vessels from different out ports, working with high pressure steam, and with the safety valves loaded *ad libitum*, by the engineers and captains, have never been able to approach her in speed. This clearly proves, what Mr. Watt demonstrated long ago, that the most efficient, safe and economical mode of working steam engines for marine purposes, is at the pressure of from 2½ to 3½ lbs. on the inch. At the same time, for single acting pumping engines, there is no doubt an advantage gained by the judicious use of high pressure steam, say of 30 lbs. on the inch working expansively, with boilers properly constructed, but which boilers, for many reasons are not at all fit for steam vessels; in fact, almost all the melancholy accidents that have occurred to steamboats by the explosion of their boilers, have been caused by the injudicious application of high pressure boilers to marine purposes." And on the next page, it is said "the high pressure steam system, has been the means of filling the journals with those ever-occurring, heart-rending, and sickening details of hundreds and thousands that are being yearly sacrificed to ignorance and prejudice, by attempting to do that by the dangerous use of high pressure steam, which can be so well effected by steam of a low pressure, and that too at one half the consumption of fuel." The practical experiments which contradict the facts set down in the table "an Engineer" has not given us, and should he attempt to find them, he would be obliged to report *non est inventus*. The table is merely a statement in a convenient form, of such information as I was able to obtain by careful inquiry, and it may possibly contain some errors—my personal knowledge could not, of course, extend to all the cases and I was consequently compelled to rely upon the accounts received from others, or contained in printed documents. And if "an Engineer" possesses more correct information, and will show in what particulars it is incorrect, I shall with much pleasure make the necessary corrections, but until errors are pointed out, I shall suppose my information was of the right kind, obtained from the proper sources, and the table correct. But "an Engineer" might have said, with truth, that the table is *now* incorrect, although it *was* correct at the time it was compiled. The Rochester then had a 43 inch cylinder, which has since been exchanged for one of 50 inches diameter, (the boiler and other parts of the engine remaining the same.)

The result of this change is, that the steam, furnished by the boilers, is worked a lower pressure upon a larger piston, and the power of the engine increased at the same time and by the same means that the danger of explosion is diminished. That the pumping engines in Cornwall use steam of 40 lbs. pressure per inch, and work it expansively, I very well know, but I know also, that all attempts to use the same plan and pressure in double acting engines, employed in any other kind of work have hitherto failed entirely to effect the same saving in fuel as is said to result from its use in pumping. The gentleman will find abundant proof of this in vols. I and II of the "Transactions of the Civil Engineers," the *study* of which, I beg leave to recommend to him, for he appears to have read the work carelessly or hastily, or he would never have referred to page 127 vol. I, for proof of Mr. Watts' partiality to high pressure steam. At that place is an extract from his specification filed on taking out the patent for his expansion engine. The steam mentioned there of 14 lbs. per inch, is that which would be measured by the common steam gauge with the index at zero—that is, steam just counterbalancing the pressure of the atmosphere.

The advantage of working expansively is admitted, and has never, so far as I am informed, been denied or hardly questioned,—it is safe and economical; but as I have before remarked, *all* its advantages may be obtained without venturing even into the *neighborhood* of Professor Renwick's cheap and moderate pressure of 57 lbs, per square inch.

The "Engineer's" quotations from Redfield deserve a passing notice too, because, as they stand, the conclusion must be inferred from the premises, and it ought to be stated. And in order to have the clearest view of the matter we will put it in the form of a syllogism, which will stand thus.

Steam of 7 lbs. pressure per square inch, is dangerous.

Steam of 18 lbs. pressure per square inch, is less dangerous.

Therefore, as the pressure is increased the danger is diminished. This being the legitimate conclusion, the question very naturally arises, how high must the pressure be to have the danger disappear entirely from the calculation, or if it retains its place, will it not appear with a negative sign if the pressure is sufficiently high? This question is a curious and interesting one, and I shall be pleased to have it answered by "an Engineer."

Meantime, I remain

Your obedient servant,

JOHN D. WARD.

Novelty Works, May 20, 1840.

MEMOIRS OF THE MOST EMINENT AMERICAN MECHANICS—ALSO LIVES OF DISTINGUISHED EUROPEAN MECHANICS, TOGETHER WITH A COLLECTION OF ANECDOTES, DESCRIPTIONS, &C. &C. RELATING TO THE MECHANIC ARTS—ILLUSTRATED BY FIFTY ENGRAVINGS—BY HENRY HOWE.

We have had the above named work for some time before us, but have not until now had an opportunity of noticing it. Mr. Howe has aimed at making an instructive and readable book for mechanics and others interested in such memoirs—and in fact who is not interested in the narrative of the struggles, experiments, partial failures and final success of men who have, in some instances, conferred inestimable benefits upon mankind.

In the work before us it will be found, that there are lives of Fitch, Evans, Slater, Whitney, Bushnell, Whittemore, Blanchard, and Eckford, which are either entirely original, or contain many items of interest, derived from relatives and friends of the persons themselves, and therefore of a highly interesting character.

The life of Henry Eckford is the first memoir of that distinguished man, which may be considered as the history of his mechanical career. In it we recognize the practical pen of an accomplished scholar, a near relative of Eckford, and one well qualified to defend his character and write his life.

We recommend the work to our readers, and give to them the life of Eckford in this number.

We are indebted to the kindness of a friend for the following memoir of one, whose talents and industry evinced in improveing the popular arm of our national defence, should render our country proud of ranking him among her adopted children.

Henry Eckford was born at Irvine, (Scotland,) March 12, 1775. At the age of sixteen he was sent out to Canada, and placed under the care of his maternal uncle, Mr. John Black, an eminent naval constructor at Quebec.

Here he remained for three or four years, and in 1796, at the age of twenty-one, commenced his labors in New York. His untiring industry and attention to business soon procured for him numerous friends; and the superior style in which his ships were built, excited general attention. At that time the vessels constructed at Philadelphia stood highest in the public esteem; but it is scarcely too much to say, that those built by Mr. Eckford soon occupied the first rank, and gradually New York built ships bore away the palm from all competitors. Equally conversant with the theoretical as well as with the practical part of his profession, he never frittered away his own time or the money of his employers in daring experiments, which so often extort applause from the uninformed multitude. He prefered feeling his way cautiously, step by step. Upon the return of one his vessels from a voyage, by a series of questions he obtained from her commander an accurate estimate of her properties under all the casuulties of navigation. This, connected with her form, enabled him to execute his judgment upon the next vessel to be built. In this way he proceeded, successively improving the shape of each, until those constructed by him, or after his models, firmly established the character of New York built ships over those of any other port in the union.

It would be impossible, within the limits prescribed by the nature of this work, to point out the various improvements in the shape and rig of all classes of vessels suggested by the fertile mind of Mr. Eckford; and perhaps their technical details would be unintelligible to ordinary readers. It is sufficient to observe, that after his models our vessels gradually dispensed with their large and low stern frames, the details of their rigging underwent extensive changes, and in the important particulars of stability, speed, and capacity, they soon far surpassed their rivals.

Mr. Eckford had married and become identified with the interests of his adopted country when the war broke out between America and England. He entered into contracts with the government to construct vessels on the lakes, and the world witnessed with astonishment a fleet of brigs, sloops of war, frigates, and ships of the line, constructed within an incredibly short space of time. At the present day, we can scarcely appreciate the difficulties and discouragements under which operations on so extended a scale were obliged to be conducted. The country was comparatively wild and uninhabited, the winters long and severe, provisions and men, with the iron-work, tools, rigging, and sails, were to be transported from the sea-coast, the timber was still waving in the forests, and, to crown the whole, the funds provided by the government were in such bad repute, that, to obtain current funds therefrom, Mr. Eckford was obliged to give his personal guarantee.

Under all these embarrassments, he commenced his operations with his accustomed activity and judgment, organized his plans, and offered every inducement to the interests, the pride, and the patriotism of those in his employ to labor to the extent of their ability. Encouraged by his presence and example, they entered upon their labors with enthusiasm, and neither night nor day saw a respite to their toils. The consequences were quickly apparent. A respectable fleet was soon afloat, and our frontier preserved from the invasion of a foe as active and persevering as ourselves. In allusion to these efforts, one of our intelligent citizens, Mr. Verplanck, in a discourse delivered before the Mechanics' Institute, has happily observed, "I cannot forbear from paying a passing tribute to the memory of a townsman and a friend. It is but a few days since that the wealth, talent, and public station of this city were assembled to pay honor to the brave and excellent Commodore Chauncey. Few men could better deserve such honors, either by public service or private worth; but all of us who recollect the events of the struggle for naval superiority on the lakes during the late war with Great Britain, could not help calling to mind that the courage, the seamanship, and ability of Chauncey would have been exerted in vain, had they not been seconded by the skill, the enterprise, the science, the powers of combination, and the inexhaustible resources of the ship-builder, Henry Eckford."

At the conclusion of the war, his accounts, involving an amount of several millions of dollars, were promptly and honorably settled with the government.

Shortly after this, he constructed a steam-ship, the "Robert Fulton," of a thousand tons, to navigate between New York and New Orleans. Unlike the light and fairy-like models of the present day, which seem only fit for smooth water and summer seas, she was a stout and burdensome vessel, fitted to contend with the storms of the Atlantic, and her performance, even with the disadvantage of an engine of inadequate power, far exceeded every expectation. The sudden death of her owner, in connection with other circumstances, caused her to be sold; and it is no slight commendation of her model, that when she was afterwards rigged into a sailing vessel, she became the fastest and most efficient sloop-of-war (mountiug twenty-four guns) in the Brazilian navy. It is to be regretted that the model then proposed by Mr. Eckford for sea steamers has not been followed. The vain attempt to obtain speed, without a corresponding change in the shape of the model, that would enable them to contend successfully with heavy seas, has been attended with disgraceful failures, involving an immense loss of lives.

A strong feeling of professional pride induced Mr. Eckford to accept an invitation from the Secretary of the Navy to become naval constructor at Brooklyn. He was desirous of building a line-of-battle ship for the ocean that should serve as a model for future vessels of that class, and in the Ohio, we believe, it is generally conceded such a model has been obtained. Her ports, it is true, have been altered to suit the whim of some ignorant officer, who has thus weakened her frame in order to imitate an English model, and her spars have been curtailed of their due proportions, to gratify a commissioner's fancy; but, under all these disadvantages, she is to remain a model for future constructors. Unfortunately, our marine was then encumbered, as it is now, with a board of commissioners composed of old navy officer, who fancied that because they commanded ships they could build them,—an idea as preposterous as it would have been to have intrusted the naval constructors with their command. Under this sage administration of the affairs of the navy, six ships of the line, costing four millions of dollars, were constructed; the constructors received their orders from the sages at Washington, and each vessel, as was to have been expected, became worse than the preceding. Two of them are permitted to rot in the mud, a third has been cut down to a frigate possessing no very creditable properties, and the others, if not humanely suffered to rot, will probably follow their example.

The same signal disgrace has fallen upon our sloops of war. Under a mistaken idea of strength and stability, their frames are solid, and in many instances their leeway and headway are nearly balanced. Some of them, we are officially informed, possess every desirable property except that they are rather difficult to *steer!* Those in the least acquainted with the subject need hardly be informed that this exception, trifling as it seems, is conclusive against the model.

At the head of this board was Commodore John Rodgers, and *his* instructions and *his* orders were to be the basis of Mr. Eckford's operations. These orders, copied, for the most part, out of some exploded work on naval architecture, were wisely disregarded, although their receipt was duly acknowledged; and he has been heard to observe, that when the vessel was completed, he would have challenged the whole board to have examined and pointed out in what particulars their orders had not been implicitly obeyed. Under the orders of the commissioners, he had prepared a model which, after due examination, was graciously approved of. When Mr. Eckford proceeded to lay down the vessel, he thought fit to introduce many important changes, and the only genuine draught of the Ohio is now owned by Mr. Isaac Webb, one of the most intelligent of his pupils. The consequence, however, of these collisions between presuming ignorance and modest worth were soon obvious. Mr. Eckford resigned his commission on the day the Ohio was launched; and shortly after received an intimation, that he would never see her put in commission as long as the members of that board held their seats. This promise, as our readers are aware, was kept for eighteen years.

Shortly after this he engaged extensively in his profession; and so great and extended became his reputation, that he was called upon to construct vessels of war for various European powers, and for some of the republics of South America. Among others, he built and despatched to Columbia and Brazil four 64 gun-ships, of 2000 tons each, in the incredibly short space of eighteen months. In these cases his accounts were promptly adjusted, and he received from all parties highly honorable testimonials of his integrity, punctuality, and good faith. He subsequently received proposals to build two frigates for Greece; but as he thought he perceived, on the part of the agents, a disposition to take an unfair advantage of the necessities of that nation, he honorably and humanely declined their tempting propositions. All are aware of the disastrous and (to this country) disgraceful manner in which that business terminated.

Upon the accession of General Jackson to the presidency, he received from him an invitation to furnish him with a plan for a new organization of the navy. This was promptly furnished, and was pronounced by all who read it to be exactly what was required for an efficient and economical administration of the navy. It was not acted upon, although its adoption would have materially advanced the interests of the country. Among other novel propositions, it was recommended to remodel entirely the dockyards.

These were to be under the superintendence of superannuated commodores, who, in taking command, would relinquish their rank and make way for more active officers. The constructor at each yard was to be held responsible for the quantity and quality of work done, and only amenable to the chief constructor at Washington. This latter office, he took occasion, however, to say, he could not, under any circumstances, be persuaded to accept. He wished, in short, from what he had himself observed of the extravagance, waste, and delay at our dockyards, to place them on a civil footing, as more consonant to the feelings of the mechanics and the spirit of our institutions.

About this period he determined to prepare and publish a work on naval architecture, for which he had ample materials, and numerous draughts of vessels of almost every class. He had also set aside twenty thousand dollars to establish a professorship of naval architecture in Columbia college, and had already entered into correspondence with an eminent constructor, Mr. Doughty, whom he had intended as the first professor, when a disastrous affair occurred, involving his reputation and his ample fortune. An insurance company, in which he was largely interested, became, in the panic of the day, insolvent, and its creditors ventured, in the madness of the moment, to throw doubts on the hitherto unimpeached character of Mr. Eckford. In this they were aided by a knot of political partizans, to whom his silent, but gradually increasing popularity, (which had, long ere this, placed him in the State legislature,) was gall and wormwood. Notwithstanding he satisfactorily proved that he had lost, by stock, and other advances to save the sinking credit of the company, nearly half a million of dollars, yet his enemies affected to discredit his testimony, upon the ground that such unparalleled sacrifices were too disinterested to be credible. The termination of the investigation resulted in his complete and honorable acquittal, but the venomed shaft rankled in his kind and gentle breast to the hour of his death. It is no consolation to his numerous friends and relatives to know, that all who joined in this base conspiracy against this pure-minded and well-principled man have since paid the forfeit of their infuriated zeal, by the silent, but withering contempt of their fellow-citizens.

In 1831, he built a sloop-of-war for the Sultan Mahmoud, and was induced to visit Turkey. His fame as a skilful architect had preceded him, and he was shortly afterwards offered the situation of chief naval constructor for the empire. A field worthy of his enterprise seemed open to him. With his characteristic energy he commenced the organization of the navy yard, and laid down the keel of a ship of the line. He had rapidly entered in her construction, and had so far advanced in the favor of the sultan that preparations were in train to create him a Bey of the empire, when his labors were suddenly brought to a close by his lamented death, from inflammation of the bowels, which occurred November 12, 1832, in the 57th year of his age.

In private life, Eckford was remarkably simple in his manners and habits. Abstemious and temperate, he always possessed unclouded faculties; and his quiet attention and kindness to all under his control enabled him to secure their ready co-operation in any of his plans which required from them willing and prompt exertions. The scrupulous observance of his contracts to the minutest particular was with him a point of honor; and his dealings with his fellow-men bore rather the character of princely munificence than the generosity of a private individual. Throughout life, and amid transactions involving millions, he maintained the same unassuming habits, considering himself but the mere trustee for the benefit of others; and died as he had lived, honored and beloved by all who knew him.

An intelligent gentleman (a foreigner) who spent the greater part of last year in travelling through the several States of the Union, and by every mode of conveyance, has favored us with the following interesting article exhibiting some curious and novel comparisons and results.

