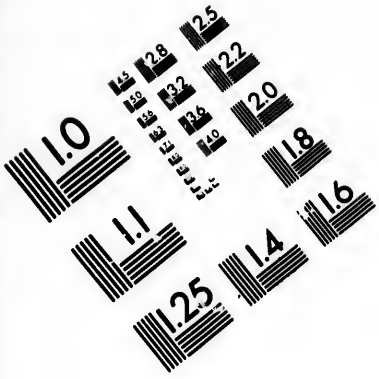

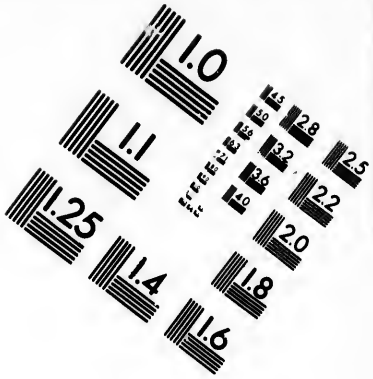

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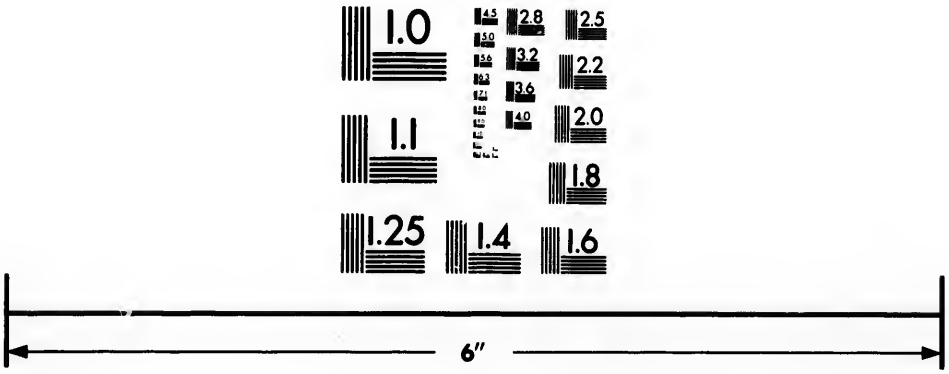

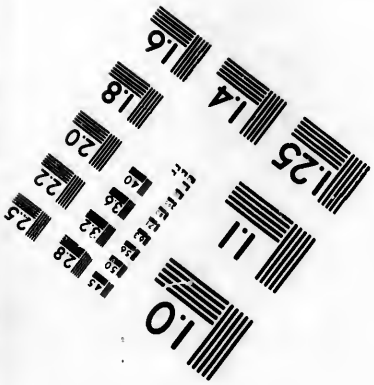

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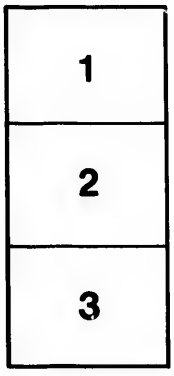

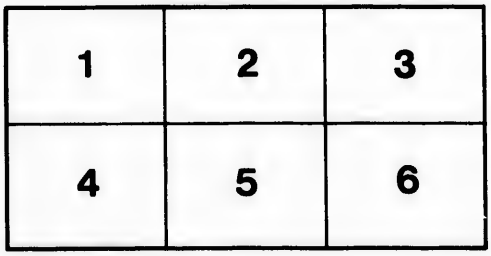

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32X

HISTORY, STRUCTURE, AND STATISTICS

OF

PLANK ROADS,

IN THE UNITED STATES AND CANADA.

By W. KINGSFORD,

CIVIL ENGINEER ON HUDSON RIVER RAILROAD

WITH

REMARKS ON ROADS IN GENERAL,

By F. G. SKINNER;

AND

A LETTER ON PLANK ROADS,

By the Hon. CHARLES E. CLARKE.

PHILADELPHIA:

A. HART, late CAREY & HART,

No. 126 CHESTNUT STREET.

1852.

Printed by T. K. & P. G. Collins.

INTRODUCTION.

THREE years since, a work was published under the title—"A MANUAL OF THE PRINCIPLES AND PRACTICE OF ROAD MAKING, BY WILLIAM MITCHELL GILLESPIE, Professor of Civil Engineering in Union College, New York."

In the preface to that work, which ought to be a hand-book in every common school in the Union, it is very justly remarked that "the common roads of the United States are *inferior to those of any other civilized country.* Their faults are those of direction, of slopes, of shape, of surface, and generally of deficiency of all the attributes of good roads. Some of these defects are, indeed, the unavoidable results of the scantiness of capital and labour in a new country, but most of them arise from ignorance either of the true principles of road-making, or of the advantages of putting these principles into practice."

Nothing can be more obvious than the effect of good or bad roads on the value of land in the region where they exist; and unfortunately the very system commonly called—"free trade"—which scatters instead of concentrating the cultivators of the soil—teaching them to go looking for the dearest market to sell in, and the cheapest to buy in—that system which most enhances the *necessity* for good roads, is the very one which most impairs and lessens the power to make or to command them. We know of no school, except our Military School, in which are regularly and thoroughly taught the principles of an operation, or work, which is intimately connected and interwoven with every step in the business and pursuits of rural life. No, not a step can be taken, in any direction, or for any purpose, that does not bring into play the difference between a road more or less favourable to the movement to be made, and the operation to be performed: the resistance or difficulty, and of course the costs of transportation depending on the nature of its surface, direction, and slopes: in a word, on the materials and mode of construction; and yet not one farmer's son in ten thousand, is taught the A, B, C, of that which every day of his life is to affect his personal comfort and the profits of his labour!

For our part, we have nothing to reproach ourselves with on this point. On the contrary, again and again, have we dwelt upon the importance of systematic instruction in all our schools, on all these subjects—the construction and management of gates, roads, bridges, &c. In the old American Farmer, as far back as 1820—thirty years ago—we endeavoured repeatedly to show, how towns and cities, by establishing good roads, might rapidly promote their growth in population and wealth; and how, to repeat our own words, "the fruit of the nursery and the produce of the plough, which are now in some localities almost valueless for want of easy transport to market, would yield to the laborious husbandman a liberal reward." In fact, if we were called upon to designate but one useful fruit of incessant anxiety to promote the welfare of American Agriculturists, we are not sure that we would not turn to articles, that would of themselves make a volume, written and published from 1820 to 1830, in the American Farmer, on the *importance of good roads and canals and the principles of their construction.*

At that time, nothing had been said or thought of about *Plank Roads;* but we are now satisfied that Plank Roads may be made extensively and highly instrumental in the advancement of the value of lands, the growth of towns, and to the progress of the arts, which is but another word for the progress of civilization itself. And hence

it is that we rejoice in the opportunity of here presenting the most thorough sketch of the history and principles of roads of that sort, that, as far as we are aware of, has yet appeared in any country. Without the pleasure of being acquainted with the author, Mr. KINGSFORD, this essay is enough to indicate his proficiency as a civil engineer, and his tact as a man of business; and the value which must result from the employment of his agency, to all who have occasion for services in that very important branch of industrial improvement.

In the July number, we published an essay on the construction of Plank Roads, kindly written for "The Plough, the Loom, and the Anvil," by the Hon. C. E. CLARKE. Though hastily sketched in the midst of his duties as a member of Congress, the notice it has attracted, and the transfer of it to journals in different parts of the country, have satisfied us that the public mind is in pursuit of more minute practical instruction on the subject.

The reader will not fail to notice in this fuller and more elaborate essay, the supply of some omissions in the one to which we have referred, and which was meant only as an outline for the inquirer. He will notice here, what we had ourselves since witnessed in the repairs of a plank road at Cohoes, N. Y., the caution to "break-joints" in laying down the sleepers, as well as the more exact estimates here given of the actual cost of materials and construction, of all the roads of this sort already built in the United States, and in Canada. The advice it contains also against laying the plank diagonally, &c. For the reasons given, we think it well to make from the "Manual" aforesaid the following extract. Speaking of laying down the planks, Professor GILLESPIE says:—"For a single track, the planks (usually hemlock, pine, or oak, according to the locality,) should be eight feet long, and three or four inches thick, and be laid across the road at *right angles* to its length. If laid lengthwise of the road, horses would be more liable to slip, and the ends would sometimes rise up: if laid obliquely, one end would tend to spring up when the weight of a vehicle pressed unbalanced upon the other."

The more one contemplates the practicability and the advantages of these roads, the more numerous seem to be the points at, and the wider the circles within which they may be beneficially introduced. To say nothing of their tendency to enhance the value of all lands to which they are accessible, their action on the growth of manufacturing and commercial towns and villages, by the increase of supplies to their inhabitants, and the enlargement of their commerce, (their construction being made, under certain circumstances, a matter of municipal undertaking,) laying all these views of the subject aside, every reader on our tide-waters can call to mind some locality within his knowledge, where a plank road might make mines of ore, of marble, of granite, or of marl; and bodies of wood and timber land available; that are now unused and rendered worthless by the expense of transportation. To aid every one in forming an estimate of what may be gained by the introduction of such roads, and to assist in understanding where they may be profitably constructed, is the object which prompts us to lay before our readers an essay which leaves little or nothing further to be learned on the subject. With these views, we submit it to the consideration of readers generally, in the belief that it will be found of much interest to all, as a matter of popular information, and especially to such individuals or companies as propose to construct such roads.

J. S. SKINNER,
Editor of the Plough, the Loom, and the Anvil.

P. S. Mr. KINGSFORD is now engaged on the Hudson River Railroad, and may be addressed by letter at the city of Hudson, Columbia County, N. Y., or care of Lockwood & Co., publishers, 159 Broadway, New York.

A

FEW WORDS ON PLANK ROADS.

WITHIN the last three years, the plank-road system has become a part of the economy of the state of New York. Special enactments have been made to meet the circumstance, and hence in the western part of the state private enterprise has been abundantly enlisted in this species of improvement. So satisfactory have been the results, that the neighbouring and more remote southern states have commenced to inquire what are the benefits which plank roads extend; and it would seem that this improved mode of communication is likely to become generally introduced.

Very little has hitherto been said upon the subject, and the writer has thought that it would not be unacceptable to many, to enter upon an inquiry as to the mode of construction and the probable cost of plank roads, and their advantages and disadvantages considered in connection with the old roadway—bringing forward statements of the results which are admitted to have proceeded immediately from the introduction of plank roads. It must, however, be allowed, that hitherto, with the advantages which are direct, and recognised by all, some demerits have been found. These, the writer believes he will be able to establish to have grown up from vicious principles of construction, and can be guarded against, and in the greater part averted by prudence and care.

HISTORY.

The first plank road laid down in this continent was on the road leading east from Toronto, during the government of Sir Francis Bond Head, in Upper Canada, in 1835–36. And the fact is recorded in the Report of the Commissioners of the Yonnge Street Road, dated 29th January, 1837. It was laid down experimentally, with 12 feet plank, without any principle of construction, beyond laying the plank on sleepers. The circumstance is thus commented upon:

"The trustees, having examined the piece of planked road made last year, and finding that it answered a much better purpose than could have been anticipated, both with regard to the ease of travelling and the very trifling expense attending the keeping the same in repair, came to the determination of proceeding with the same: they accordingly contracted with the proprietor of the steam saw-mill to plank one mile, which was completed in a very short time, for the sum of £525. ($2100,) exclusive of forming the channels, and laying on a coat of loam, or sand, to prevent the wear by horses' calks and friction of the wheels. They beg further to state the road has given more general satisfaction to the country, and as it is evident from the experience they have already had, that the cost attending it is very little more than one-fourth of a stone road; and the expense of keeping a Macadamized road in repair being greater than was anticipated, they have altogether abandoned the idea of Macadamizing, and have contracted for continuing the plank road early next season."

There is no certainty as to the originator of the experiment. It is, however, generally believed to have been Mr. Darcy Boulton.

During the following year, troubles broke out in Canada, and all public works were stopped, until the arrival of Mr. Thompson, (afterwards Lord Sydenham,)

when an impetus was given to the whole country. The Hon. Mr. Hamilton Killaly was appointed President of the Board of Works, and under his direction plank roads became one of the improvements of the day. They were introduced with great success in Upper Canada. In Lower Canada, Col. the Hon. George Catheart* was the means of the first plank road being laid down between Longueil and Chambly, in 1841.

As yet, nothing had been done in this state towards bettering the lines of communication, and it was reserved for the city of Syracuse to be the first to set other localities an example. In 1837, the Salina and Central Square Road was laid down under the direction of the Hon. Mr. Geddes and Mr. S. Alvord, who are entitled to the credit of having introduced the plank-road system in the United States, and of having contributed most of the improvements on the *modus operandi* observed in Canada.

One cannot help contrasting the difference in the progress the system has made in Canada and in the state of New York.