TRAVELLING STATISTICS.

Since my arrival in New York in December 1838, I kept a Journal of all my travels in the United States, in which I noted 1st, the date and hour of departure from, and arrival in every place; 2d, the time spent on the journey, and the duration of all the stoppages, which gave the time of actual motion; 3d, the distance travelled over; 4th, the manner of travelling or kind of conveyance; finally, 5th, the speed exclusive of stoppages, and 6th, the rates of charges.

On the 14th of January 1840, I finished a journey through nearly all the States of the Union; having left New York on the 24th of December 1838, the whole time spent on the journey was one year and 20 days, during which I travelled

Upon railroads with locomotives	3,329 miles.
do. do. horse power	215 "
In steamboats upon rivers	2,220 "
do. do. lakes and sea	813 "
In stage coaches	2,614 "
do. sleighs	335 "
In canal boats	375 "
In a sailing vessel	136 "
In private conveyances	293 "
On foot and horseback	100 "
Total distance.	10,430 "

equal to 150 degrees of the meridian.

These 10,430 miles were travelled in 175 separate journeys, being at an average distance of 60 miles. The number of Railroads over which I passed was 64, and I took passage in 24 different steamboats. *I have not met with a single accident of the smallest kind during the whole time.*

The following statement contains accurate results as taken from my journal.

Manner of travelling, (conveyance.)		Number of miles travelled.	Time occupied exclusive of stoppages, hours.	Speed in miles per hour.	Charges for a single place (or person) whole distance.	Average charge per mile. (cents.)
Railroads	Steampower	3,329	219	15	$177	5
	Horsepower	215	36	6		
Steamboats	Upon rivers	2,220	252 1-2	9	149 50	4 9-10
	Lakes and sea	813	79 1-2	10		
Stages and sleighs		2,949	602	4 9-10	207 50	7
Canal boats		375	96	3 9-10	17 20	4 6-10
Sailing vessel		136	54	2 1-2	10	7 3-10
Private conveyances		293	42	7	36 80	12 1-2
Total.		10,330	1,381	av.7 1-2	598 00	5 8-10

From the above it appears that of an inland voyage of over 10,000 miles, the travel upon railroads amounted to more than one-third of the whole distance.

The speed upon railroads is 50 per cent. greater than that of steamboats, to which I have however to remark, that the passage in steamboats upon rivers was nearly exclusively up stream. The speed upon common roads is less than one-third of that on railroads, the speed of canal boats only one-fourth. The average speed on the whole voyage, which is obtained by dividing the number of miles travelled by the time of motion was 7½ miles, or half the speed on railroads.

The fare in steamboats and canal boats includes board, and is therefore the cheapest, the stage fares are 40 per cent. higher than the railroad charges, and the average rate per mile for the whole voyage was 5 8-10th cents.

The time spent in travelling, *inclusive* of stoppages, was 1,835 hours; the stoppages amounted therefore to one-fourth or 25 per cent. of the whole time occupied; and the average speed *inclusive* of stoppages, was 5 6-10th miles per hour.—*Commercial and Statistical Register.*

NEW YORK AND ERIE RAILROAD COMMENCED.

The Susquehannah Division of this great work, extending from Binghamton to Hornellsville, 117 miles, is commenced, and is contracted to be finished so that the cars will run the whole distance, on the fourth of July 1842. On the occasion of driving the *first* Pile, it was deemed proper by some of our citizens, in conjunction with the Chief Engineer and Agent of the Company, to commemmorate the event by an appropriate celebration. The Ladies, too, actuated by the same spirit which has borne onward this splendid enterprise, had conceived the idea of presenting an appropriate banner to the Company, to be elevated on the stately machine, which is destined, under the guidance of skilful operators, to bear so conspicuous a part in the execution of this grand work.

The day fixed for this "ocular demonstration" that the road will be built, was Wednesday, the 13th inst., and, as rain has been, of late, so frequent and unexpected, its dawn was looked to with intense solicitude. It came, and with unclouded brightness. All hearts were animated with this indication of the favor of a kind Providence, and every countenance beamed forth its gratitude.

At 3 o'clock, the hour designated for the commencement of the work, the ground on which the PILE-DRIVER had been erected, about one mile east of the village, was thronged with an anxious multitude—from the grey headed veteran of the Revolution, to the stripling school boy of six or seven. All were eager to witness the operations of the locomotive monster which, before known, was so much sneered at and abused. And well did the machine vindicate its majesty and power. Seizing the heavy piles with the greatest facility, with a little exercise of manual skill, they were placed in an upright position, directly under the hammers, each weighing 1000 lbs.; and as soon as adjusted, which was but the work of a minute, these ponderous weights were raised to the height of 30 feet, from whence they descended on the head of the pile, driving it home with resistless force.—This hammering continued, until it had attained a sufficient depth, when a circular saw, which projects from the machine between the piles, was put in motion, and the pile sawed off at just the required elevation. This operation is rapidly repeated—without any hindrance—only requiring the constant attention of the hands—the engine being supplied with fuel from the tops of the piles which are sawed off. It is proper to say that the *first* pile which was driven on this occasion, was also the first one which was cut, on the 20th of February last, by the agent of the Company, of which we gave due notice at the time.

We believe that none who witnessed the operation of the machine, will now doubt the permanency of the work. Indeed, we saw many who were credulous before, now exclaiming rapturously in its favor. It demonstrated with certainty, and with power, its capability of effecting all which its most sanguine friends had predicted; and we feel quite sure that it will go on conquering and to conquer, removing all the obstacles which prejudice, party feeling, and illiberality have reared, until the New York and Erie Railroad shall be completed.

We saw in the crowd, the lengthened visages of some, who had been assiduously engaged in misrepresenting the views of the Company—denouncing their acts as hypocritical, and intended only for political effect; charging them with "supporting an idle set of vagrants along the route," and laboring with rancorous zeal to prejudice the people against them. These men are now convinced, though *against their will*, that the road will be made, and they want only a plausible pretext to take the back track. They saw around them, yesterday, the happy countenances of the many, by whom their jaundiced croakings were heeded as the idle wind, congratulating each other on the opening prospects of the southern tier, under the enlightened auspices of an Internal Improvement administration; and they saw in this "ocular demonstration," the utter discomfiture of all their plans—the dissipation, like the mists of the morning before the rising sun, of all their hopes. No wonder they were crest fallen—objects of pity, rather than scorn.

In the course of the afternoon, the presentation of the flag, spoken of above, took place. The ladies marched to the ground in procession, preceded by the Nichols Band in a splendid wagon drawn by six horses. The band, under the direction of their leader, Mr. Tuttle, a gentleman of superior musical talents, enlivened the scene with "sounds which would create a soul under the ribs of death." On reaching the designated spot, the ladies were ranged in a semi-circular form—the gentlemen in a like manner, opposite, forming a circle, with the band, and a platform for the speakers in the centre. On behalf of the Ladies, Mr. I. B. Headley then addressed Mr. Macomber, the agent of the Company, in the following terms, closing with presenting him the flag.

Mr. Macomber, *Agent of the New York and Erie Railroad Company:*

Sir—The Ladies of Owego, with their own hands have wrought this beautiful banner, and honor me with its presentation to the Company, on this joyful occasion.

The work, heretofore done in the prosecution of this noble enterprise, has not been regarded as a sure guaranty of its ultimate achievment. But, Sir, the long night of doubt and despondency has passed away. We are assembled to witness the first blow on the line of this road, which can be hailed as the signal of its certain and speedy completion. The ladies, whom I have the honor to represent, have therefore inscribed upon this banner the cheering words "ocular demonstration." Every heart in this assembled throng responds to the sentiment. In our souls we feel its truth. The preparations of this field proclaim it; this mammoth machine as it steps through our beautiful vallies, with this banner floating over it, will give a voice to this inscription; every stroke of its ponderous hammers will thunder in our ears "ocular demonstration!" and the listening hills will give back their answers in startling echoes—"ocular demonstration!"

Upon the reverse field of this banner, the fair givers have written the bold prediction, "July 4, 1842," the time appointed for the completion of the Susquehannah Division. They, Sir, do not doubt the company's ability and determination to redeem this pledge. And when the day of its redemption shall have come, it will be to us a proud recollection, that the ladies of our own beautiful village graced the first pile driver with this banner, and traced upon its ample folds this prophetic inscription.

To you, Sir, the indefatigable agent of the Company; to the experienced Chief Engineer and his assistants; to the enterprising contractor and the gentlemen connected with him, I cannot offer a more pleasing assurance of the lively interest felt by my fair constituents in the successful prosecution of your gigantic undertaking, than to remind you, that *their banner will be over you.*

They tender to the Commissioner, to the Directors, and to the Stockholders, their warm congratulations for this auspicious day. With them, they rejoice in the promised consummation of an event, which is to unite the shores of Lake Erie with the banks of the Hudson. They, and we all unite with the thousands who people these southern counties, in joyfully hailing the prospective completion of a work, which shall hurry, in swift and perpetual circulation, a mighty tide of human life and human enterprise, through this long forgotten and forsaken region.

Sir, In behalf of the young ladies of Owego, I now present to the New York and Erie Railroad Company this banner, attended with their best wishes for the speedy completion of the greatest internal improvement of our age.

Mr. Macomber, on behalf of the Company, acknowledged the compliment, by addressing Mr. Headley, as follows:

Mr. Headley—Sir: In accepting this beautiful banner, from the fair donors, allow me on the part of the New York and Erie Railroad Company, as their Agent, to return them through you our sincere and grateful thanks for the gift, and to assure them that if aught was wanting to enhance the value of the presentation, it is found in the pleasing recollection that in all our struggles to reach our present position, we have *ever* received the encouragement and smiles of the Ladies, and we feel convinced that to *this* as much as to any other cause, are we indebted for our success in overcoming all difficulties, and triumphing over all opposition.

And as we feel that the clouds of doubt and disappointment are beginning to break away, and the sun of prosperity to burst upon us, we cannot but be grateful to *all* who have stood by us in the dark days of our noble enterprise, and to pledge ourselves to them, and to all who truly wish for the increasing wealth and happiness of these Southern Counties, and of the Empire State, that nothing on our part shall be wanting to push this work to a speedy completion; and with the broadest and longest Railroad in the known world, to put another link into that iron band which will one day unite the Atlantic with the Pacific Ocean, and remain an enduring monument of American enterprise, energy and greatness.

To the ladies whom you represent, and to yourself I would again tender the thanks of the Board of Directors and of the Commissioner, of the Chief Engineer, and his assistants, of the Contractor and his operatives and of myself, and to assure you that with this banner above us, this fruitful soil beneath us, these friends around us, and the blessing of God over all, the New York and Erie Railroad must and shall be made.

The Flag presented on the occasion, exhibited on one side our National Symbol, the stars and stripes, with an inscription on the lower edge, "ocular demonstration." On the reverse, the corner usually devoted to the Stars was occupied by the figure of a Locomotive, on a Pile Road, on a blue ground. On the lower stripe, was inscribed, July 4, 1842, as designating the time when this division is to be completed.

On the close of this ceremony, it was suggested that some one of the numerous spectators, should announce their feelings on this interesting, and auspicious occasion. By intuition, as it were, all eyes were turned to E. S. Sweet, Esq. as the man on whom this task should devolve. Ever ready

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to obey the wishes of the people, Mr. Sweet ascended the platform, and though wholly unprepared, electrified the audience with a speech of thrilling eloquence, of half an hours duration.

We wish we could transfer to paper this admirable address, but we cannot. We can only say it was listened to with breathless attention, and answered with a round of cheers from the congregated multitude.

The company then returned to the village—the citizens retiring to their respective homes, while the operatives attending the machine, to wit: Capt. Thomas Sharp, with his men, Albert Savory, Peleg Briggs, George Parkhurst, Benjamin Wood, Elias Phelps, and William Robinson, and the Contractor, Chief Engineer and assistants, Agent, and a few guests, repaired to the Hotel of Mr. Manning, and sat down to a sumptuous repast.

After the repast several toasts were drank, appropriate to the occasion, of which, the following have been handed in.

By C. B. Stuart, Chief Engineer. The Contractors and Operatives.—Their energetic operations on other works, is a sure guaranty that this Division of the New York and Erie Railroad will be finished July 4, 1842.

By D. O. Macomber, Agent. The New York and Erie Railroad.—The past all gloom, the present all joy; the future all hope.

By Mr. Manrow, Contractor. The Operatives.—Without them we are powerless, with them we are mighty.

By A. H. Calhoun. The Pile Driver.—It has fulfilled the expectations of its friends, and blasted the *hope* of its enemies.

By Jonathan Platt. His Excellency Wm. H. Seward, Governor of the State.—The firm friend of the New York and Erie Railroad.

By I. Spalding, Engineer. The Ladies of Owego.—May the flag which they have wrought with their own fair hands, float triumphantly over our Machine, until it reaches the western termination of its labors.

By a Guest. The Nichols Band.—Prompt at a pinch, unrivalled in their art, and ever ready to *treat* their friends.

Mr. Robert Chas. Johnson being called upon for a toast, remarked, that when the citizens of this place first convened for the purpose of petitioning the legislature for a survey of the route, of the New York and Erie Railroad, it was considered by many as wild and chimerical. He well recollected encountering a gentleman, who asked him if he really thought this work would ever be commenced, to which he replied, yes, most surely.—The gentleman then replied, in a sneering manner, "It can never be—you may as well attempt to scull a pot-ash kettle up the falls of Niagara, with a crow-bar, as to effect this visionary project." In view of what has been done, and the certainty of the speedy completion of the road, he would give,

The Pot-ash Kettle sculled up.

The company dispersed at an early hour, in good spirits, and high hopes for the future.

Royal Geological Society of Cornwall.—Boring Granite Rocks.

Mr. Prideaux observed, that a year or two since it had been suggested to him whether some chemical process could not be adopted to bore hard rocks. After some consideration, and trying several experiments, he at last found that a stream of hydrogen-oxygen gas applied to a piece of granite soon produced heat, and on application of cold water the stone became soft, and yielded to the tool. He repeated the experiment with the same result in every case. Mr. P. then explained how the gases should be mixed, and how it might be infused into the hole in the rock. He also said that a great deal of the difficulty of getting the gas at the bottom of the mines might be obviated by very simple means. Oxygen might be superseded by common air from a pair of double bellows; and the common coal gas would be foud better than hydrogen, because it contained more inflammable matter in a given space, and it might be procured from any neighbouring gas-works, and conveyed down into a mine in a copper vessel. (Mr. Prideaux explained the kind of vessel by diagram.) If, said Mr. Prideaux, oxygen gas should be found absolutely necessary, nothing was easier to procure where there was a steam engine; they had only to get a litile iron retort, and in a country like Cornwall, abounding with manganese, they need never be at a loss for oxygen gas. He did not, however, suppose, in the present state of underground management in our mines, this plan would be adopted, but he was of opinion, should the Mining School be continued for two or three years, there would soon be many young men ready to carry it into effect.—*Mining Review.*

MEMORIAL OF SUNDRY PROPRIETORS AND MANAGERS OF AMERICAN STEAM VESSELS, ON THE IMPOLICY AND INJUSTICE OF CERTAIN ENACTMENTS CONTAINED IN THE LAW RELATING TO STEAMBOATS ASKING TO BE RESTORED TO THE RIGHTS AND PRIVILEGES WHICH BELONG TO OTHER CITIZENS ENGAGED IN NAVIGATION.

(Continued from page 313.)

No. 2.

*Schedule of Accidents to British Steam Vessels.**

No. 3.

Known accidents and Disasters to American Steamboats since the Law of 1838.

October 27th, 1838, Cynthia, Detroit river, burnt; passengers and crew saved by running on shore.
Nov. 25, Gen. Brown, Mississippi, explosion, thirty lives lost.
Jan 1839. Clarendon, Sav. and Darien, burnt; crew and passengers saved.
" Ploughboy, Mobile, sunk, on arriving at Mobile.
" Somerville, Mississippi, sunk.
Feb. Oswego, Ohio, sunk, near the mouth of the Kentucky.
" Alert, Mississippi, eruption of steam; 4 scalded.
" Alice, Pearl river, sunk.
March, Reporter, Ohio, eruption of steam; 4 scalded.
" New York, New Haven, burnt.
May, Avalanche, Ohio, eruption or collapse; 5 killed.
" Rhine, Missouri, explosion,
" Pilot, Mississippi, explosion or collapse.
" Ponchartrain, New Orleans for Tampico, explosion.
" Geo. Collier, Mississippi, eruption of steam; forty-five killed or scalded.
" Erie, Hudson river, collapse, 1 slightly wounded.
" Bee, Arkansas, sunk.
" Indian, " sunk.
" Buckeye, Mississippi, explosion; several killed or wounded.
June, Empire, Ohio, sunk.
" Massilon, " collision and eruption of steam.
" Tenessee, Cumberland river, burnt and sunk; passengers saved.
Nov. Wilmington, Mississippi, explosion; nineteen killed or wounded.
1840. Gallatin, Cumberland river, collapse; three scalded.
" Lexington, Long Island Sound, burnt; about 124 lives lost.

* One hundred and one accidents.

It may be seen that the most numerous and fatal of the accidents by steam have happened soon after the semi-annual inspections of the first of April and October. This fact will not appear surprising to practicle men; who fully understand that the care and skill of official inspectors cannot be advantageously substituted for the uncontrolled vigilance and practical knowledge and skill of those who are in the constant care and superintendence of the boats and engines; and to whom a good reputation, the desire of safety and the love of life, afford stronger and more efficient motives to correct action than can ever be furnished by the requirements or penalties of any special enactments of the legislative power.

The Cincinnati Gazette is stated to have published a list of steamboat disasters on the western waters during the last year. The sum total of losses is 40: of this number, 32 were an entire loss; snagged, 21; struck rocks, or other obstacles, 7; burnt, 5; burst their boilers, 4; run into by other boats, 3—40. There were snagged on the lower Mississippi, 11; on the Missouri, 4; on the Ohio, 4; on the Yazoo, 1; on the Red River, 1. It is remarkable that a majority of the boats were snagged on their downward trips. Lives lost, by bursting boilers, 39; by other causes, 6. Total, 45. The amount of property destroyed in boats and their cargoes, is supposed to be not less than a million of dollars.

On events like these, the provisions of statutory law can have but little influence; except as they may operate to deter the men of means, foresight and mental ability, from a business already too hazardous to their private interests, and which, most unwisely, has been made subject to the porscriptive action of the popular press and of the national legislature.

No. 4.

Losses in Ordinay Navigation and the Comparative Hazard of Navigation by Steam.—Some of the following paragraphs are taken from a communication made to the Secretaay of the Treasury by one of the memorialists.

"So alarming have been the accidents in steam navigation on our western rivers and elsewhere, as to induce a belief in the minds of some, that of all modes of conveyance this is the most hazardous. That a degree of danger has attended this mode of traveling which ought to be lessened or avoided, it were vain to deny; but when we reflect on the recent origin of the art, and the vast numbers of persons who are transported by its means, and when we also consider the exposure and comparative accidents of other modes of navigaton and means of conveyance, this impression will be materially altered, and we shall rather have cause to wonder, that under all the circumstances of the case, so small a fraction of the traveling public have become victims to this hazard. We have, indeed, a fearful list of steamboat explosions; but the sufferings and fatalites which have attended other modes of transport and conveyance, pass off with but little notice, as common occurrences, and their statistics are seldom known. Consequently, the public mind does not become excited in contemplating these casualties, which are treated only as evils which are incident to the common lot of man.

It appears from statements in the London Nautical Magazine, that the whole loss of property in British vessels by shipwreck or foundering, is estimated at 3,000,000*l.* sterling, annually; and the annual loss of life at sea at not less than 1,000 persons, not including the numerous losses of life on their own coast.

As regards our own navigation, we find the following notice in the Sailor's Magazine, for January, 1838.

Shipwrecks in the year 1837.

During the year past, there has been published in the Sailor's Magazine, a monthly list of shipwrecks which have occurred, principally of American vessels, and which have been published from time to time in various newspapers. Those only have been selected which resulted in a total loss of the vessel. The number of vessels thus reported during the year is as follows: ninety-four ships and barques, one hundred and thirty-five brigs, two hundred and thirty-four schooners, twelve sloops, and fifteen steamboats; making a total of four hundred and ninety-three vessels which have been wrecked. Of these forty-three were lost toward the close of the previous year, though the account was not published till the commencement of this; thirty-eight were lost in the month of January, fifty-four in February, twenty-four in March, thirty in April, nineteen in May, fifteen in June, forty-two in July, fifty in August, thirty-two in September, forty-three in October, forty-three in November, and six in December. The precise time when the remaining vessels were lost could not be satisfactorily ascertained.

" In the above named vessels, one thousand two hundred and ninety-five lives are reported as being lost. This, probably, is but a part of the whole, for, in many instances, the crew are spoken of as missing, and in other cases nothing is said, where, perhaps, there was a total loss."

This statement is said to comprise no deaths by steamboats, except in casses where the vessel was totally lost. On the other hand, a very large proportion of the fatal accidents in ordinary navigation, must have escaped the knowledge of the inquirer.

Now, in view of this immense waste of life, let it be considered, that in the art and practice of navigation other than by steam, the world has had the experience of more than four thousands years, and the efforts and intellect of many generations have been tasked for its greater security; while, on the other hand, *a quarter of a century has scarcely elapsed* since the powers of steam became prominently known in navigation, and we have as yet only witnessed the brief *infancy* of its application to this important purpose. Surely, then, it is not suprising that disastrous and fatal accidents should sometimes have attended its use. There is cause for astonishment, rather, that so great a degree of average security should have been attained, in so brief a period.

Each great district of our widely extended country possesses its own peculiar facilities and hazards in this species of navigation, and exhibits, also, differnt stages of improvement and security in the use of steam. In this quarter, the average degree of security enjoyed by passengers in our steamboats is certainly greater than is posesed by persons who walk the streets of our large cities. During the last five years, *millions* of passengers have been carried on the steamboats which run from this city, [New York,] and, among all these, the catalogue of deaths by steam explosions is almost inappreciable.

It is probably true, that in hardly any other circumstances in which such numbers have been placed, has the occurrence of mortality been so entirely wanting. It is with a strong sense of injustice, therefore, that those who are enagaged in this important and not always profitable avocation have found themselves selected as the objects of special and seemingly invidious legislation.

Disasters at sea, in the year 1839.

A record has been kept at the office of the American Seamen's Friend Society, during the year just closed, as in past years, of disasters at sea, so far as they could be ascertained, which resulted in a total loss of the vessel. The following is the result:

The whole number of vessels lost is		442
Of these there were,	Ships and barques	74
do.	Brigs	124
do.	Schooners	187
do.	Sloops	16
do.	Steamboats	9
do.	Unknown	32
		884

Of these there were lost, towards the close of 1838, but were reported in 1839.		52
Wrecked in	January,	26
do.	February,	27
do.	March,	32
do.	April,	21
do.	May,	29
do.	June,	18
do.	July,	15
do.	August,	29
do.	September,	64
do.	October,	30
do.	November,	27
do.	December,	8
time unknown,		61

Added to the above entire and known losses, there has been reported thirty-seven missing vessels during the year, which, with their crews, have most probably been entirely lost, five hundred and thirty-seven lives have been reported as lost, but the loss of life is undoubtedly much greater than this, as many vessels were reported as abandoned, or bottom up, where the crew was missing, and no intelligence has been received from them. The above facts speak a language concerning the sorrows of seamen, not to be misunderstood, and they should be most solemny pondered by those who have a heart to feel and a heart to relieve.—*Sailor's Magazine*, Jan. 1840.

In the foregoing list* we have reported the loss of 84 vessels in the month of December, and the loss of 89 lives, which if added to the 89 vessels, and 90 lives lost in the great gale of the 15th of that month, and to eight other vessels reported as lost in December, in our last Magazine, and we have a total of 181 vessels, and 179 lives, lost within that month.—*Sailor's Magazine*, Feb. 1840.

In addition to the above, the Sailor's Magazine for March, 1840, also records the loss, by fire, foundering or wreck, of fifteen more vessels in 1839, and reports also, in Febuary and March, eleven vessels as missing; for the safety of which with their crews and passengers, little or no hopes are entertained. The accounts of *total loss* for 1839, so far as heard, stand as follows:

Losses mentioned in the Magazine for		January,	884
do.	"	" February,	173
do. and missing,	"	March,	11
			1068
Deduct steam vessels included in the above			9
		Total,	1059

* This detailed list is omited here

Thus showing the total loss of more than one thousand vessels, already ascertained, and the probable loss of between one and two thousand valuable lives, all in a single year!

Are these immense losses of life and property, which had been entirely subjected to the care and control, discretion or indiscretion, of the owners of vessels and of their several commanders, while at a distance from all wholesome oversight and restraint, less worthy of the special interference of the power which is authorized to *regulate commerce*, than the persons and property embarked in steamboats, which are under the almost constant oversight of the owners and pcblic? Or, must the result of popular misapprehensions and erroneous excitements be substituted for more sober legislation, in controlling the business concerns of this growing republic?

It is believed that the statistics which are found in the foregoing table of the steam navigation of the port of New York, may not unfairly represent *all the steam navigation of the United States*, with the exception of the Mississippi and its branches, or the waters which discharge in the Gulf of Mexico. With perhaps this exception, both the existing and the contemplated legislation appear to be almost wholly unwarranted; either by the origin, progress, or present state of the art of steam navigation.

The south-western waters, however, appear subject to greatly increased hazards; which may have resulted, mainly, from a less perfect system of practical engineering, which has been imposed either by choice or necessity; from less perfect means of outfit and repair, than are found in older states or countries; and, above all, from the greater multiplied dangers of their local navigation. It may be well questioned, however, if even here the new legislation be well adapted to the end in view. If, as is believed, there be errors in the western practice, these will doubtless be abandoned, so soon as they are practically seen and felt to be errors. But the character of the American people is greatly mistaken, if it is for a moment supposed that a combination of prescribed formulas with inquisitorial and penal enactments, will remedy evils which are beyond the reach of professional knowledge and pride, and an enlightened self-interest.

The true character or hazard of the western steam navigation is too often but little understood, or but imperfectly appreciated. It has been eloquently and justly described by the Hon. Mr. Rumsey, of Kentucky, on the floor of Congress, who vindicates the memory of the founders of steam navigation in America, and the results of their labors, as follows:

"Sir, you have no arithmetic of powers vast enough, by which to estimate the benefits of the steamboat in a pecuniary point of view alone. Their labors, too, have tended, in no small degree, *to the presrvation of human life*. I am aware that the truth of the last assertion may not be universally admitted; but it will scarcely be questioned, at least by a western or south-western man, who recollects the old mode of conducting our commerce. Small as the commerce was before the introduction of the steamboat, it drew off a larger portion of the population than is now necessary to transact it, although so immensely extended. Even then, more died in the long, and exposed, and laborious voyages in keels and barges, or the exhausting return by land, under a vertical sun, than now perish by steamboat explosions. But they dropped off one by one; they sank obscurely into the grave by the way-side; or, after reaching their homes, fell victims to disease incurred by a sojourn and travel in southern climes. The consumption of life, though known to be great in the aggregate, happening so much in detail, made no publc impresion. But now, every steamboat accident creates a sensation, and is pro-claimed in the universal press of the country. If the mighty commerce now in progress on the western waters, had to be conducted in the old way, it would require the agency of so many individuals, that it would not be long before the sides of the publc roads from New-Orleans to the upper States, and the banks of the great river which pours into the gulf the congregated waters of nearly half a continent, would be almost continued grave-yards."

For the American Railroad Journal, and Mechanics' Magazine.

METEOROLOGICAL RECORD FOR THE MONTHS OF JAN. and FEB., 1840.

Kept on Red River, below Alexandria, La., (*Lat.* 31.10 *N.*, *Long.*, 91.59 *W.*)

1840	THERMOMETER.					REMARKS.
Jan.	Morn.	Noon.	Night.	Wind.	Weath.	
1	28	36	36	calm	clear	white frost and ice
2	26	42	41	NW	..	"
4	30	51	51	SW	..	"
4	47	68	59	..	..	
5	44	71	64	S	..	
6	49	68	66	..	cloudy	
7	60	71	69	..	clear	
8	52	60	57	SE	..	
9	50	59	59	..	cloudy	
10	64	56	52	..	..	
11	46	56	60	NW	clear	
12	38	50	48	..	..	white frost
13	40	50	52	N	..	
14	46	52	50	calm	cloudy	rain in the night
15	44	43	40	..	clear	
16	27	48	54	NW	..	white frost and ice
17	32	56	53	SE	..	white frost
18	34	41	40	NE	..	"
19	30	44	42	N	..	white frost and ice
20	30	60	56	calm	..	"
21	50	59	59	SE	cloudy	rain in the night
22	60	58	50	W	..	
23	36	60	40	NW	clear	white frost
24	36	50	58	calm	..	"
25	40	50	56	..	..	"
26	44	56	50	..	..	"
27	42	66	64	SE	cloudy	
28	60	62	62	..	..	rain light showers all day
29	58	68	70	..	..	
30	40	46	65	NW	clear	
31	38	38	36	NE	cloudy	light showers, drisling rain all day and night
	42	55	54	....	....	mean temp. of the month, 50.
Feb.						
1	34	32	32	NW	clear	white frost and ice
2	27	34	38	..	..	"
3	24	46	40	..	..	"
4	27	52	50	calm	..	"
5	48	64	66	S high	cloudy	
6	58	63	60	calm	..	showers in the morning, cloudy all day
7	52	58	58	..	..	all day
8	58	62	64	..	..	showers all day
9	58	70	70	SW	clear	
10	59	57	56	NW	..	
11	37	56	58	calm	..	white frost
12	46	69	65	SW	..	
13	59	71	68	SW high	cloudy	all day, showers in the night from west, wind
14	40	46	42	NW	clear	[high all night
15	32	54	44	..	..	
16	48	55	60	SE	cloudy	light shower all day, heavy rain at night
17	50	56	54	calm	clear	
18	46	60	67	SW	..	
19	66	76	71	SE high	..	rain in the night
20	56	60	60	calm	..	
21	57	70	72	SE	cloudy	foggy morning
22	58	76	68	..	..	rain in the night
23	66	66	70	calm	..	showers all day
24	56	64	68	..	clear	
25	54	62	64	S	cloudy	
26	62	72	70	..	clear	
27	65	73	74	..	..	
28	58	73	74	calm	..	foggy morning
29	60	72	72	..	..	"
	50	61	60	....	....	mean temp. of the month 57

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 12, Vol. IV. New Series. | JUNE 15, 1840. | Whole No. 360. Vol. X.

The present number concludes the fourth half-yearly volume, of the New Series of the American Railroad Journal, and likewise brings us to the termination of the *eighth* year of its existence. Having abstained from any thing of the kind during the progress of the last volume—we will venture at its close to take a review of our labors, and return thanks to those to whom it is due.

It will be found on examination, that the quantity of original matter is nearly *one half of the volume*, and much of this too, is from the pens of gentlemen well known in their profession, and fully able to contribute to the general stock of professional intelligence. We can safely say that no effort has been made to procure these contributions, other than by a simple request, and in many cases we have been largely indebted to voluntary contributors.

To the writer of the vigorous and well reasoned articles, signed "*Fulton*," we are greatly under obligation for a series of papers, which have been extensively copied throughout the State, and which will be found to contain a more lucid statement of the resources, condition, and future prospects of the Erie Canal, in regard to its enlargemant—than we fear can be found in the documents of the canal board itself. We hope for a continuation of these papers, and among other topics we desire to have from "Fulton," a criticism upon the famous Report on the future revenue of the Erie Canal, laid before the Legislature during the last session. The gentlemanly tone of "Fulton's" language has rendered these papers generally acceptable while the sound reasoning and well drawn conclusions have not failed to carry conviction to the minds of those who have given them an attentive perusal.

We are also indebted to our esteemed friend William R. Casey, for a number of excellent communications. That on the Western Railroad, is peculiarly interesting as it developes the resources and prospects of a work which, although not within our own territory, will have an important bearing upon several of our main lines of communication with the west. For this and his other papers, Mr. C. deserves our best thanks, and we hope for many more in our next volume.