In the former, where, dating from the arrival of Lord Sydenham, plank roads have been known ten years,

	Miles.
Government have constructed	192
And private enterprise about (this total is assumed, as no statement has been published)	250
Total miles	442

In the state of New York, where the system has been introduced about four years, upwards of 2106 miles have been registered, and are constructed, or are in the course of construction, at an average cost of $1833 per mile.

COMPARISON WITH OTHER ROADS.

The road which must be considered principally in connection with plank roads is the Macadam road. And if it can be shown that the cost of a plank road is infinitely less—that it is easier for the horse to draw upon—and that such a road costs less for repairs and is more durable than a Macadam road—the proposition of superiority may be considered proven.

The question of draught is the one first to be considered. Experiment has determined the load which a horse is capable of drawing on the plank road to be so weighty, that one almost hesitates to set it down from fear of the accusation of exaggeration. On the Salina and Central road, a few weeks back, for a wager, a team† brought in, without any extraordinary strain, six tons of iron from Brewerton, a distance of twelve miles, to Syracuse. One and a half cords of green beach is a common load, which is equivalent to 90 cwt.—4½ tons. And there is so little resistance on a properly constructed road, that an average team can travel with this load from thirty to thirty-five miles day after day, at the rate of from three to four miles an hour. Indeed, the farmer does not seem to make any calculations of the weight taken. He loads his wagon as best he can, and the only care is not to exceed the quantity which it will carry; whether the team can draw the load, is not a consideration—for those who travel on plank roads affirm that the only danger is that the wagon cannot bear the load, not that the horse cannot draw it.

* The present Governor of the Tower of London, and one of the most distinguished cavalry officers of the day. Col. Catheart was at Waterloo, as aide-de-camp of the Duke of Wellington; and was formerly Colonel of the King's Dragoon Guards. He is one of the many instances of military men bringing to civil life a high order of intellect, which service seems to have quickened. And like his great master, he thinks no detail too insignificant—no labor too great. The Chambly and Longueil Road was constructed principally after his instructions.

† Where this expression is made use of, it means two horses.

A good instance of what can be accomplished may be related of the Western Road, which commences at Albany. A farmer who had a large timbered farm, having sold the wood, carted it to the side of the plank road, and piled it. His contract was to take the wood into Albany, a distance of eleven miles, at $1.50 per cord for hauling. With a single team his load consisted of a cord and a half, and having engaged to transport plaster for a miller, at 75 cts. the ton, he loaded his wagon for the return trip, which was weighed in the usual manner for the adjustment of the carrying account. The ordinary load was three tons. The trips backward and forward were easily made in a day. Thus his receipts were

Cartage 1½ cord of hard wood, @ $1.50	$2.25
" 3 tons of plaster, @ 75 cts	2.25
	$4.50
Payment of tolls, 11 miles each way, 22 @ 1½	.33
Return per diem	$4.17

That great loads can be drawn on Macadam roads (or metal roads, as they are often called) cannot be called in question, but at the same time it is to be remarked that, on the first construction at least, the resistance to the tractive power will be greater than on the smooth, even, compact surface of the plank. A period must even intervene before the metal becomes solid; and those who have at all watched how metal roads are influenced, admit the necessity of constant repairs. In and about large towns the main Macadamized avenues have annually to be covered with an entire coat of metal, and the road, to be kept in order, has constantly to be watched from the day the stone is first placed upon it. Thus, independently of the difference of surface of the best metal road and of the ordinary plank road, constant repairs increase the resistance. When newly laid, the resistance for heavy trains on the latter has been calculated variously at 1 in 98 and at 1 in 70, while that of the stone road in perfect condition is named at 1 in 67. But while the plank road for at least two years after it has been laid down retains an equality of surface, the stone road is never in such order that so low a ratio of resistance can be received. In ordinary condition, the resistance of 1 in 25 is received. Taking a mean of the two, we may call the average resistance of the Macadam road 1 in 46.

To recapitulate, we have the two resistances:

On the plank road 1 in 70.
On the Macadam road 1 in 46.

Nor can it be said that this comparison is much exaggerated. Even those who differ from it supply data but little less favourable. The comparison even continues as both roads are worn. On the Macadam road the *detritus*, which in dry weather finds vent in dust, in wet weather exercises considerable resistance, so that whatever inequalities exist are felt in all weathers; whereas on the plank road, in dry weather, the cavities which are worn are traversed imperceptibly by the tire, for they are closed up by the indurated sand and earth deposited on the surface. But in wet weather it is not so—the sand softened by the water offers no resistance to the tire, which sinks down to the worn plank. And as in pine roads the surface is generally worn with regularity, although inferior to a new road, there is nothing strikingly objectionable in it, after it has been somewhat worn. Some comparison can therefore be made between a Macadam road and a plank road in that state. In dry weather the planks, being protected by the sand placed over them, present a hard regular surface; while on the Macadam road whatever is bad is felt by the traveller without counterbalancing influences. Nor in wet weather is the

plank road much deteriorated. For so long as the planks are firmly fixed and do not spring, there is little increased friction; but with regard to Macadamized roads, independently of ruts and holes, the resistance is increased by the pulverized stone, formed by the water into an adhesive matter; so much so, that a word has been appropriated to denote this state. Thus, to speak of "heavy roads" is to convey a clear and definite meaning. It is therefore apparent that, in pursuing the inquiry, to what extent the tractive power is impeded on each class of road, in the different stages of newly laid and out of repair, the superior advantages of the plank road become fully established.

Some attempt has been made to draw comparisons between the time a horse will last on a Macadam and on a plank road. It has been asserted that horses travelling mostly or occasionally over plank roads are ruined before their time. But it will be found that this opinion rests altogether upon what is observed to occur, either when the plank surface is badly constructed, or where the power of the animal is mismanaged. If, for instance, the stringers are laid without care, the percolations of the water increase the defect, and any weight passing over the road is succeeded by a rebound varying with the velocity of the passage; and it is this rebound or elasticity which operates perniciously on the horse. It is only necessary for a man to run some little distance on a causeway having this defect, and he will feel at once the difference between a well and ill constructed road. Mismanagement is a principal and frequent cause of deterioration of the horse's vitality and endurance. Owing to the trifling resistance encountered on a plank road, and the consequent ease with which a great weight is drawn, drivers, without noting the rate at which they travel, press their horses beyond their strength. The axiom has long been received that it is speed, not weight, which destroys the horse. "It is the pace that kills." The argument against the plank road derived from this observation, and making its inference from the very excellence of the road, is palpably vicious. On the Albany road two gentlemen in a hired buggy with an ordinary hack, went a distance of twelve miles out, and returned. This was in the month of April last, at the breaking up of the winter, when the other roads were nearly impassable. The distance between two gates, five miles, was performed at the usual natural gait, without the animal being in the least kept up to his work, in twenty-three minutes going, and twenty-seven minutes returning. On their return to Albany, the horse evinced no signs of fatigue. In reality, there is nothing to warrant the inference that the horse is a sufferer on a well-made plank road. On the contrary, it may be said without contradiction,—that the horse, when not pressed beyond his strength, can work longer and be always in better condition on a plank road than on any road whatsoever.