From Mr. Charles Ellet, Jr., we have received several valuable reports, and a description of the Schuylkill Wire Suspension Bridge, the engraving of which as appended to No. 5, being a present from Mr. Ellet of no small value. When engineers not only furnish us with useful matter, but also provide the illustrations already engraved, we feel ourselves under heavy obligations, as the expense of this kind of work is entirely beyond our means. We hope, however, that Mr. E. will not consider that he is freed from further obligation to assist us.

We can hardly find a number of the Journal, either in the present or former volumes, in which we do not find ourselves under obligations to our indefatigable friend "J. E. B." We are particularly indebted to him, for several admirable summary, and comparative views of the various important lines of railroad in the United States and in England. The short and pithy notices of this gentleman, have done much to the diffusion of popular intelligence in regard to Railroads, and his articles always are accepted with a hearty welcome. We may remark that the aid we have received from this gentleman, is not to be measured by the number of articles which bear his signature, for his ever ready eye detects whatever may prove serviceable, and been the means of providing us with many useful items.

Mr. Roebling, and Mr. Cushman, have likewise furnished us from time to time with articles of interest, and we are happy to be able to rank them among our regular contributers. The communications of Mr. Roebling have one unusual character, which has always rendered them doubly welcome—they are written in the plainest possible hand, and the extraordinary neatness of his diagrams and formula, have saved us much trouble, and himself much mortification in correcting errors. Some fatality however, appearsto have attached to the communications of Mr. Cushman, and to have rendered numerous errata necessary. We beg leave to apologise to Mr. C., promising to use every effort in our power to prevent a recurrence of such mistakes. The proof of the article in question was read several times, and by different persons, and yet a few errors crept through unobserved.

The valuable notice by Mr. John M. Fessenden, of his new rail and chair, accompanied by cuts, has been treated with apparent neglect, the cause of which was the illness of our engraver, and the impossibility of obtaining the cuts for an earlier number. We trust that Mr. F. will not be discouraged by this circumstance, from contributing his ever welcome notices.

Mr. Shotwell, has likewise been so kind as to furnish us with a quantity of original matter.

Mr. Williams and several other gentlemen, are also entitled to our thanks, for various notices; a repetition of which is respectfully requested.

Mr. Aycrigg, who has furnished us with matter of interest, we hope will continue his valuable assistance. We understand that he has made the investigation of the Steam Engine a matter of much study, and we desire to hear from him upon this point.

In respect to an article entitled "English and American Railroads," we find that we were right in our conjecture, and that they were written by Mr. Klein, the companion of the Chevalier de Gerstner. We are in hopes that an arrangement will be made with this gentleman, to become a regular contributor to our Journal.

We have made it a point particularly to acknowledge our indebtedness to our friends, as it has been an unusual circumstance to receive so many original communications in so short a space of time; and we hope that this promising commencement will not disappoint us and our readers. Our chief aim being to render our Journal as useful as possible, we always wish to see in its pages a large portion of original matter from members of the profession—conceiving that by this means, we are not only contributing to the diffusion of really valuable matter, but also bring about a better acquaintance between Engineers themselves.

In conducting a public Journal of any kind, it appears impossible to avoid controversy, and in fact, we are not opposed to a fair and critical examination of various topics; the constant fear however, is, that these things may be carried to excess. We wish it to be distinctly understood, that we do not admit articles because we agree with the writers in any respect, and we therefore disclaim any idea of the adoption on our part, of the opinions of any or all of our contributors, unless so expressed. It is to be desired, that when gentlemen feel themselves called upon to dispute the opinions of others, it may be done in the manner least calculated to wound the feelings, and best adapted to bring about a fair understanding. We have had in the present volume, but three cases of controversy, two of which originated in matter previously published, and therefore may be considered as a discussion growing out of the subject. The third case, however, was originally commenced as a criticism, in our pages. We hope that this matter settled, that gentlemen who have taken part in it, may be induced to furnish us with something of another character.

We are well convinced that the value of the Journal will be greatly increased by the mutual exchange of opinion through its pages, and we repeat it, that the best results to the profession will grow out of the increasing contribution of Engineers, each one chosing that topic for the consideration of which, he has had the best opportunity.

We consider that one feature in the past volume is a good one—having curtailed our subscription list, by cutting off nearly all our non-paying subscribers, we have endeavored to avoid all dunning notices. We are fully persuaded that this curtailment has enabled us to do more justice to our real friends, and spared them the mortification of reading what was intended for others.

Several arrangements have been made, which will, we hope add to the value of the next volume of the Journal; and we shall spare no pains to make it worthy of the kindness which has hitherto been extended toward us.

For the American Railroad Journal, and Mechanics' Magazine.

EARLE'S METHOD OF PRESERVING TIMBER.

MESSRS. EDITORS.—The above method of curing timber, in spite of the incredulity, and prejudice, and opposing interests of rival processes, begins, we understand, to be very highly accredited. The processes of Kyan and of Bill, (the latter improved by Mr. Renwick) have long been known, and their sufficiency for their purpose well established; and by the addition, now, of this other process of Dr. Earle, we may congratulate the public on having an enlarged choice of the mode, in which every one may, according to his preference, avail himself of an important benefit. But it is of the latter alone, we at present, intend to speak.

The favorable attestations of the learned committee of the Franklin Institute, and of many of the most scientific men of the U. S., as published some time since by Dr. Earle, have not been without their effect on public opinion; and we learn, with increased satisfaction, that the value of his process, has recently been recognized by the honorable Secretary of War, and gentlemen presiding in the several bureaux of his Department. That, as a first step towards the adoption of it into public service, the preparation of a large quantity of timber is now in progress, under the superintendence of the patentee, at the Watervleit arsenal in this State, and that there is just reason to believe that similar patronage will presently be extended to it by our Naval Department also. We find too, in some of the Philadelphia newspapers, that the State Penitentiary, near to that city, requiring extensive renewal of the wooden parts of the cells and central building, is to be repaired, under a decision of the Inspectors, with timber cured by this method. These are very creditable proofs of the estimation in which this process is now held by many whose intelligence fits, and whose interest and duty prompt, them to examine and judge capably of it. Nor is it to be regarded as a less honorable testimony of its merit, that it is attracting foreign attention; and especially, that it is likely to be soon employed in the naval architecture of Russia.

But the signal advantages of this process are, that it employs materials of the greatest abundance and cheapness, and of a perfectly inoffensive character. By an improvement too, very recently adopted by Dr. Earle, in his mode of conducting the process, the cost of the apparatus is greatly reduced, and its construction so improved in simplicity, and the freeness of its parts, as to be easily transportable to, and employed in, any situation in which it can be required. It is capable of being accommodated to operations of any magnitude; from the smallest to the greatest; and the terms on which the right of using this process are granted by the patentee are, as our inquiries inform us, of the most liberal kind.

With such a mode of giving durability to the blocks, how desirable does it become that our city should enjoy the comforts and advantages of wooden pavements;—especially that our Halls of Justice and our Temples of worship, should be freed from the disturbing noise of passing vehicles, at those hours when peace and quietness are most desirable. We confess it has been one of our chief objects in attempting this favorable, but, we believe, just view of Dr. Earle's process, to bring it precisely before our city authorities, and induce them to move in a matter at once so practicable, so desirable, and withal so reasonable.

By giving currency to the above through one of the pages of your valuable Journal, you may, perhaps, do acceptable service to many; and will oblige one of your subscribers, and

A Friend to Improvement.

New York, June 5th, 1840.

To the Editors of the American Railroad Journal, and Mechanics' Magazine.

Gentlemen.—I find by the editorial remarks in your last number, that my explanation of the comments upon Professor Renwick's account of American Steam vessels, and the accompanying table, have not proved satisfactory, as my last communication is preceeded and followed by remarks of your own, the authorship of which I do not question, in which some of your former objections are repeated and amplified. The table in my first letter appears now to be the principal part objected to, and this because the power of the engines is not properly estimated. The dimensions of the cylinders are given, however, and every engineer and editor is, or ought to be, able to elucidate the power of the engines, if they are properly proportioned in other parts, and they are permitted to assume any pressure, of steam they choose, as they certainly would be in this case. The table was compiled with a view to show the *actual consumption* of fuel by the different engines *named while working at the usual rates;* but I shall be pleased to see it amended by yourselves or "an Engineer" and the power of all the engines calculated by the same rule, whatever that may be.

But for better understanding the subject let us examine it a little more in detail. The Rochester had one cylinder of 43 inches diameter, and 10 feet stroke; the Liverpool two cylinders of 75 inches diamater each, and stroke of 7 feet each. The Rochester was worked 26 strokes per minute, with steam at a pressure of from 20 to 40 lbs, per square inch, and the cylinder filled about $\frac{1}{8}$ of its length at each half stroke. To do this requires about 655 cubic feet of steam per minute.

The Liverpool was worked 16 strokes per minute, with steam at a pressure of $3\frac{1}{2}$ to 4 lbs per square inch, and each cylinder filled $\frac{3}{4}$ of its length at each half stroke, which required about 10300 cubic feet of steam per minute. To produce this large bulk of steam at that low pressure, requires more than twice the amount of caloric that is required to produce 655 feet at even

40 lbs per inch; and yet the amount of fuel consumed, per hour, on board the Rochester, was greater than on board the Liverpool, in the proportion of 5 to 4. But I did not question the correctness of the plans, or proportions, or workmanship of the American engines, nor say any thing which can be construed into a doubt that they *may be* worked economically. I simply set down the results of the *practice which is followed*—nor have I ever expressed a doubt "that of two boats precisely equal in all respects, the one obtaining the highest possible speed, will burn more fuel in travelling a given distance than one travelling at a certain rate beneath that of the first." Or the case may be more clearly stated thus:—the higher the pressure of steam, the greater the expenditure of fuel in procuring a given amount of power. This is an incontrovertible fact, proved by experience; and I am happy to find distinctly admitted by yourselves—but by what means this *fact* is to be reconciled with the *opinion* afterwards expressed, that "the greatest economy" is "to be derived from the use of steam of high pressure, the limit of course to be dependant upon the strength of the boiler," I do not exactly see.

Whether I understand the phrase "the mere pressure of steam," correctly I shall leave your readers to decide. But a "mere verbal criticism" will not prove either the correctness or incorrectness of the opinions expressed by Doctor Renwick, nor the most minute grammatical accuracy in the language used in discussing them, render a practice in conformity with his theory economical, or divest it of danger.

I am your obedient servant,

JOHN D. WARD.

Novelty Works, 4th June, 1840.

For the American Railroad Journal and Mechanics' Magazine.

SWISS CURE FOR BLISTERED FEET.

Having frequently experienced the inconvenience of blisters, and tried several remedies that nearly alleviated the pain; I was much pleased with the immediate and permanent relief experienced from the prescription of my guide when travelling among the Swiss mountains in the fall of 1837.

The preparation being very simple, and the materials procurable, at any farm house, I value the information very highly, and therefore think that I can hardly offer a more acceptable little present to my professional brethren.

Take the albumen or whites of two eggs, mix them with an equal quantity of whiskey or brandy. Pour the half into each shoe. Wet the inside thoroughly, and then put the feet into the liquid, so that the thick woolen stockings may be saturated, over the entire surface of the feet. Leave the stockings on till the cure is complete.

The liquor used in my own case was kirchenwasser, but any strong alcoholic liquor, will doubtless answer the same purpose.

The immediate effect of the application is to reduce the pain by the stimulus of the alcohol joined with the cold produced by the evaporation from the surface of the leather, but the principal cause of the cure is mechanical; for I found, on removing the stockings, that they were closely glued to the feet, and thus, in place of rubbing off the blisters after they had been raised, the stockings alone received the friction of the shoe, and furnished a perfect protection to the natural skin.

Those who have never tried a similar expedient, will be astonished, as I was, at the efficacy of the cure; for after my feet were covered with blisters, I found no need to reduce our usual rate of 8 to 10 French leagues per day, but accomplished within three days, between 60 and 70 miles, on the route from the "Lake of the Four Cantons," to the Hospice, at the summit of the St. Gothard road, thence to the "Spital," thence among stones, rocks, and snow, over one of the highest passes among the Alps, to the source of the Rhone, and traversed the glacier of the Rhone; during this route ascended and descended between three and four miles in perpendicular height, frequently running down the steep side of the mountain in order to relieve the constant strain on the muscles of the thighs, and thus throwing a greater labor on the feet, and still, at the end of the time found the blisters entirely healed.

I found no need of making a second application of the mixture, during this excursion, of more than three weeks constant travelling of the severest description, since my feet had become seasoned, while, if I had stopped, I should not only have lost the time, which could ill have been spared when winter was fast approaching; but the difficulty would probably have been renewed when I recommenced, as I should have lost the benefit of the previous exercise.

When blisters are anticipated I should apply the mixture and glue the stockings to the feet before the difficuly occurs.

The cure would, at times, evidently be of great utility, in the army.

In a long row, on a sudden emergency, I presume that the hands might be protected in the same manner.

The same principle is applied to the harness of a horse; since the most effectual sweat collar, is a piece of cloth made to fit closely to the neck, tied together where it meets on the crest, and then fastened to the saddle and girth, so as to fit as tightly as the skin. This receiving all the friction of the drawing collar, leaves the skin meerly to bear the pressure.

B. Aycrigg.

We publish with pleasure the following interesting communication, from T. P. Holcomb, Esq., and trust that our neighbors in Connecticut, will examine the suggestions of Mr. H. We should suppose the dense population along the line of the Farmington canal with the agricultural and manufactured productions of that region sufficient, to pay legal interest on a railway communication, that should cost $175,000.

In the commencement of our Journal, we took ground, of the superiority of railways over canals. On the 15th Nov. last, No. 10, vol. III, New Series, we admitted a communication "Railways destined to supercede Canals" from a gentleman who has contributed largely to dispel the errors and prejudices which have been entertained, even by the profession, against railways. It appears that this communication, with those of subsequent date, to wit, in No. 7, vol. IV. "Railroads and Canals," has produced us the valuable communication from Mr. Holcomb.

It is from the frank discussion of this subject, that light, and a favorable impression can be made on the mind. Had the views of the gentleman alluded to, met the candid consideration of our Canal Board, we should have saved millions on millions, now squandering on the enlargement of the Erie Canal. Railroads would have been built, on the lines of the Chicago, the Black River and Genessee Valley canals, at $\frac{1}{4}$ to $\frac{1}{3}$ the cost of the works, that can only be used $\frac{2}{3}$ of the year in the high latitudes of this State.

For the American Railroad Journal and Mechanics' Magazine.

ENGINEER'S CAMP, CENTRAL RAILROAD OF GEORGIA, April 30th, 1840.

TO THE STOCKHOLDERS OF THE FARMINGTON, AND HAMPSHIRE, AND HAMPDEN CANALS.

GENTLEMEN—I saw in the Railroad Journal, the other day, an observation to this effect, that the Hartford and New Haven railroad having been finished, the Farmington canal might be considered, as having made its last dying struggle: and although my predilections have ever been much in favor of that work, I am forced to the same conclusion.

I look back upon the Farmington canal, as to a first love, for it was there that my first practical lessons in engineering were taken; it was there that I commenced laying in the stores of experience, which have since been of much service to me. There is nothing surprising then, though engaged in a section of the country, distant from that, if I still send a thought after that enterprise.

The New Haven and Northampton canal is in length, I think, about eighty miles; besides feeders, navigable and otherwise; making the total length, nearly or quite, one hundred miles.

This was no ordinary undertaking; for every one must be aware, that to push a canal through any part of New England, for that distance, many serious obstacles would have to be encountered and overcome: yet, by the energy of its projector, the late Honorable James Hillhouse, and others, it was urged forward to completion. But the buoyant hopes and sanguine expectations, that had thus far attended the work, were doomed to disappointment; notwithstanding the great Clinton had said, that it would be to New Haven, what the Erie canal is to Albany; and to New England generally, what that canal is to the State of New York, it being at one time contemplated to extend the Farmington canal to the Canada line.

It was found, though too late, that in the Connecticut river, it had a formidable rival: for although the cost of transportation by the river was somewhat greater—the certainty of arrival was also greater; and certainty is one of the features of commerce, for which people will pay liberally.