Sufficient data are at hand to form a proximate ratio of the superior advantages of the plank road.

The preponderance in favour of the plank road, as compared with a common country road, may be stated as ranging from 2¼ to 1, to 6 to 1—varying with the season and the locality. The former ratio may be considered to denote the average comparison, at the commencement of the bad season, on gravelly soils—the latter, where the road passes through heavy sand. Farmers take a cord and a half of green wood, in place of half and three quarters of a cord; 80 bushels of rye and 100 bushels of oats, when, formerly, they carried 40 and 50 bushels; 200 plank in the place of 80 to 90. This is done at the rate of four miles an hour; whereas, three miles an hour, when the road was in tolerable order, was considered rapid travelling with a team. A manufacturer of Utica formerly transported from the railroad to his establishment—a distance of seven miles—ten bales of cotton per day, with two teams, which made, each, but one daily trip; but on the recently con-

structed plank road, one team performs the journey twice, delivering 15 bales daily. The average weight of a bale of cotton is 5 cwt.; therefore, one team is now equal to the work of 75 cwt., while on the old road it was equal only to 25 cwt. These loads must be considered fair average burdens, without the energies of the horse being unfairly taxed. On a level, Macadam, English road, writers agree that the extreme weight of draught for a single horse, in perfect condition, is 3100 lbs.—and that "to place on more becomes a cruelty," which would give the maximum power of traction to a team of 6200 lbs. That such is inferior to the amount which has been carried on a plank road, without distressing the horses, the incident of six tons taken on the Salina road is a proof. While, therefore, we take 3 to 3½ tons as a medium load on a plank road, we may assume 2 tons to be fair draught on the Macadam road—the same time to be made by each.

These calculations would give a ratio of 3 to 2 in favor of the plank road. Mr. Gillespie, in his work on roads, rates the difference at twice as much.

COMPARATIVE COST OF THE TWO ROADS.

The next inquiry is the comparative cost of plank and Macadam roads. This, of course, will vary with localities. Known results in one region will assist in forming estimates for another.

It is stated in the report of the Commissioners of Board of Works of Canada, for the year ending 1848, that the average cost of the fifty-six miles of Macadamized road under the jurisdiction of the Montreal turnpike trustees, was $3462 per mile. Two miles were laid by the way of experiment, costing $3233 per mile—the lowest price at which any Macadam road was made—the greatest cost being $4888. But on this road, extending seven miles from Montreal to Lachine, there was heavy cutting on two hills. The repairs for the last eight years have been, annually, $200 a mile—about $\frac{1}{15}$ of the original cost. At Quebec, the average cost of thirty-one miles, was $3600 per mile; the repairs amounting per mile, annually, to $165; $\frac{1}{20}$ of the whole cost. On the Port Hope road, the repairs per mile were $300; on the road from Toronto to Springfield, $511; but this road is described as worn out in many places. Therefore, the cost of a Macadamized road may be safely assumed at $3400 per mile, with the necessity of an annual expenditure of about $130 per mile.

The cost of a plank road depends on contingencies, but may be stated, with tolerable accuracy, to range from $1200 to $2000 per mile, where there is no extraordinary item of expenditure, and according as the road may be built of hard wood,—maple, or hemlock. The reader is referred to Appendix No. 1, where the prices of some of the roads constructed are given in a schedule, with other items in connection with this inquiry.

For the sake of establishing a comparison, a medium cost, $1750 per mile, is assumed.

The repairs which a plank road will need for the first two years ought to be trifling. To a great extent, at this early period, they depend upon the mode in which the road has been constructed. If it has been well kept up and well drained, and the sleepers have been carefully laid, there is little fear of the road settling, nor will any of the plank become loose. Even on roads built before experience had pointed out a good mode of construction, the repairs were not a heavy charge. The Chambly and Longueil road, Canada East, was laid down in 1841, with white pine, which generally lasted about four years. It has since been renewed, and the road has been more carefully constructed; and there is a reasonable expectation that it will last seven years. The ordinary annual repairs have been $7½ a mile. It is not possi-

ble to give the exact traffic, as the tolls for sixteen miles are farmed out for $5220 per annum. It cannot be considered, by any means, that this road is too favourable a criterion, for it was among the first built on the continent.

I assume that one man can keep miles in repair during the first years of the road, and the following estimate of yearly expense will be found nearly correct in practice:

1st year	$2.00
2d "	5.00
3d "	7.00
4th "	10.00
5th "	10.00
6th "	15.00
7th "	20.00
8th "	relaid
	$69.00

Averaging annually for 7 years, say $10.

After the third year some of the planks may require to be replaced; but no serious repairs will be called for, especially if pine be used, which, being clear from knots, however worn, will afford no impediment to the travel, until the plank break through, when it will become necessary to raise them.

The eighth year we may consider that the road will require re-covering. From the roads already built, we are satisfied, that at this period the stringers are comparatively uninjured; and, therefore, the cost of plank and the labour of relaying have only to be taken into account, viz.:

$5280' \times 8' \times 3'' = 127{,}000$ feet, board measure.

Timber, (say) @ $7	889.00
Relaying—per mile	120.00
Cartage—127,000, say @ $1	127.00
Sanding surface ..	150.00
	$1286.00

It is almost needless to remark the price of the timber is the main matter for consideration; but it will be seen that the sum assumed is by no means a low one—hemlock having been purchased at $5.50.

Working upon these liberal data, we can arrive at a proximation of the comparative cost of a plank road and Macadamized road—including the repairs for seven years—assuming that at the expiration of the seventh year, the planks have been relaid and the Macadamization thoroughly repaired; both roads, consequently, being in perfect order.

Plank Road.		*Macadam Road.*	
Original cost per mile	$1750	Original cost per mile,	$3500
7 years repairs @ $10	70	8 years repairs @ $130	1040
Cost of relaying	1286		
	$3106		$4540

Being nearly in the proportion of 3 to 2.

Thus, the Macadam road costs with regard to the plank road, so far as the means of comparison exist, on an extended period of eight years needing repairs and restoration, in the ratio of 3 to 2.

WHAT PLANK ROADS DO FOR CITIES FROM WHICH THEY RUN AND THE PROPERTY THROUGH WHICH THEY PASS.