The uncertainty by the canal, has been owing to two causes—the extremely sandy nature of the country through which a part of the canal passes, and the consequent liability to breaks—and on some of the levels a scarcity of water; evils which even the great skill of the resident Engineer, with the scanty means at his control, has not been able to remove. How nobly the citizens of New Haven have come forward, when accidents have occurred, I need not mention. Such enterprise as theirs, if directed in the right channel, must be crowned with success; and the object of this communication, is to incline it in that direction; for if I mistake not, in addressing the stockholders of the New Haven and Northampton canal, I address many of those citizens. My object is to point out how the canal can be turned from a heavy tax to a *certain means of profit.* And how is that to be done, do you ask? I reply, that it is to be done, by draining it of its useless waters, and laying down a *railroad* upon its bottom; and this I shall endeavor to prove to the satisfaction of all. It is true, writing at this distance, and without any conveniences for reference, at hand, I labor under many difficulties, but I think notwithstanding, that I shall be able to make my position good.

Of the capabilities, and general utility of railroads over canals, I trust little need be said. Instances are too frequent of their complete triumph, when the latter have been as complete failures, to require much comment. I will instance the Camden and Amboy railroad, not as an isolated case, for there are many of them, for wherever railroads are found, laboring under no *restrictions,* and unconnected with *state management,* they are found to bear off the palm.

And what does the Camden and Amboy railroad exhibit? It exhibits an instance of a railroad, which cost two and a quarter millions of dollars, having paid for itself in seven years, notwithstanding one of the finest canals in the United States, runs parallel to it, in dimensions the same as the enlarged dimensions of the Erie canal, admitting the passage of steamboats and schooners: which canal has languished for want of patronage—having paid to the stockholders the fraction of one per cent. per annum. I allude to the Deleware and Raritan canal. Yes, here is an instance of a canal on a route where the business is immense, that is but just able to keep itself in repair; while a railroad upon the same route, has paid at the rate of eleven per cent. per annum, upon the investment.

I notice in the papers that the railroad is carrying flour from Philadelphia to New York, at twenty-five cents per barrel, notwithstanding the facilities offered by the canal, and also by the Delaware river, and thence coast-wise.

The Schuylkill canal might be instanced, the stock as I see, having fallen, on the mere anticipation of the completion of the Philadelphia and Reading railroad, from three hundred and sixty dollars ($360 00) per share of $100 00, to one hundred and sixty dollars ($160 00). The Blackstone canal from Worcester to Providence, it is well known, is a complete failure; but, for the success of the railroad leading from the same point, (the Worcester and Boston) in somewhat different direction, it is true,—I would refer you to the report of the directors. This is the conclusion that I arrive at; that the failure of a canal connecting two points, is no evidence that a railroad would not succeed. Nor need it be thought surprising that one flourishes where the other languishes. In these days of "*going ahead*," speed and certainty take precedence of every thing else.

The next inquiry proper to be made, is in relation to the inducements held out for a railroad from New Haven to Northampton. I have no means of learning the amount of business likely to offer from those towns through which the railroad would pass, or from the valley of the Connecticut river above Northampton. The amount is certainly large, most of which at present finds an outlet by the Connecticut, and the New Haven and Hartford railroad; and in so doing, much of it of course, crosses the canal. Is it for a moment to be supposed, that if instead of the tardiness and uncertainty of a canal, the speed and certainty of a railroad were to be substituted, this would continue. The average distance between the canal and the river is about 10 miles; this is a narrow strip of country, but it abounds in agricultural and manufacturing wealth. As far up as Hartford, the Hartford and New Haven railroad would divide the business of this strip, but from that point the proposed railroad would sweep the very banks of the river, and be without a rival on the right or on the left. If the Hartford and New Haven railroad can successfully compete with the steamboat route to Hartford, and who doubts it? What may we expect of a railroad above that point where the navigation is obstructed by rapids, and where only the very smallest class of steamboats can be used? The proposed improvement would cross at Westfield the Massachusetts Western railroad, thus opening a route, and who will not say a desirable one, having as it would but a few hours of steamboat travel, (that is to say, from New York to New Haven) from New York to Springfield, Worcester, and Boston, and also to Albany. The many pleasant towns and villages which would attract the notice of the traveller for pleasure,—from among which I will mention Farmington, Westfield, and Northampton, are well known; or, wending his way on towards Albany, he might feast his eyes on the wild grapes of the Pontoosuc. I cannot perceive that there would be any clashing of interests whatever, between such a railroad and the Western railroad, crossing as they would, at right angles. On the contrary, they would furnish business for each other.

It now remains to show the practicability at a small expense, of making a railroad on the site of the canal. First then, drain it effectually, by running ditches along the sides just at the foot of the inner slopes. Let the outer slopes of these ditches be continuations of the inner slopes of the canal—let the ditches be, say four (4) feet wide at top, and one (1) deep. The slopes of the canal are 1 foot perpendicular, to $1\frac{1}{2}$ horizontal; preserving the same slopes for the ditches, their bottom width would be one foot. The bottom width of the canal is twenty (20) feet,—the ditches occupying four (4) feet on each side, still leaves sufficient width for the railroad between them. The earth obtained from the ditches, would be sufficient to raise this space six inches, which would leave a dry solid roadway, one foot six inches, above the bottom of the ditches, ready to receive the superstructure. In a few instances the canal is "below bottom;" that is, in crossing ravines, a single bank was sometimes thrown off, forming the towingpath—the water being allowed to spread itself the whole length of the ravine. In such cases a culvert would be necessary, to drain off the water, and the towing-path would require to be leveled down to form the roadway. When a number of locks occur together it would probably be necessary to change the location for a short distance: there may be some five or six instances where this would require to be done; in all other cases the elevation could be overcome without leaving the line of the canal, and at a very trifling expense; where they occur singly, which is frequently the case, the elevation would be overcome by a plane =1056 feet long, on an inclination of fifty feet (50) to the mile. Wherever they are 1056 feet apart, the elevation would be overcome with the same ease. By adopting such grades as those on the summit division of the Western Railroad—79.9 feet per mile, the line of the canal need be departed from, in not more than one or two instances. At Granby for instance, there are six locks; the elevation overcome is, I think, thirty-six (36) feet, and the distance from the lower to the upper one, is half a mile, which brought to a plane, gives an inclination of 72 feet per mile. The planes at the locks where they occur singly, to bring them to a grade of 50 feet to the mile, would each require about (2000) two thousand cubic yards of earth to be moved, in cutting and filling which, at 10 cents per yard, gives ($200 00) two hundred dollars. But I will suppose the obstacle presented by each lock to cost in its removal ($1000 00) one thousand dollars. The whole number of locks is about sixty (60). We have then the sum of $60,000 sixty thousand dollars for this item. I will state in this place that there is one level on the canal twenty-eight miles long. The ditches give for the 80 miles, 78,160 cubic yds. of earth, at 6 cents per yd. gives ($4689 $\frac{60}{100}$) four thousand six hundred and eighty nine dollars and sixty cents. Levelling down the towing path at certrin places, I will estimate at ($500 00) five hundred, dollars per mile. The superstructure for a single track, may be safely estimated at ($5000 00) five thousand dollars per mile.

RECAPITULATION.

Planes at 60 locks.	$60,000 00
78,160 cub. yds. of earth in ditches, *a* 6c. . .	4,689 60
Leveling down towing-path at certain places, *a* $500 00 per mile, ...	40,000 00

Superstructure, ...	*a* $5,000	400,000 00
Total, ...		$504,689 60
Average per mile, . . .		$6,308, 62

Thus you have a railroad, for the last mentioned sum per mile, equally as good, as one, which, were it graded for the express purpose, would cost ($15,000) fifteen thousand dollars per mile. It is true there are many short curves in the canal, but it need only be borne in mind, that these curves will occur on *level grade*, and the difficulty vanishes. I think there are few of less radius than 400 feet curves, which are frequently to be found on railroads combined with steep grades. On a railroad in Pennsylvania, there are curves of 240 feet radius. Some of you may apprehend danger to such an enterprize, from the competition of other roads, either built or contemplated; but allow me to present you with this view of the case. The Hartford and New Haven railroad was estimated to cost about $800,000 00. It has probably cost fully that sum. Suppose it extended to Springfield, or even to Northampton, at the rate of ($15,000 00) fifteen thousand dollars for a single track a low estimate, and we have the sum of ($1,460,000 00) one million four hundred and sixty thousand dollars as the cost of a railroad from New Haven to Northampton, by the way of Hartford, or an average sum per mile of ($18,250 00) eighteen thousand two hundred and fifty dollars, besides having the disadvantage of not being a continuous line. It is true the Hartford and New Haven railroad is graded for a double track.

I now ask, can you have any thing to fear from a railroad which would cost nearly three times as much as yours? I may safely say nothing. Once having reached Northampton, the valley of the Connecticut is before you to invite your enterprize.

The estimate of cost which I have made is necessarily quite a rough one, but I am satisfied it cannot vary much from the truth. Locomotive power &c., have been excluded as being in this communication unnecessary.

I will here add, that the aqueducts, which might be used as viaducts—and culverts, on the canal, are of the most permanent and substantial kind.

If this communication shall be so fortunate as to awaken inquiry on the subject, I shall feel that it has not been made in vain; for I am satisfied that, the project needs but be fairly investigated, to be carried into operation.

The stock in the canal is worth so nearly nothing in the market, that I have not set down any thing, under that head, to the cost of the railroad. Its full value in the present state of the canal, might, I suspect, be added without affecting the result.

Yours, respectfully,

F. P. Holcomb, *Civil Engineer.*

We cheerfully insert the following communication from Mr. Levi Williams, and beg leave to state that he has altogether misunderstood the character of our remark appended to his article. It should be borne in mind by our subscribers and friends, that their communications have to travel some distance, to reach us, that in the next place we are obliged to have the matter for any one number on hand, at least two weeks before the date of publication, and in this way it frequently happens that a communication is not seen until it is too late to be answered in the next number, and several numbers intervene before replies can be made.

In this case, by some accident, for the numbers have always been regularly issued on the day of publication, Mr. W. had not received his numbers of Feb. 15th, nor March 15th, in the former of which we pointed out the error alluded to, and in the latter the writer explains himself. Our note was appended to the article of Mr. Williams with the intention of reminding our readers, that the mistake had been corrected, and of course, without any knowledge on the part of Mr. Williams, as he would not have undertaken to point out errors before noticed. We did not particularize, as we had supposed that the order of the papers would speak for themselves, but the misapprehension arose from the non-receipt of the numbers in question. Our intention was to point out the fact of the existence of the previous correction with the very view of intimating Mr. W.'s ignorance of its existence; we were misunderstood, and exceedingly regret having pained that gentleman for one instant. We feel satisfied that this explanation is sufficient to remove from the mind of every man, any error occasioned by our remark.

For the American Railroad Journal, and Mechanics' Magazine.

Messrs. Editors.—I have just received your Journal dated April 1, 1840, in which is published my communication in regard to "Railway Constants," etc., which was forwarded to you about the 8th or 9th of March last.

By an editorial remark, at the conclusion of my communication, I perceive that the errors which I had therein pointed out, as contained in certain criticisms upon the works of Dr. Lardner and Mr. Wood, published in a former number, were corrected in the Journal of the 15th March. As the Journal of that date, and also of the 15th of April have not been received, of course, I cannot at present speak concerning anything upon this subject which was contained in the former, or may possibly be contained in the latter; for even the causes which produced the failure in the receipt of those two numbers, and the delay attending the one just received, are at present obscured. As the editorial remark, by accident, I presume, omits any reference to dates, you will readily perceive that the subject is left open for readers to infer that I had undertaken to correct errors that already stood corrected before the public. Presuming that you had no intention to give any coloring of that kind to the subject, I trust that you will have the goodness to insert this note in the next number of the Journal, and forward me the two missing numbers to Palmyra, Wayne Co., as soon after the receipt of this, as you conveniently can.

Yours, respectfully,

April 27th, 1840. L. Williams.

COMMENCEMENT OF THE IMPROVEMENT OF THE WELLAND CANAL, AND CONTEST FOR THE WESTERN TRADE BY BRITISH TONNAGE.

We are reminded by the following, which we take from the Kingston Chronicle of the 27th of May, of the importance of an enlarged communication from Lake Ontario to the Hudson. If we recollect, such are the advantages, of natural waters by the Oswego river and Lake Oneida to Wood Creek, 58 miles, that there would only be about 100 miles of canal to make, from that point of the river to the Hudson. The estimated expense for a canal to Utica, by this route 9 feet deep, 90 feet wide, with locks 30 feet wide by 130 feet long, was about $1,300 000,--it was calculated, and with more certainty than the enlargement of the Erie canal, that a separate canal of the same dimensions, could have been constructed along the north side of the Mohawk for six millions of dollars.

Time will test which was the best project for the State of New York, to retain the Western trade. The contest hereafter, will be to take it from lake Ontario and the outlet of that lake—the St. Lawrence.

The saving of about 150 miles of toll on the Erie canal, and the well known fact, that the extension of a voyage three or four days adds but little to the freight which has been overlooked in a desire to prevent "*the Western trade being let down into lake Ontario*,"—and that it would take the St. Lawrence.

COMMENCEMENT OF OUR PUBLIC IMPROVEMENTS.—WELLAND CANAL.

It is with sincere pleasure we find the following announcement in the Montreal Gazette of the 21st inst. The speedy enlargement of the Welland Canal, is a matter of vast importance, and when the corresponding improvements from Prescot to Montreal are effected, the St. Lawrence will not only compete with the Hudson river, but with the Mississippi, for the commerce of the Great West.

The immediate commencement of the Welland canal, is at present of importance in another point of view, namely, as affording prompt employment for the more destitute portion of the numerous emigrants now daily arriving at Quebec.

"We are happy to learn that His Excellency the Governor General has assented to the immediate commencement of the permanent work on the Welland canal. The dimensions of the locks are not decided on, but nothing less than twenty-four feet width, by one hundred and ten feet in length, has been proposed. A liberal sum has been authorized to procure materials, and the work will be prosecuted with vigor.

The importance of this undertaking is now generally acknowledged, and we understand the increase of business this year far exceeds the past, up to the same period. As this is the point where the contest between the two great rivals, the St. Lawrence and the Hudson rivers, will commence, for the commerce of Lake Erie, no time should be lost in finishing this work. *It will, in a measure, counteract the effects which the enlarge-*

ment of the Erie canal would otherwise produce, and may retard the commencement of the canal around the Falls of Niagara, which the Legislature of the State of New York, during the last session, authorized the General Government to construct, by ceding the lands necessary for that purpose."

PROGRESS OF INTERNAL IMPROVEMENT.—It gives us pleasure to state, that the Lehigh company's railroad, of 20 miles in length, which connects the Lehigh canal at White Haven with the North Branch of the Susquehanna at Wilkesbare, is on the eve of being ready for use, Fifteen miles of the road extending from White Haven to Solomon's Gap will be opened for trade early in July next. The remaining distance of five miles will be ready for business in September.

A letter from that quarter states as follows:

"From present prospects nearly all the merchandize, &c., for the Wyoming Valley and the Upper North Branch of the Susquehanna will come up the Lehigh navigation, and pass over the railroad this fall."

Another letter says—"A great many of the North Branch lumbermen are anxiously inquiring about the completion of the Lehigh and Susquehanna railroad. They express a strong desire to have it finished, so as to enable them to bring all their *choice* lumber this way."

We learn that the lumber from the great and newly opened timber region of the Upper Lehigh has begun to descend the navigation in boats, &c., in considerable quantities, and that a large and regular business in that line will continue to be done.—*North American.*

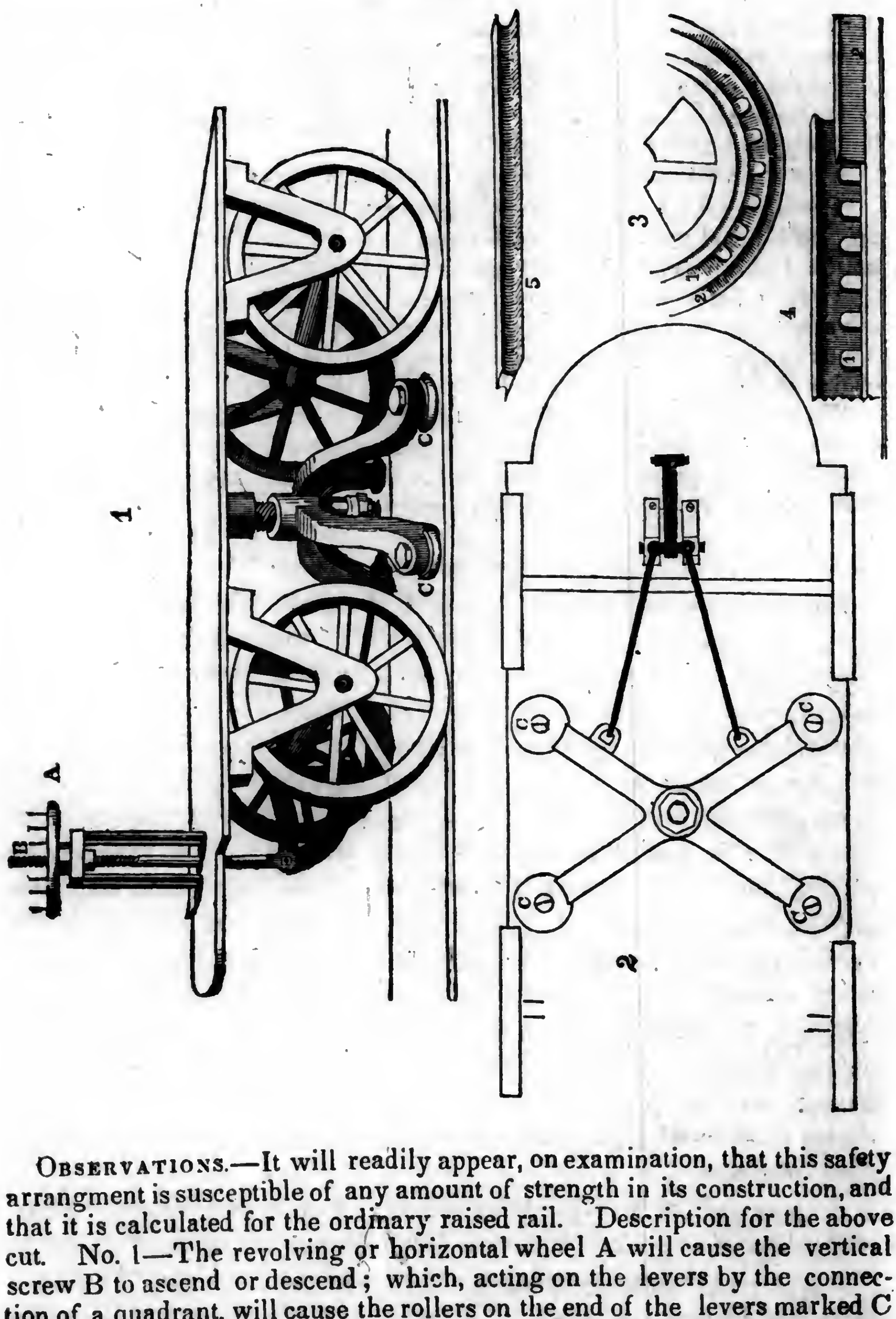
THE NEW SAFETY BREAK.

There is no community on the face of the globe, that has a greater interest in the subject of railroad communication, than our own. The rapid interchanges of commerce, pleasure and friendship, among a people so intimately related as are the citizens of the States and Territories of the Union, but especially the great breadth and extent of our dominions, make this subject one of vital consequence and urge us to the careful scrutiny in selecting the means by which this peculiar method of inter-communication may be most wisely extended and secured. From the variety of regions, into which our country is divided and the depressions and elevations of surface necessarily existing through so great an extent of territory, railroad travel is attended with difficulties which it might not be required to encounter in a country differently constituted. The contrivance, therefore, by which ascents or descents are safely made with cars or locomotives, becomes one of leading importance. The one in present use, it must be admitted by all, is incompetent to perform many of the duties required of it, and the way is clearly open for the introduction of any efficient substitute.

Such an one, without prejudice or bias, is found, we think, in "*King's Safety Break*," recently patented; and unless some substantial objection (for none such has as yet been advanced) can be discovered, we look for its speedy employment on the chief railways of the country. If its character be that which is claimed for it, it must be evident that such roads as are furnished with this Break would enjoy a great advantage over others, employing the ordinary Break, and in the upshot, succeed in diverting travel from such routes as are unprovided with the new contrivance.

We give below, the circular and drawings of the patentee, which explain the leading features of his invention.

PUBLIC SECURITY.



OBSERVATIONS.—It will readily appear, on examination, that this safety arrangment is susceptible of any amount of strength in its construction, and that it is calculated for the ordinary raised rail. Description for the above cut. No. 1—The revolving or horizontal wheel A will cause the vertical screw B to ascend or descend; which, acting on the levers by the connection of a quadrant, will cause the rollers on the end of the levers marked C to approach or recede from the inner sides of the rails, as may be desired. The cut marked No. 2, letters C C C C, represent the angles of the levers and their connection. Numbers 3 and 4 are each numbered 1 and 2, the number 1 showing the cog arrangement for ascents in the wheel and rail —number 2 showing an additonal tread on the wheel and the line of rail on which it would engage. This arrangement is simple, although very peculiar, and is fully explained in my specification. A few words in anticipation of an objection that might possible present itself. It is this: that the rails would be liable to be moved when the power is applied. Such apprehension is groundless (from the fact the adhesive power is all that is brought in action) as much as the opinion that existed in the infancy of railroads, that the adhesion of the wheels on the rails would be so trifling that cogs would be necessary for a level road. Number 5 is a section of the ordinary rail. This improvement is believed to be valuable on three accounts: First, by its negative use, an engine or car could not be run off the rails: Second, its immense power as a safety brake to prevent accidents, collisions, &c.: Third, descents of any grade can positively be travelled at any given speed desired, with absolute control and security, independent of stationary engines, ropes, &c. Also, it is believed that this appliance, in connection with the cog arrangement for ascents, would abrogate the stationary engine as unnecessary. It may be observed that a calculation is made for raising the levers when necessary; and should it be desirable, it can be so planed as to raise and lower them when required, by the same operation that causes their original action. This extraordinary power is graduating and accommodating, and in its operation will suit itself to any and every possible contingency; also, it is so easy and ready in its action, that a boy could manage and control it. A working model can be seen by all interested.

Patent.—Dated May 8th, 1840.

Respectfully submitted,

MATTHEW W. KING, *New York.*

We recommend Engineers and railroad proprietors, (and the public too, who have an interest quite as deep, in this matter) to examine the model, at the Mechanics' Institute in this city.

The Monthly Chronicle for May, which is just published, contains a very interesting article on the railroads of Belgium. We extract from it the following:

RAILROADS OF BELGIUM.

In this prodigious movement of nearly seven millions of persons transported in a period of four years, if there were no other advantage than the more easy and complete amalgamation of all parts of the country, and the exchange of ideas which results from the contact of men with one another, this alone would be an excellent result, political and moral; but the economy of time, the developement of industry, the facilities for bussiness which such a circulation must promote, cannot be estimated in figures. Belgium already reaps the fruits of it.

The Belgian Government had reduced its tariffs to an excessive extreme. It has since been found indispensable to raise them, and the result has been fovorable.

In Sept. 1838, the same number of sections were in operation as in 1839; the mean price received, and the total produce, at these two epochs, were as follows:

	Mean price paid by each passenger.		Total produce.	
In September, 1838,	1 fr.	43 c.	412,542 fr.	28 c.
" 1839,	2	6	461,339	31

This change had become urgent, for without it the productiveness of railroads would have been left in doubt. The following table will show the effect of it.

	Receipts.		Expenses.		Nett produce.	
1835, 8 months,	268,997 fr.	50 c.	168,772 fr.	73 c.	100,224 fr.	77 c.
1836,	835,132	85	431,135	67	403,997	18
1837,	1,416,982	94	1,189,988	62	226,994	32
1838,	3,097,833	40	2,733,167	93	364,665	47
1839, 9 months,	3,140,999	99	1,899,006	52	1,241,993	47
	8,759,946 fr.	68 c.	6,422,071 fr.	47 c.	2,337,875 fr.	21 c.

The new tariff was established by royal decree, on the third of February 1839, and we see that the net produce of the first nine months of this year is alone greater than the total net produce of the three years and eight months that preceded it. On account of the increase of revenue which results from the raising of the tariff and from the transporting of merchandize, the Belgian railroads become a means of profitable speculation, especially a speculation made by the State, under the particular circumstances. The former tariff was ruinous.

It should be observed that the working of the line from Brussels to Antwerp, the only one in operation in 1839, gave a greater net profit tha nof the year 1838, when ten sections were put in operation.

This result shows that all the routes for the Belgian railroads are not equally well adapted; that there are several of them that do not clear the expenses of operating them; and that they ought not to have been undertaken, if it were not necessary to satisfy local exigencies.

The transportation of merchandize was commenced in 1838. Before this time only baggage was transported, and it was not until 1839 that it reached an amount of much importance. The following table will show the progress of this branch of transportation :

	Produce of the baggage.		Produce of merchandize.	
1837,	16,994 fr.	36 c.		
1838,	103,421	39	58,594 fr.	28 c.
1839, in 10 months,	112,768	46	351,754	90

The increase of the receipts on merchandize is more remarkable still, if we follow it, month by month, in the course of that year.

January,	7,713 fr.		June,	37,998 fr.	
February,	7,159	50 c.	July,	48,564	
March,	6,277	50	August,	64,272	70 c.
April,	13,097		September,	67,584	
May,	24,291	50	October,	74,790	70

And the minister declares that the supply of 400 wagons for merchandize is far from being sufficient for all their wants.

The report of the minister states a remarkable fact, and one at variance with the anticipations of most persons. It was supposed that this new mode of transport, introduced to the extent now practiced in Belgium, would destroy the old, and that the use of horses and ordinary carriages would be superseded. Such is not the fact. On the contrary, while railroads have been, in succession, extending themselves over the whole of the soil of Belgium, the produce of the tolls on the ordinary roads, instead of diminishing, has progressively increased. In proof of this the following statement of the produce of the tolls is given.

1831,	2,390,882 fr.	1836,	2,447,985 fr.
1832,	2,195,343	1837,	2,584,791
1833,	2,360,464	1838,	2,759,548
1834,	2,415,769	1839, 10 months,	2,749,301
1835,	2,385,430		

Mr. Nothomb makes a comparison of the advantages to the public, in time and money, between the old mode of travelling by diligences, and the rate of travelling under the new tariff, which went into operation in 1839. The average result is a saving of *half the time*, and of 33 per cent. in the price.

The saving in price is thus subdivided: in diligences 15 per cent.; chars-a-bancs 30 per cent.; wagons 60 per cent. It is the lower class who profit most by the establishment of railroads. Teey not only find the means of transport, which were almost denied them before, but they find the means of labor increased. It is officially stated in this report, that the building of the railroads of Belgium has produced the result of increasiag the produce of all the indirect taxes, and has enabled the state to alleviate the effect of the late manufacturing crisis, by affording it the means of giving orders upon the principal manufactories of the country, for future wants.

THE UNITED STATES STEAMER.

This vessel is admitted by all who have inspected her to be beautifully modelled. Her frame throughout is of the choicest British "heart of oak." Her timbers, from her kelson to her bilges, are laid close together, and interially caulked, so that her bottom to that extent, would be water tight, even if her planks were removed. Her garboard stroke (of 8 inch plank) is bolted together through and throughout her kelson. Her flooring timbers are all cogged, or dowelled together, and further secured by strong rods of iron driven through them, fore and aft. Her bottom planks are of American elm; and such is the joint thickness of these and the timbers, that they form a solid mass of 18 inches in thickness. Her sides are proportionately strong, and so bound together, that it would seem impossible that she could be at all shaken by any casualty at sea. Her bends are of African oak; her upper planks of English oak and fine red pine, which last is, between wind and water, equal in durability to any other timber. Her sider are strengthened by bands or strips of iron, of 5 inches in breadth and $\frac{3}{4}$ inch thick, counter-sunk diagonally into the timbers, and bolted through them, those forward inclining towards the stern, and those aft towards the bow. Over these are diagonal wooden riders of English oak, each 9 inches by 6 inches in thickness, also bolted through, so that both form counteracting stays, or binders, giving the vessel extraordimary strength. Her clamps are all screw bolted through the sides; the fore and aft beams of the boiler hatch are of iron, and interiorly she is fairly studded with the ends of the screw bolts from her sides. The hold presents a magnificent specimen of the magnitude and perfection to which naval architecture has attained. The frame work of the engines is an exceedingly massy piece of carpentry—composed of immense beams of African oak. The thickness of these, from the flooring, is no less than three feet.

The United States will be rigged with fore-topmast and top-gallant-mast. Under the taffrail are the arms of England on one side, and those of America on the other. The following are her dimensions:

Length from stem to stern, - - - -	235 feet
" of keel, - - - - - - -	215 feet
Breadth across the centre, - - - -	60 feet
Depth of hold, - - - - - -	38 feet 6 inches
Height between decks, - - - - -	7 feet 6 inches
Length of each saloon, fore and aft, - -	70 feet
Breadth " " " - -	42 feet
Burden, besides her coals, - - - - -	800 tons
Total admeasurement, - - - - -	1400 tons
Engines, - - - - - - - -	420 horse power.

We have been thus particular in order to give a slight idea of these truly "gems of the sea." In short, when we say that nothing that art can invent or labor and perseverance accomplish, it will be understood that little is wanting in order to complete the perfection of these "offerings of our own times;" upon the construction of which, as a nation, we may justly pride ourselves.

London Surveyor, Engineer, and Architect.

Comparative Statement of Arrivals, Tonnage and Passengers at the Port of Quebec, to the 23rd May inclusive, for the years 1839 *and* 40.

	Vessels.	*Tonnage.*	*Passengers.*
1840,	250	90,686	2223
1839,	132	40,135	435
More this year	118	50,551	1788

Office of the Chief Agent for Emigration,
Quebec, 23d May, 1840.

Return of the number of Emigrants arrived at the Port of Quebec during the week ending the 23d instant:

England,	421
Ireland,	2275
Scotland,	143
Lower Ports	0
	2839
Previously reported,	898
	3737
To corresponding period last year,	620
Increase in favour of 1840,	3117

A. C. BUCHANAN, *Chief Agent.*

CAST IRON RAILROAD.—We have thus far delayed making any comments on the cast iron railroad, laid on the Greenwood addition to the Mount Carbon railroad, more than the mere mention of its completion.

This was for the purpose of obtaining the estimates of its cost and other data which we presumed would be of interest to our friends; these have been politely furnisned us by Andrew Russel, Esq. agent for the Greenwood property, and by their aid we lay the follwing facts before the public:

The length of the road from the Mount Carbon road to the Steam Mill, which has been relaid with cast iron rails is 1200 feet, a double track; making 4800 lineal feet or 1600 yards of rail. In this distance there are 9 full turnouts or crossing places, which require 486 lineal feet or 162 yards of rail, exclusive of the plate. The rail is called the *house joice pattern*, and is cast in lengths of six feet; the pattern was first made for 70 lbs. of iron to the yard of rail, but was altered by increasing the size and strength of the flanges to about 80 lbs. to the yard. The quantity of rails used in constructing the whole road, was about 62 tons, they are laid on sills which are 3 feet apart from centre to centre, these being again supported on the graded road by square blocks of stone under the end of each sill, where the rail rests on it. The sills cost 42 cents each, and the cost of laying the road, including grading, of which but little was required, it being laid on the old track, was 80 cents per panel of 3 feet. Cost of putting in each turnout for labor and workmanship $45.

The road has now been in use some weeks, and heavy trains of loaded coal cars have passed over it, and it does not appear to give way in the least, nor has a single rail broken. It is believed by all to be strong enough for any road where horse power alone is used. What effect the frost in the fall may have on it, is yet to be tested.

Taking the foregoing data, as the basis of a calculation, a mile of a railroad laid with these cast iron rails, will cost as follows:

1760 yds., 80 lbs. to a yard, is a fraction over 62 $\frac{8}{10}$ tons, which for double track is 125 $\frac{6}{10}$ tons, costing say, $44 per ton, . . .	$5,400 80
760 panels of 3 feet at 80 cts.	1,508 00
1760 sills at 42 cts.	739 20
3600 lbs., about, of bolts and spikes at 10 cents,	360 00
	$7,008 00
Contingencies, ...	92 00
Cost per mile, ...	$8,000 00

These rails were cast by Mr. William Lyman, at his furnace on the Island; it was originally contemplated to make them at the blast furnace, but as that blew out shortly after the contract was made, Mr. L. erected a small cupola, for the purpose, and made them of Anthracite Iron of his own smelting.