Those skeptical of the advantages which plank roads have extended in the short space of a few months, would do well to examine into the results collected by the writer, which he appends in detail.

Indeed, the communications leading to and from cities are paramount in importance for the furtherance of prosperity. A city which has been rendered by art or nature accessible on every side becomes the centre of the surrounding country—its magazine and store-house—and the point from which radiate the impelling causes of industrial and agricultural activity.

ALBANY has one plank road in connection with the city. Three others are projected. The traffic in the direction of the eleven miles laid down has increased 110 per cent.; farms lying contiguous to the road have increased in value 20 per cent., from the acquired facilities of taking produce to market. The road was only completed in September, 1849.

TROY.—A short plank road of two miles and a half leads from Troy to Lansingburg. Since it has been constructed, the traffic has doubled between the two places. The brush manufactories have increased in number and in extent of business, and the site of a foundry, which has been built, was determined by the vicinity of the road. The people in the neighbouring towns, taught by experience to appreciate the advantages of plank roads, have commenced the construction of two new lines—

The Lansingburg and Pittstown, . . . 7 miles.
The Washington and Rensselaer, . . . 26 miles.

On both roads farmers have taken large amount of stock, and land has been given with such good will, that the land-damages will not exceed $300 on either line.

HAMILTON COUNTY.—The Amsterdam and Fish-house road, 16 miles in length, opens a communication from this thinly populated county to the Schenectady and Utica Railroad. This plank road is to be continued to a village named Northville, six miles further; and although only opened last fall, has already had considerable influence on property. The business of the tanneries has already increased, owing to the greater facility of carting hides and taking leather to market. Three new tanneries are now in operation on the line. The value of land on and near the road has increased 20 per cent. Owing to the woodlands in Hamilton county thus becoming accessible, they have risen greatly in value. Several new saw-mills have been erected, and lumber at the mill, without regard to the market price, is rated at a higher price. Previous to the road being planked, these lands had no sale. They are now brought into the market—the attention of people is directed to them. Owners are beginning to look up long neglected tracts, and are setting guards to see that the trees are not cut, and that trespasses are not committed. The average value of farm land is about $8, and farmers have commenced to pay much more attention to them, since an avenue has been opened for their produce.

THE FONDA AND CAROGA ROAD runs from the small village of Fonda, northerly, along the Cayaduta creek, and one of its branches, up to lake Caroga, in Hamilton county. Before its construction, property at the northern end was not saleable from being inaccessible, and any quantity of it could have been bought from fifty cents to one dollar the acre: it is now held at $2 and $3. Lumber, at the mills manufactured, has increased in value to the owner $1½ per thousand—being the difference of expense in transporting it to water communication. But the lumberer experiences a greater advantage. Heretofore he has had to lie out of the money paid for carting, for six months;

winter having been the only period when lumber could be brought down. With the plank road, lumber can be removed in any season, and he can keep it by him until the opening of the navigation.

The price of firewood in Fonda has, on occasions, been as high as $6—the ordinary price was $3½. The uniform cost is now $2.75—and can always be purchased; when formerly, the weather often prevented wagons from coming in, and, as usual in such cases, the poorer population suffered.

Fultonville and Johnstown road, five miles in length, has been continued a further distance of six miles, to Bennett's Corner. The company had to purchase an old bridge across the Mohawk, to connect Fultonville with the country north of the river. On opening the road, the bridge-toll was reduced from nine cents to four cents, including the toll of the road to the second gate. The increase of travel has been 25 per cent. Property in Fultonville has increased in value about 10 per cent. The traffic between the two banks of the Mohawk has been doubled; along the line of road farms have risen in value. This road is, also, one of the communications opened to Hamilton county; and at its termination, lands have been affected to the extent already described.

Utica.—One hundred and sixty-three miles of plank road may be said to belong to this city and converge towards it. These roads, further, connect the city with roads leading to Sacket's Harbour, a distance of seventy miles, and to Oswego, a distance of sixty miles. Prior to the introduction of plank roads, during the fall and spring, farmers could not take to the city loads exceeding 8 cwt. At these seasons, the streets, markets, and hotels would be deserted, presenting a painful aspect of depression of industry. In fact, it was only in the deep winter, when the sleighing was good, and in the clear summer months, that active business could be relied upon. The plank roads have equalized the seasons. Farmers can now come in every day in the year. There is a steady trade carried on, and it is asserted that business has increased 100 per cent. The streets bear witness to this prosperity, for in all weathers they present a bustling and animated appearance. Indeed, it is on wet days that farmers often prefer driving to the city, having little occupation at home in bad weather.

Property has increased in value 15 per cent.; the population 25 per cent. A new trade has grown up. On the northern road, the woollen manufactures in operation, some few miles from Utica, were in the habit, on the one hand, of obtaining their supplies by the canal—and on the other, of importing their manufactured articles by the same communication. They now purchase the raw material at Utica, and sell their goods there—thus creating a more profitable and better kind of business. Generally, the plank roads about Utica prove that the travel is soon doubled. What rate of increase will follow cannot be anticipated. The surrounding wood lands have considerably increased in value; formerly, they were scarcely saleable. The timber is now regularly cut; consequently cord-wood has been reduced in value one dollar and a half a cord—the difference of carting from lots some short distance from Utica; and, as 35,000 cords are annually consumed in Utica, there is an annual saving of $52,000, which would be the original cost of about thirty miles of plank road.

On the Rome and Utica road, property, some few miles from Utica, has gone up 25 per cent.

On the Utica and Illion road, the advance is laid at 15 per cent.

The Utica, Clinton, and Waterville, and the Utica and Waterville roads, furnish a good instance of the influence of plank roads. The latter was the old main road, and when the former was built, all the traffic was turned to the new road; and the little village of Hartford, situated on the old road, was

quite deserted. The result was the determination of the residents there to continue a road direct from Waterville through New Hartford to Utica, by which means the lost travel not only returned to the road, but property increased in New Hartford about [illegible] cent., and in Waterville 20 per cent.

On the Utica and Frankford road, the advance on property has been 15 per cent.

Rome is the centre of one hundred and forty-eight miles of plank road: as in the case of Utica, the trade has been equalized—for there is business for every day in the year, and its amount is much extended. The storage and forwarding business has increased 33½ per cent, while travel to and from Rome and adjacent places has been doubled. Property commands a much more ready sale at an advance of 10 per cent., and a general impetus has been given to this enterprising little city.

On the Rome and Oswego road, lands have increased in value $5 an acre; formerly, they were not saleable except at a great sacrifice.

On the Rome and Western road, the increase has been $5 an acre.

On the Rome and Taberg road, the advance has been $5 an acre.

Syracuse.—Ninety-nine miles of plank roads run into Syracuse, and their beneficial influence upon the prosperity of the city is fully established. The city has become the focus of a lively and an extended trade, and it is considered that these roads have been more instrumental in conducing to prosperity than the Erie Canal. The forwarding trade has received a great stimulus. The population has more than doubled; and as in the case of Utica and Rome, there is a steady trade in the fall and spring of the year—the periods of bad roads—when before there was none at all. Real estate has increased in value 15 per cent. north of the canal; on the Salina side, the increase averages 25 per cent., and in some locations directly on the line of the road Wolfe street property has more than doubled in value. The roads have had much influence on the price of wood, having kept the supply regular, and the price uniform. Owing to the Salt Works at Salina, a great quantity of wood is used, to the amount of 325,000 cords annually. A large supply comes by the canal, but about 75,000 cords are brought in from the surrounding country. The stock generally was laid in during the summer, but the supply did not always equal the demand, and the price was often high. This began to be sensibly felt the winter preceding the construction of the Salina and Central Square Road, when the price rose to $6 and $8. The constant price of cord-wood now is from $2½ to $3 a cord. The holders of woodlands also have been directly benefited, as wood on the ground is now worth 50 cents a cord; whereas, with the former imperfect means of transport, it was valueless. The demand for barrels for the use of the manufacturer of salt has increased, and it has been possible by means of the plank road to sustain the supply at uniform prices, 15 per cent. lower; nor can it be said that this reduction has been made at the expense of the barrel-maker, since double loads are now drawn. The barrels were formerly brought from within a distance of fourteen miles. They now come a distance of fifty miles. Wood is also brought double the distance it was formerly carted.

On the Salina and Central Square road, farm land has increased from $9 to $15 per acre. This increase extends three miles each side of the road.

On the Syracuse and Manlius Centre road, land has increased in value about $10 an acre.

On the Syracuse and Bridport road, property five miles out has increased in value $5 an acre.

Salina, Liverpool, and Clay road, land has increased the value of property at least 50 per cent.; especially wood lots, which have been brought into the market for the first time.

On the Syracuse and Tully road, property cannot be purchased within $5 per acre of the old price. The lands are generally held in greater importance. Some farms have increased $10 an acre.

Fig. 1.

That the advantages of a plank road are held in high estimation, may be proved by the accompanying sketch. Farmers who pass by the South Onondaga Valley, if they follow the direct road (marked Old Country Road, Fig. 1), which has been used for the last forty years, have heavy grades to ascend; their loads are consequently very much lessened. This led them to apply to the directors of the Tully road to make the road A B, a distance of two miles, so that they might get on the plank road at B. The company took the matter into consideration, and concluded that the cost of the right of way was a serious impediment, and declined to undertake the improvement. But the farmers of Onondaga Valley have subscribed among themselves $1500, to buy the right of way; and they offer to pay the usual tolls over the section to be constructed if the company would lay the plank down. Under these circumstances the road will be commenced.

Oswego.—One hundred and twelve miles lead out of Oswego, and the influence which plank roads have exercised on the city has been most beneficial. The same effect of bringing all the surrounding trade to a central point, and equalizing it throughout the year, is to be recognised here. Property has risen in value 25 per cent.—population is fast increasing. The retail trade has doubled. Other business has been extended one-fifth. The delivery of lumber has exceeded all former returns. Steamboat travel has increased. The milling trade, with regard to flour and shorts, has been multiplied.

Wheat is not raised in the county, and farmers were in the habit of buying their flour from the nearest manufacturer; now, from the ease of draught, they proceed to Oswego, a distance of seventy miles, or less, as the case may be, and there purchase their wheat, which they get ground on their own account at custom mills near them. Thus a large trade in wheat has grown up in Oswego. The markets are alway, regularly and well supplied at reasonable prices; whereas, when the roads were bad, butter would rise from twelve to sixteen cents; hams from twelve to fifteen cents; wood from $2 to $4; hay from $6 to $12. In the article of wood it may be estimated that the steamboats and canal boats consume 10,000 cords, and the inhabitants 45,000. The price of the former—being a softer description of wood—is $1.50; the latter costs $2. This low price is mainly attributable to the plank roads, for although a great quantity comes in by the canal, a large supply is obtained in the neighbourhood. The reduction of the price, owing to the introduction of plank roads and the increased facilities which they extend, is estimated at $1, making a saving to the inhabitants of $55,000 annually. The maximum value of land within fifteen miles of Oswego, is $40 per acre, the minimum $7. The least calculation of increased value on the lines of road may be named at 10 per cent.

Rochester has but two short roads of eleven and a half miles in operation; but seven others, equal to one hundred and thirty miles, are in the course of construction. In the neighbourhood of these two roads, land has benefited from 10 to 100 per cent. Traffic along their lines has been doubled. The markets have been benefited. The price of grain and horse fodder has been equalized. They have even had great effect on the trade of the city, much increasing it. Real estate has also received an impetus. The value, it is

anticipated, will be increased 25 per cent., and many capitalists, with this result in view, are buying freely. Property is even affected two miles beyond the road, and in Charlotteville, which is now quite a little village, a year ago there were but three or four houses. On this road, hay, ten miles out, is worth as much, within fifty cents, as at the city line. The increase in the value of land near the city is trifling; but five miles out the advance has been 50 per cent.

WHAT PLANK ROADS DO FOR THE FARMER.

The farmer has what he never had before—a good road every day in the year—the same in all seasons. Formerly, the spring and fall were periods, when the avenues to the neighbouring city were closed to him. On the plank road, he can select for his journey days when he cannot work on the farm, taking with greater ease, in half the time, three times what he formerly could carry; and while residing close to the road, he sees his neighbour living five miles off, bringing two wagons to the planks, and then transferring the contents into the larger, and moving off with it—he can load his single vehicle with the full amount it can carry, and proceed onward without delay. His woodlands acquire, intrinsically, a value which they had not before, for he can cart sufficiently in one load to pay him for the expense of carting and cutting, allowing a fair value for his timber. His farm increases in value from 10 to 50 per cent., and commands a sale from the fact that the produce never lacks a market, and has a more regular and higher *net* value. By the current price, he knows what he can count upon. His grain is worth what all grain fetches in the next market, deducting the cost of cartage to take it there, which he can calculate to a cent, and deliver when he needs money. The adjoining tannery (and the probability is that there is one within twenty miles) will buy his bark. His cord-wood can be carried the same distance. He sells, for remunerating prices, his perishable produce, such as vegetables and fruit, pumpkins, corn-stalk and fall apples, which brought him, previously, a very small sum, as the only market was in the small villages where there was little demand for them.