THE NEW YORK AND ALBANY RAILROAD.

The arrival at Boston of a steamer from Liverpool, the first of a line to sail half monthly, has at last aroused the attention of our citizens to the quiet, but vigorous efforts of our enterprising neighbors; who desire to win back a part of the foreign and coasting trade which the ***Packet system*** centered in New York after the completion of the Erie canal.

Our success with canals only stimulated Eastern enterprise. They cast about for a plan to share with us the Western trade. They examined the line for a canal to connect Boston with lakes Champlain and Ontario, and were obliged to abandon it. The complete success of the Liverpool and Manchester railway in transporting large burthens of merchandize, produce, live stock, &c., turned their attention to this new species of improvement. The capital of New England has been directed with profit to railways diverging from Boston. The statesmen and merchants of Massachusetts fixed their eyes on the Western trade entering at the outlet of the Erie and Champlain canals. They resolved to participate in it, by the construction of a *railway* from their *Albany wharf* to our State line at West Stockbridge, and immediately put measures in a train for the accomplishment of the object. Our Legislature, in the spirit of liberality, granted a charter to construct a railway from Albany to West Stockbridge, with authority to the city of Albany to issue their bonds to the extent of $650,000, on the pledge faith of the city, to be used towards the completion of said road.

The citizens of Boston and Massachusetts, with a liberality that certainly deserves thanks of the city of Albany, have cashed these bonds, and have commenced the construction of this important work in this State, under the direction of their own Engineer and Agent, and will no doubt have it finished the ensuing year.

The Editors of the Journal of Commerce, in a very interesting article on this subject, in their paper of the 4th inst. truly say, "It may now be taken for granted that before the winter of 1841-2, there will be a continuous railroad in operation from Boston to Albany, and from thence to Buffalo,—

a distance of over 500 miles (517) in nearly a straight line." They add, "The North river is closed three to four months, and the Erie canal five months in the year. On the completion of the Albany and West Stockbridge railroad to Boston, she will come in with us as a competitor for the Western trade, with or without our consent." They then ask the question, if our property holders will permit Boston "to have the trade *exclusively* for one-third of the year?" There can be but one response to this,—*No.*

The period has arrived when the construction of the New York and Albany railroad, within our own State and jurisdiction, cannot be looked upon by our citizens with indifference, nor can it any longer be scoffed at as a "*visionary project.*" It is a work of the first necessity to the commerce of this city. The surveys and estimates, with the report of Mr. Edwin F. Johnson, Civil Engineer, maps and profiles of the road, have put this question beyond cavil.

The fall of real estate in the first ward, and rents generally in this city may, in part be attributed to the neglect of our best interests. Whilst we have been worshipping the enlargement of the Erie canal, at an expense of not less than thirty millions of dollars, our neighbors have been quietly engaged in constructing the "better improvement of the age,"—railways—to take from us our spring and all our winter business in the article of bread stuffs.

The cost of the New York and Albany railroad is the next question. It can be demonstrated by proposals presented from responsible men, *with adequate security*, that a single track with suitable turnouts, from Harlem river to Greenbush, opposite Albany, (140 71 miles,) can be constructed and put in operation for $2,450,000. This sum tncludes 10 locomotive engines, 40 large double passenger cars, and 100 freight cars, but not the ground, or *right of way*, on which to construct the road.

It has been proposed, for the sum of $2,450,000, to make the road, equal, if not superior, to the Utica and Schenectady, or Utica and Syracuse railroad, both of which are considered good roads.

If it shall be determined to intersect "the Boston and Albany railroad" in Columbia county on the line of the Hudson and Berkshire road, at a point to be agreed on between Ghent and Groats, there will be a saving in the cost, of twenty-five miles of railroad, at the above rate. Provision, it is understood, has been made in the Albany and Stockbridge charter, to secure the use of *the Boston road*, on equitable terms to the New York and Albany railway. It is not pretended that the sum of say $2,000,000 to reach Groat's (115 miles, by recent survey,) can construct as good a superstructure as the Western railway will have. With an increase of say half a million of dollars to add to the weight of the iron and fixtures to receive the T rail, of say sixty tons to the mile, the road may compare with the best roads in the United States. The question naturally arises, whence is the diminished cost of the New York and Albany railroad, compared with the Boston and Worcester, and the same line continued to Springfield, and to our State line at West Stockbridge? The answer is obvious. On a glance at the map it will be perceived, the Western railroad crosses a succession of elevated ridges of land, at right angles, and this too over several summits. The one near Pittsfield is 1440 feet above tide water. The New York and Albany railroad, by a most singular formation of the earth, (arising from four streams, running in contrary directions North and South for 100 miles on the line,) gives the road a succession of Valleys, to pass its summit, in the town of North East, Dutchess County, at the lowest depression which exists over the Alleghany mountains, 769 feet above tide water; with the exception of the pass through the Highlands. This fact also proves that the New York and Albany railroad cannot be competed with by any route from Boston to Charleston, to drain the trade North of the Ohio river, and from the St. Lawrence volley.

The New York and Erie railroad has a summit in Alleghany county of 1780 feet, and a succession of high-lands at right angles with the road. Pennsylvania has a summit of 2397 feet. Maryland, 2754 feet, or a tunnel of 4 miles. Virginia, 2551 feet. South Carolina, 2168 feet. Obstructions from snow, over such elevated ridges, in a given latitude, may be calculated on, nearly in proportion to the ratio of elevations. The comparison of grades and curves on these several lines, is more favorable for the line from New York by Albany to Baffalo. The distance is also less to the Erie, to wit, 464 miles.

Number two, will endeavor to answer the question, "Can the New York and Albany railroad, pay an interest on its cost, with the Hudson river distant 15 to 25 miles, with steamboats running at $1 to $2 exclusive of meals? J. E. B.

PENNSYLVANIA APPROPRIATION BILL.

The appropriation bill reported by Mr. Hegins of Northumberland, contains the following appropriations:

To complete the railway to avoid the inclined plane at Columbia,	$58,000
To purchase locomotives and ropes on the Columbia & Portage railroad,	30,000
Th renew the North track of the Columbia road from the 22d milestone to White Hall,	100,000
To pay debts due for repairs on the Sinnemahoning extension West Branch,	34,124
To pay debts due on the Gettysburg railroad,	150,000
To pay debts due on the Alleghany feeder,	1,100
To pay balance due for doubling locks on the Eastern division of the canal,	7,402
For repairs on the different lines of canals and railroads,	600,000
For new work on finished lines, pay of canal commissioners, &c.	30,000
To pay debts due for motive power and repairs contracted prior to first Febuary 1839,	50,000
To pay damages,	30,000
To the Erie extension,	600,000
To the North Branch do.	600,000
Wisconisco canal,	60,000
	$2,350,626

In addition to the foregoing, the bill proposes an appropriation sufficient to pay the interest falling due on the public debt on the 1st of July next.

Railroad Reports.—The report presented to the proprietors of the London and Birmingham railway, at the late half-yearly meeting, contains several statements of a highly satisfactory nature, to which we may here briefly advert, as all other companies must look with interest to the results afforded by this magnificent and ably conducted undertaking. The directors remark that the receipts for passengers have been advancing steadily since the early part of the year; and it appears that the number conveyed by the railway, for the six months, has been 268,527—the daily average for the whole length of the line having been 857. The revenue for the half-year amounted to 270,814*l.*; the charges upon this sum, including interest loans, and a reservation of 14,000*l.* for depreciation of stock, was

165,684*l.*, leaving an available balance of clear profit (including a surplus of 7,083*l.* from the previous half-year), amounting to 112,213*l.* It was recommended by the directors that a dividend of 3*l.* 10s. share (7 per cent. per annum), and amounting to 109,375*l.*, should be declared; and the report was, of course, carried unanimously, having evidently produced feelings of satisfaction in every proprietor present.

OPENING OF THE TIDE-WATER CANAL FROM COLUMBIA TO HAVRE-DE-GRACE, TUESDAY, MAY 27.

The stockholders and invited guests left the city in a special railroad line (three cars) at 5 o'clock, with a band of music. Breakfasted at Wilmington, and reached the shore of the Chesapeake (sixty miles) at a quarter past 9 o'clock. They were then conveyed across the river in a mammoth steamboat to Havre-de-Grace—the boat moving off so gently, that one on board whose eyes were not directed to the shore, water, or sky, could not have known that she was in motion, for the rotation of the wheels was not heard. In three quarters of an hour the Baltimore company arrived, also in a special train (eight cars) accompanied by a band. That from Columbia, including the President, Chief Engineer, and others, came in a canal boat. The line of March was then taken up in the following order:

Music—Engineers and Assistants—Superintendent of Canal and Collector of Tolls. Committee of Arrangements. State Executive Officers of Pennsylvania, Delaware, and Maryland. Chief Justice of the United States, Judges of District, County and City Courts. Mayor and Council of Baltimore Commissioners of Havre-de-Grace. Invited guests and stockholders, six abreast.

The procession moved to the Canal basin, and embarked on board the boats, (eight) with flying streamers and music, and decorated with a profusion of busines of the very beautiful native laurel (Kalmia augustifolia) then, fortunately, in full bloom, on the wooded, even hills, along which the boats passed to Deer Creek, a distance of five miles.

As the boats proceeded, the company were saluted with a national salute from artillery placed on the heights, and from a piece in a flat boat from Columbia. Ample refreshments were provided on board of the boats.—Here it may be noticed, that the scenery on the Cecil county side of the river is highly picturesque; the land is high, and apparently under good cultivation, with some large stone mansions embosomed in forest trees, the former owners of which were noted for their hospitality. Among others, is that of the late Philip Thomas, whose honest, unaffected, but sometimes rather rough manners, are remembered by friends who justly esteemed him.

The company then returned to the Canal Basin, (again saluted by artillery) and proceeded to the steamboat Carroll, moored at the outlet lock, when an address was delivered by Mr. Bose, of Baltimore, one of the directors in which he took a view of the internal improvements of Pennsylvania, which, for accuracy, could not have been exceeded by the best informed Pennsylvanian on those subjects, and for elegance of composition, would be sufficient to stamp him as a first rate writer, had not that character been long since acquired by his able productions in the "American." As the address will doubtless be published, it would be premature to attempt even a sketch of it. The company then descended to the cabin, with keen appetites, from the fresh and delightful early morning air they had inhaled, aided by the exercise they had taken, and the excitement of the scenery, pleasant social intercourse, and the occasion generally, to a well spread and handsomely arranged table, provided by Mr. Seymour of Havre de-Grace. Those who could not be accommodated below solaced themselves with good things on deck, or waited until there was room in the cabin. After dinner, the company met on deck when they were addressed by Mr. Biddle, of Philadelphia, on the subject of American improvements generally—railroads and canals—their amazing extent, and incalculable importance in promoting the prosperity of the Union. The address, it is understood, will be written out for the "American," of Baltimore. Toasts were then drank. At 6 P. M., the company from Philadelphia walked to the wharf at Havre de-Grace, and were again conveyed across the river, in the noble steamboat, which, without a perceptible movement, or noise to those engaged in conversation, glided gently off into the stream. At Wilmington, they were once more refreshed by supper, and reached Philadelphia at eleven o'clock, without the slightest accident.

On the whole, a more delightful day was never spent by mortals; and those who partook of the hospitality of the Directors of the Corporation, cannot ever forget it. ONE PRESENT.

SPEECH OF MR. NICHOLAS BIDDLE, ON OPENING THE TIDE-WATER CANAL, AT HAVRE DE GRACE.

The Stockholders of Philadelphia—whose public spirit so largely aided in the completion of the work we meet to celebrate.

After this toast was announced, Nicholas Biddle, Esq. rose amidst the calls and cheers of the company, and responded to it in the following terms:

Mr. Biddle said, that ss one of the Stockholders of Philadelphia, he returned thanks for the cordiality with which the sentiment had been received. In the early stages of the work some fears had been entertained lest the trade of Pennsylvania might be thus diverted from the exclusively Pennsylvanian channels. But this anxiety was only momentary. We believed that it was due to the great interests of the interior, that they should be allowed to seek their natural course to the sea; that this trade, after it reached the Chesapeake, would still be an object of generous competition between our two commercial cities; and more especially, we felt that truth too often neglected in the jealousy of rivals, that there is quite room enough in the world for us all. We, therefore, the stockholders of Pennsylvania, unite as cordially as you do, gentlemen of Maryland, in celebrating the success of our joint labors.

But for myself I rejoice the more at it, because its completion, and the respectable assemblage who have come to witness it, prove the unabated interest felt in the prosecution of those great works which are now in danger from the caprices of public opinion. Some years ago, with the characteristic enthusiasm of our countrymen, and some touch perhaps, of their imprudence, we began an extended system of internal communication. But before the works are finished the general troubles of both Europe and America rendered it more difficult to raise the funds for their completion. and some disappointment arose in the sanguine hopes of immediate profits from them:—so that now the ardor with which we began is succeeded by a relaxation of effort, by a tone of subdued expectation, nay often by a timid and childish despondency. Men begin to complain how much these works have cost—as if we expected to have them for nothing. They lament that we have paid more than the estimates, as if any man ever built a dwelling or barn that did not cost more than was as at first imagined. They regret that there was much waste in erecting them, as if, in a career totally new, young nations, like young men, must not pay for their experience—too happy to have youth, with all its elasticity, on their side, to repair, a thousand fold, all their errors.

These are the maudlin lamentations of men unfit to lead a great nation. Instead of disparaging, or regretting, or desponding over them, we should be proud of them, as the noblest achievements of the country. Cut off, by the happy tranquility of the world, from the pursuit of military glory, the great distinction among nations now is their advance in civilization—in moral instruction, in social improvement—more especially in enterprises for developing their resources; and in these we may claim for the energy of this infant nation, a superiority both in the character and the multitude of its works, over not merely the ancient nations but over the foremost of our cotemporaries.

With respect to ancient times, one may be allowed to wonder or to smile at those stupendous monuments which our childhood was drilled to admire. —Take for instance the pyramids of Egypt. Within a space of one hundred miles, there are in Egypt, about two hundred masses of rocks, brought from a distance and piled into what are called pyramids. A single one of these is estimated to contain sixty millions of tons of stone—and to build one of them required the labor of one hundred thousand men for twenty years. Look then at the immense waste of human labor upon these huge absurdities in stone. For no man can tell who built them—no man can tell what they were built for—and the only important discovery which has rewarded the labors of our day, is a parcel of relics which proved to be, not as was fondly hoped, the remains of at least a sovereign—but the mere thigh bone of a cow! Alongside of these pyramids is a low sandy desert about sixty miles long, where a canal from the Red Sea to the Mediterranean would cut off the circumnavigation of the whole continent of Africa. This canal, not requiring one forrth of the labor of that which we this day visited, was at last made by the efforts of a succession of Egyptian Kings—but afterwards closed, and now no longer exists. Why there is a little strip of land about five miles across from Corinth, where a canal would save the circuit of the Morea. Half a dozen emperors, and the greatest of them all, Julius Cæsar among the number, tried in vain to make this canal, which was abandoned, because, it is said, they did not understand how to make locks, such as we see before us. Contrast withthese the gigantic utilities of this country.