The wear and tear to his horse, harness, and vehicle is reduced at least one half. The tolls not only pay themselves in this saving, but even leave a surplus in the pocket of the farmer which would otherwise have been spent on repairs. Horse-shoes last twice the time. Instead of frequent new shoes, it is only necessary to have the old ones periodically removed. The very labour of cleaning the horse comes into calculation; one farmer assuring the writer that in very bad weather, setting aside all question of increase of load and saving of time, he would sooner pay the tolls than have to rub down his horses in the state they used to be after travel on the old road.

The price of cartage having generally been reduced where plank roads have been laid down, it becomes an inquiry, whether it is at the cost of the teamster. Some instances are given in a former part of this *brochure*, and we will adduce two others to show that the increase of load carried, and the time made, more than counterbalance any reduction of price.

On the Taberg and Rome road, there is a furnace nine miles from Rome, from which furnace to the canal at Rome, $1.25 per ton was formerly paid for carting. The load each way was precisely one ton, equal to two tons per day at $1.25—giving $2.50 for the day's work. Now, the price allowed is $0.75; but the teamster takes two and a half tons each way, equal to five tons per day, at . . . . . $0.75=3.75
Deducting toll for eighteen miles, say 25

$3.50

being an increase of one dollar in the daily wages of the teamster.

The Rome and Turin road passes through a dairy country, and cheese and butter are brought by it to the canal, where they are shipped. Formerly, farmers brought 1500 lbs. to the canal, and took two days to go and return; —now they cart from forty to fifty cwt., and return the same day. The smallest load carried is thirty-six tubs of butter. A farm ten miles off from a city is almost as near as one only a mile from it; the surplus distance being in calculation convertible into time. But at a more extended distance, say one hundred miles, it is worth while examining how the plank road can compete with the railroad. Canals being main links of water communication, do not suggest themselves as a matter of inquiry. But many vegetable products now find their way to market by the railroad; and if it can be established that a farmer, using his own motive power on the plank road, can travel at half the cost, a very essential benefit is established.

Plank Road.		*Rail Road.*	
The farmer leaves with 40 cwt., proceeding to market, 100 miles distant, (carrying his own corn,) at the rate of 30 miles a day, the fourth day he gets in.		40 cwt., freight @ 25	$10.00
Cost 3½ days on road @ $1	$3.50	Cartage from depot to market	5.00
1 day in town	2.00	Agent's charge	5.00
2 days coming back	2.00		
200 miles gate	2.50		
	$10.00		$20.00

Thus, it is evident that the farmer does his own business, to his own satisfaction, with a wagon to make a return trip, bringing back all his family may require from the city; such as a quintal of cod fish, a chest of tea, a barrel of pork and flour, assorted articles, cheaper than he could buy them at a country store; together with the experience of his trip, and the information picked up at the inns where he has stopped; and all for exactly half the cost, if he had sent by railroad, and had his business done by an agent. It is presupposed that the farmer can be absent from his farm, without injury to himself.

On Sunday, the farmer can go to church with regularity, which was not always possible in the fall, when the church was one fourth of a mile from the farm. He can live with more friendliness with his neighbours—for the plank roads have led to an increased intercourse between families. Socially, the farmer becomes a better and a wiser man. He can meet people of his own pursuits more frequently, and converse upon prices current and improved modes of farming. He learns what is new, and what benefits any particular experiment has led to. In case of sickness, relief can be obtained readily, and with despatch; and if medical skill can save the head of a family or a young wife, the physician can be soon brought to the bedside.

Indeed, all the advantages which result from a road of superior excellence accrue to the farmer. There is nothing which so much retards improvement as imperfect communications. "Of all inventions," says one of the greatest writers* of the day, "the alphabet and printing-press alone excepted—those inventions which abridge distance have done most for civilization. Every improvement of the means of locomotion benefits mankind, morally and intellectually, as well as materially; and not only facilitates the interchange of the various productions of nature and art, but tends to remove national and provincial antipathies, and to bind together all the branches of the great human family."

If ever such a remark could be directly applied, it is to sections traversed

* *Macaulay.* Hist. England, Chap. iii.

by plank roads. The family, instead of periodical visits to the neighbouring city, are continually passing to and fro. The change, the bustle, the animation, all have their influence. The farmer sees other farms, finds them, perhaps, better fenced than his own—better cultivated, and better "cleaned off." A spirit of emulation is excited in him, and his outbuildings and fences gradually acquire a greater air of neatness. The comforts of the city make the want of them to be painfully felt in his own homestead, and his wife and daughters are awakened to exertion by the contrast. His dress is marked by a greater air of neatness. The same can be said of the female members of the family. Indeed, in all the ramifications of life, the contrast with civilization, brought about by improved communication, causes itself to be felt. In a word, the farmer learns that there is such a thing as progress.

A gentleman, who was among the first to introduce these roads into the country, remarked to the writer, concerning a road which it is obviously not necessary to name: "The farms are no longer the same—the proprietors have cleaned them; pulling out the stumps, erecting better fences, and generally improving their property; some even, at their own expense, have run plank roads to their lots, to assist the draught of the horses. The people too are changed, dress better, look better—their manners are better. Their wives and daughters are no longer the same persons. They have improved wonderfully."

Such are the results that have in every instance attended the introduction of plank roads.

WHAT PLANK ROADS DO FOR THE STOCKHOLDER.

The tolls authorized to be collected in the state of New York, by the plank-road law, are not to exceed one cent and a half per mile for a vehicle drawn by two animals; and one half cent per mile for every additional animal; for every vehicle drawn by one animal, three-quarters of a cent per mile, and for each horse and rider, or led horse, half a cent per mile. In the original enactment, the profits of the road were limited to a dividend of ten per cent., and the appropriation of ten per cent. as a sinking fund. But this clause was repealed in 1849; so the above tolls can be levied irrespective of profits.

There are, however, some non-paying exceptions, such as jurors, witnesses, troops, and travellers attending religious meetings.

With the above rates, the profits of existing companies have been made, and the best criterion of the character of the stock is to examine what these profits have been.

Some few companies depart from the rates prescribed, and charge less; taking 6¼ cents for the five miles. Some companies agree with the farmers to charge the distance per mile they live from the gate. These cases are exceptions to the general rule.