I remember, for it seems but yesterday, when a few of us sent an engineer to Europe, to inquire about these strange novelties which rumour had announced under the name of Railroads. While they have made little progress in Europe—out of England—there are in this country, according to the report of the Austrian Commissioner, sent to examine them, more than four thousand miles of railroads: and in return for the mission of our engineer, there have been Commissioners sent by the Governments of France and Russia, and Austria, to examine and to take models of these improvements. The American locomotives are used both in England and on the Continent. It is probably true that there are more canals and railroads in the United States than in the whole of Europe put together. And shall we not feel proud of these distinctions? The first to invent and to use the steamboat—the foremost in canals and railroads—the great tests of civilization—are not these worth money—are they not worth infinitely more than money? Does not every man of us feel better because he belongs to an active and distinguished community? And shall we be dissuaded from these high pursuits—by small calculations and smaller calculators—as if a great nation could be ciphered out of its renown;

But these honors stand by the side of great responsibilities—and we are now called upon to prove that we are worthy of them. You all remember that three years ago, when the great commercial embarrassments fell upon us, our merchants were largely indebted to Europe, and there arose abroad intense alarms about these debts. But true to themselves and to their country, the American merchants made the most extraordinary efforts to pay their debts, and all Europe rang with applauses of the energy and uprightness of the commercial character of this nation. And now, when the States themselves have beeome in turn the debtors, the same alarms are renewed, sharpened by the violence of political antipathies. It is a favorite theme with those who wish to degrade all free insititutions that these Democratic Governments of ours may do well enough in the sunshine, but are wholly unfit for storms;—that our Democratic assemblies are prompt to borrow but impotent to pay;—and that in the loose and feeble structure of our political system the representatives are afraid to ask, and the people unwilling to give the supplies necessary to sustain their credit.

Now it is duty to stand up for the governments of our own choice—to prove that a democracy is just as honest as the most servile despotism—that as all the people have voted to borrow, and all shared in its benefits, all are for that reason, the more ready to pay. That truth we must demonstrate at all hazards and at every sacrifice. And fortunately, it can be done without any sacrifice at all.

For, after all, what is this debt of ours? Take the most indebted of all the States—our own Pennsylvania. She owes a debt of thirty-five millions of dollars—payable through a long series of years—during which her improvements are growing in productiveness, and all that is now wanted is the mere interest on it. Thirty-five millions! Why the present debt of France is one thousand millions of dollars, all of which is absolutely gone without leaving a single particle of benefit. Spent at Moscow—spent at Waterloo—spent in first conquering the allies and then in paying indemnities to the same Allies, when they in turn became conquerors. Thirty-five millions! Why the debt of England is four thousand millions of dollars —totally sunk like that of France—invested in profitless victories and irreparable losses,—so many millions for losing America—so many millions for subsiding the Continental powers—so many more for invading France but all gone forever. While for the whole of our debt we have actually in our possession the improvements purchased by it in full operation—yielding a present revenue to be infinitely augmented hereafter, and adding to the value of the property, a hundred fold their cost. Look again. The entire debt of the whole twenty-six States of the Union is not more than one fifth of the debt of France—nor one twentieth of the debt of England—spent without a vestage remaining. To anticipate any infidelity to such engagements is a reproach not less on their understanding than on their integrity. Not to sustain their credit is to throw away all future resources of that kind for the completion of these works themselves—since how can a State expect to be trusted hereafter if it is faithless to those that trusted it before. But a far nobler motive is the dishonor which it would bring not merely on the States, but on the great cause of political freedom. Whatever shades of distinction we may find among ourselves, to foreign nations we are essentially one single people. The stain which falls on the youngest member of the Confederacy spreads over the whole. The States are firmly linked hand in hand with each other, and the electric shock which touches one instantly thrills through the whole. The first State then, which shall be false to its engagements, should be tabooed—stricken from the rolls. Her fallen star would be blotted from the nation's flag as no longer worthy to share its glories—her very soil would be deemed pestilential, and men would go round its borders to shun its infection. But that can never be. If for a barren tract of pine logs—or even a more barren diplomatic punctilio, we should be summoned to war for some real or imagined wrong—when once the blood of the country is up, no sacrifice of men or treasure would be withheld, and shall we be less zealous to redeem the pledged honour of the nation? States may sometimes be overborne by numbers in a field of battle—sometimes desolated by pestilence; but a voluntary dishonor—a disgrace by Act of Assembly—this scattering with our own hands a blight over our golden harvest fields—is inconceivable. Should that day come, let us first tear from our history the past glories of the country which we will be unworthy to inherit—and destroy these works themselves, which, instead of being the trophies of honorable industry, will become the lasting monuments of our shame.

And now let our public men look to it. We private citizens, have given them the country's honor. Distrust these paltry demagogues by whom public life is too often invested—men with no property to assess and no character to lose; men who make a scanty living by the trade of popularity, and who fear to hazard the least portion of their precarious subsistence. These men are always ready to inflame our passions against each other, but never dare to remind us of our duties, because they can succeed only by bringing us down to their own level. It is such men, and such men alone, who would whisper into the country's ear these base counsels—plunder the strangers who have confided in us. But the true statesman will scorn such appeals to our selfishness. It is his duty, instead of yielding to these momentary weaknesses, which will occasionally overshadow for a moment the brightest public spirit, to rally up the country to the high thoughts which befit its destiny—to fix its gaze upon some elevated object and carry his countrymen up to it, regardless of the timid who falter and the faithless who desert. That man we shall follow because we see that he is fit to lead. For myself, I am, like all of us, a mere private citizen, without the slightest pecuniary interest at stake, and if I am to be taxed, it will be exclusively for the benefit of others. But you or I—or any of us, less anxious to escape from the degradation of witnessing our native commonwealths disgraced, the whole Union tarnished, and the cause of free institutions, of which we are guardians, forever overthrown!

The time is coming when we, the people of the country, shall be called upon to redistribute its honors. On that day we shall look out, not for the miserable demagogue who insulted us by not daring to ask us to pay our honest debts—not for the little politician with his endless speeches, which he thinks immortal, when they are only eternal—but we shall seek out the man who, in the hour of public danger, first flung down the faded livery of party, and put on the true blue uniform of his country—and was then foremost in action. To that man, from whatever ranks he came, we shall give our voices for any station to which his honest ambition may aspire. Such a moment is the present. Let then our public men come forward, and in a tone of honest manliness tell us the public wants, and ask us to relieve them. They will be answered from every quarter with instant and cordial co-operation—for where is the man in this whole nation, from the humblest to the highest, who has an American heart within him, who would not cheerfully pay his part of the burden rather than bear his share of the dishonor? If you all think so—pledge me in this sentiment—

The plighted faith of the American States—Woe to any man or any party, who shall dare to dishonor it!

FIFTH SEMI-ANNUAL REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA, TO THE PRESIDENT, DIRECTORS, AND STOCKHOLDERS.

ENGINEER DEPARTMENT, CENTRAL RAILROAD,
Savannah, May 10th, 1840.

To W. W. Gordon, Esq. President:

SIR—The period has arrived, when it is expected, that according to the practice of this department, an account of its operations, and of the condition and progress of the work will be presented for the information of all persons interested in the enterprise. The transactions of the last half year do not afford any incidents calculated to give extraordinary interest to the present report; it will therefore be confined to a brief detail of the current operations, with such remarks as the circumstances seem to suggest.

Since the date of the 4th report, the contracts for grading have been extended to a point 142 miles from this city, and within six miles of the Oconee river; all contracts for grading that have been made during the last year, have been, with a provision for the payment of 75 per cent. of the consideration in the stock of the Company at its par value, and 25 per cent. in cash.

The last sections put under contract, embrace the heaviest work between Savannah and the Oconee river, the first mile from this city excepted. The contractors are responsible men, and are progressing satisfactorily with their work.

The total distance graded is 136 miles. The superstructure is laid for a distance of 109 miles, and is in progress with a force of upwards of 100 hands. The whole force now employed on the line amounts to a little over 300 hands.

Near the 100 mile station we commenced the use of the edge rail of the T pattern, as described in the third report; and find all our expectations of its advantages fully realized. The transition from the flat bar to the T rail at the pont of junction, is instantly perceived by all persons in the train as it passes over, and the smooth and easy motion of the cars, compared with the jarring uniformly attending the use of the flat bar, affords of itself, a sufficient consideration to induce the adoption of the edge rail, to say nothing of the great saving of the wear and tear of the machinery, and the advantage of being able, with the same power, to drag much heavier trains.

We have received nearly one half of the 2000 tons of this iron, ordered by the board during the last year, and expect to receive cargoes at short intervals until the whole order is accomplished. The iron received is of the best quality, and manufactured with the greatest care and exactness as respects conformity with the model.

We are much indebted to the attention of the house of Andrew Low & Co. of this city and of Liverpool, through which most of our iron has been ordered, for the superiority of the article.

The progress of laying our superstructure was impeded for a short period, and the use of the road for a short distance at its upper end suspended, by a freshet that occurred in the Ogechee river, in the month of March, which was almost unprecedented in its height, and the violence and rapidity of its approach: as our road skirts along the flats of the river for the distance of nearly eighty miles—frequently running into projecting bends of the swamp, it could hardly be expected that it would entirely escape injury from such a sudden rush of water; more especially when we consider the extreme drought that has prevailed during almost the whole time of its construction, and the consequent want of compactness of many of the embankments. From these causss, a breach occurred near the 100 mile station, and about 1400 feet of an embankment averaging 5 feet in height, was partly swept off. This, of course, obliged us to suspend the use of that portion of the road until the damage could be repaired, which was effected in about ten days by the prompt and energetic exertions of Mr. Oliver, our contractor for superstructure. He immediately withdrew his large force from his regular work, and placed them at the repairs.

On making a settlement with Mr. Oliver, it was found that the cost of these repairs was less than one thousand dollars.

The embankment at this point, will be made much stronger than originally constructed, and protected by a revetment of rock on the river side. These, and some other preventive measures, will ensure a security against the recurrence of a similar injury. The damages occasioned by this freshet, to the remainder of the road below the 100 mile station, did not amount to one hundred dollars.

The cost of maintaining the road, as regards repairs and renewals, is a subject of much interest to all persons interested in its success. For the last half year, the expenses of this department have been about fifty dollars per mile, which would amount to ten thousand dollars per annum for 100 miles. Although this expenditure has been found sufficient to keep our road in good repair, during the last six months, we must of course look for an increase of the expenses on this head at a future day, as the superstructure grows older, but considering that some considerable part of the track has been laid upwards of three years, and that portions of the timber of the lower end of the road were unavoidably the "Loblolly Pine," the cost of repairs is certainly unusually light. That part of the repairs comprising the *preserving of the arrangements of the parts of the superstructure*—which on most wooden roads forms a very important item in the expenditure, is, with us a mere trifle. Our plan is such as in a great degree to preclude any liability of the parts to get out of adjustment; we have no wedges or keys, no nutches, knees or brackets on the ties, and after a string piece is once laid in its place, it is never again disturbed until it is almost entirely decayed, excepting in occasional places that have settled, to be raised by a lever and rammed—On ordinary wooden roads, the string pieces require renewal as soon as they exhibit symptoms of decay. With our plan they may be suffered to remain with perfect safety until they are almost entirely decayed, as the iron rail and ribbon are placed along the centre, and the string pieces being firmly bedded in the earth, will support the weight of the engine, until they absolutely crush under it. But if the flat bar were applied directly to the surface of the string piece, that surface would require to be kept always sound and solid—this is effected in our plan, by replacing the ribbon, which is done at a trifling expense.

A portion of the truss bridge over the Little Ogechee river (about 40 feet,) was destroyed by fire in December last, but was rebuilt without interrupting the passenger trains, and the freight trains only lost two days. It is impossible to determine whether this was the result of accident or design.

For the last half year we have run our trains at a speed somewhat reduced from the former rate—the time now occupied in accomplishing the 100 miles, is seven hours including about $1\frac{1}{4}$ hour stoppages, this is a runniug speed of 17 4-10 miles per hour. During the last year our rate was about 22 miles per hour: we find great benefit from this change; our engines now run for weeks—even months with scarcely any repairs, while with their former speed, scarcely a trip passed, but some repairs were required by the engine or cars. I have no doubt this reduction of speed has reduced the item of cost of repairs at least one half.

The works at the Spring Hill Depot in this city, comprising the requisite buildings for the accommodation of the transportation and motive power departments, with the necessary machinery for the latter, have been steadily progressing in their construction, and we shall soon have our shops provided with all the conveniences for effecting any mechanical operations, required for the road.

In the department of motive power we are well furnished, in comparison with our equipment for the last season's business; we have now seven engines, viz:

The Tennessee	undergoing repairs	made by M. W. Baldwin, Philadelphia.
" Georgia	in good order	
" Macon	do.	
" Savannah	do.	
" Atlantic	do.	
" John Bolton	do.	Rogers, Ketchum & Grosvenor,—Paterson, N. J.
" Oglethorpe	do.	

The two last named are entirely new, and have been used very little, the others are all in excellent condition, and are capable of performing a maximum amount of service, with the exception of the Tennessee, which will be equal to a new engine when the repairs are completed.

We have five 8 wheel passenger cars—48 8 wheel freight cars capable of carrying 30 square bales of cotton each—8 four wheel burthen cars ordinarily used for baggage cars, and 9 lumber cars frequently used for cotton and other freight.

With this ample provision of motive power we apprehend no danger of being overrun with freight as we were for a time last fall.

In reference to the actual and prospective condition of the commerce and revenue of the road, it may be remarked, that although a great improvement has taken place in both respects within the last half year, and although it has produced a great augmentation in the receipts for that period, the road is still too far short of its completion to afford any thing like the proportionate profits that may reasonably be expected whenever it shall reach its destination. This increase, has of course been occasioned by the use of the railroad having been adopted throughout a more extended area of country, and as we shall have reachad a point in September next more than forty miles beyond the terminus of last fall, we may, from the greater extent of the road in use, and the enlarged region of country that will be accommodated, together with a more ample supply of motive power—confidently say that the prospects of the next business season are most encouraging to the stockholders.

Taking the successful progress of the South Carolina, and the Georgia railroads as affording in some degree a criterion by which we may measure our future prospects; we certainly find no occasion to be doubtful of our own success.

It may be seen by an examination of the reports of the South Carolina roads that their receipts for the half year ending May 1st 1833 were $18,-982 92. This particular period of the operations of that road is selected for the analogy it appears to bear to the condition of ours for the last six months, as regards the state of advancement of the enterprise, distance completed, and other circumstances. They were then running 72 miles. Had a motive power of 7 engines and 46 cars. We for the most part of the last half year have been running 80 miles with a motive power of only 5 engines and 12 to 15 cars, though our distance has lately been extended to 100 miles, and our motive power to 7 engines and 48 cars.

It will be seen by a reference to the table at the end of this report, that our receipts for the corresponding period, have been $69,183 96, nearly two hundred and fifty per cent. more than the South Carolina road under similar circumstances.

That road has however been going on increasing its earnings at an average rate of upwards of 21 per cent. per annum., and by their last report it appears that for the year 1839 the receipts were $422,841—and the sum total from the commencement of operations to the end of the last year is $1,758,435 58. I am informed that the business of the Georgia Road, also has, during the last six months been fully equal to the expectations of its friends.

A locating party under the direction of Mr. Holcomb is now employed in definitely fixing the line of the road from the Oconee to Macon, and I am happy to be able to give the most positive assurances that the cost of the road throughout will not exceed the estimate given one year since in my third report, and recent examinations lead me to hope that a considerable reduction will be made in that amount.

The state of forwardness of the grading of the Monroe road, the vigor and energy with which that work is prosecuted, and the very favorable route of the road from Forsyth to the Eastern terminus of the State road, give us ample assurance that a connection of these roads will soon be effected. It certainly appears to me to be the policy of this Company to press on with our work to a completion with all the means in their power, and I am happy to state that this is the determination of the Board of Directors so far as I am informed on the subject, and I doubt not with the means within their reach, they will be able to accomplish the completion of the enterprise, even though they should never receive one dollar by way of aid from the State.

Whenever this consumation is effected, the benefits of the system which are now unfolding themselves to various parts of the State, and have been particularly manifested to this city, will burst forth in their full effulgence upon the interests of all classes of the community, and the commercial prosperity of our State and our city, be placed on a basis beyond the reach of contingency.

I am sir, very respectfully,
Your ob'dt. serv't., L. O. Reynolds,
Chief Engineer.

Statement of Freight and Passage per Central Railroad of Georgia, for six months, ending 30th of April, 1840.

	Up Freight.	Down do.	No. of Passengers.		Total.
November,	$6746 46	$8324 68	1116	$3335 75	$18406 89
December,	3582 52	7436 79	1257	3520 00	14539 31
January,	2773 10	5774 13	1073	2968 25	11515 48
February,	3501 59	5566 24	1005	3058 69	12126 52
March,	2630 48	1586 31	964	2885 00	7101 79
April,	1740 80	1317 67	1010	2435 50	5495 97
	$20974 95	30005 82	6425	18203 19	69183 96