Among the many roads constructed in the state, some few have been built more as the means of opening up the communication than as an investment. In these, farmers have freely subscribed. But, throughout the state, it can be asserted positively, that the stock of no plank road is below par. Nor can any stock be bought, except from individuals who are pressed for money, and, in common with plank-road stock, have to sell other property, to obtain it.

Where the travel is limited, the plank will of itself decay, and need restoration, without a sufficiency of receipts to pay for restoring it. But from such a postulate, no deduction can flow. A road, to be remunerative, must first be required. A good road increases travel; but there must be other causes to create it.

But if, on the other hand, the road is worn through by an extraordinary amount of travel, it must be evident that the event is the more advantageous to the stockholders, for the decay of the wood is a cause which ceases to operate. The wear bears direct proportion to the money received. And if it can be proved that roads pay even when subjected to the two destructive influences of travel and decay, it must be evident that they will pay infinitely better when subjected to travel alone; the principle, therefore, may be laid down, That the more often the wear upon the road renders it necessary to replank it, the greater the profit and the larger the dividend.

What roads have already done, may be best learned from the following statements, collected in the localities of the several roads from responsible persons.

The Albany Western Road, laid down about six months, promises to enable the company to pay a fair dividend on the shares, and to lay by a sinking fund to keep the road in repair and to restore it. Eighty thousand teams pass annually.

Troy and Lansingburg Road in building incurred a debt of $1400. This debt has been paid, with semi-annual dividends of 10 per cent., and a large sinking fund laid by. The stock is in few hands, and cannot be purchased at all, and is so good that it is difficult to obtain information on the subject.

The Rome and Utica Road incurred a debt of $4000. The road has been in operation twelve months, and during this period enough has been accumulated to pay off the debt. The road is expected to pay 10 per cent.; laying by 10 per cent. as a sinking fund. The tolls received amount to $6000.

The Utica Northern Plank Road pays 9 per cent., laying by a sufficient sinking fund. The traffic during the months of November and December, 1849, showed an increase of 33½ per cent. on those months in 1848. Ninety-five thousand teams pass annually.

Utica and Frankfort Road.—The first gate was opened in June, 1849, the whole road went into operation in October. A dividend of 10 per cent. was declared; but as the whole stock had not been paid up, the dividend was carried to account as an instalment. The teams pass through at the rate of 45,000 per year.

Utica and Burlington Road has declared a dividend of 20 per cent.; but as the road is to be extended from five and a half to thirty miles, it will be carried to account as additional stock, which is at par in the market.

Rome and Turin Road, thirty-one miles, opened in the fall of 1849, has paid off in six months a debt of $12,000, contracted during construction; consequently, the stock, of which $38,000 was only paid in, is now worth $50,000, and is at par.

Rome and Western Road, built six months, declared a dividend on 1st May of 5 per cent., laying by a sinking fund. About 40,000 teams pass annually.

Rome and Taberg Road, nine miles.—In building this road the directors incurred a debt of $3500. In eleven months this sum has been paid off, and 5 per cent. divided.

Salina and Central Square Road, the stock, of which 80 is paid up, is worth 110. Seven and a half per cent. has been divided every six months, and the road has been kept in excellent repair, with a sinking fund to relay it. One hundred and fifty thousand teams pass through the first gate annually; eighty thousand may be considered the average travel.

Salina, Liverpool, and Clay, in operation eighteen months, has paid three dividends of 5 per cent., laying by a sinking fund. About 70,000 teams pass over per year.

Rome and Oswego Road has paid 10 per cent. annually, laying by a sufficient sinking fund. The revenue is $17,000.

Syracuse and Tully Road was put in operation in September, 1848.

It has paid three semi-annual dividends of 5 per cent. on the whole stock, of which 95 per cent was only called in, laying by a sinking fund. About 45,000 teams pass annually.

Oswego and Hastings Centre has one gate, at which $500 was collected between November, 1849, and March, 1850.

Oswego and Ha. sbal Road.—No dividend has been declared; the receipts have been taken to assist in construction. Seventy thousand teams pass through first gate.

Allen's Creek Road, Rochester, gives such large returns, that the directors decline stating them—frankly asserting the reason. Stock cannot be purchased.

Charlotteville Road has paid two half-yearly dividends of 10 per cent., and lays by a sinking fund. This stock cannot be purchased.

The stock of all the other roads in Rochester now in progress is already at a premium.

Aurora and Buffalo Road divided 25 per cent. in stock, owing to the instalments not having been paid in. The stock is held at par, and can fetch par price if offered for sale.

The above are a few of the instances of the return plank-road stock will make to the stockholder.

ON THE FACILITIES OF TRAVEL GIVEN BY PLANK ROADS.

There is some difficulty in instituting a comparison between a plank road and a railroad. Both have their distinct uses. The railroad is important to the manufacturer, the miner, the metal founder, who have to send their fabrics and their coal and iron a distance from their localities, the means of doing which they have to hire; and the numerous class of travellers who desiring to be carried with despatch, must seek a public conveyance. The plank road is for an agricultural population, and for the accommodation of those who, having cattle, need not incur the expense of motive power. To lay greater stress on the utility of the one, the circumstances of the comparison must be given.

To examine the difference of cost, we can refer to the Annual Report of Railroad Statistics for the State of New York, made to the Legislature 20th February, 1850. We learn in this document, that the whole amount which has been expended on the 1201 miles of railroad in the State, to set them in operation, is $46,604,921, giving an average per mile of $38,805 for construction, and about eight years' repairs. The cost of construction and of eight years' repairs on the plank road, may be assumed at $3106.*

The average pace of railway passenger trains is twenty-three miles an hour, and of freight trains fourteen miles an hour. The fare is about two cents per mile for long distances, and from three to six for short distances.

On the plank road a stage-horse can travel from eighteen to twenty miles a day, at the rate of seven to nine miles an hour.

Stages weighing from 1600 to 1800 lbs., carrying fifteen passengers, are drawn from Utica to Whitesboro, a distance of four miles, with two horses, for . . . . . 12½ cts.
To Yorkville, a distance of three miles, with two horses, for . 12½ "
To Waterville, sixteen miles, with eighteen passengers, four horses, (the same horses making two trips each way daily,) for . . 50 "
To Boonville, twenty-one miles, with eighteen passengers, four horses, for . . . . . 75 "
To Frankfort, fifteen miles, twelve passengers, two horses, for . 50 "

This is done at the rate of from six to eight miles an hour—the same horses performing one trip daily.

* Page 10.

From Rome to Waterton, a distance of seventy miles, a stage goes daily each way with seventeen passengers, for $2.50; the horses going backwards and forwards the same nine miles each day.

On the Salina and Central Square road, one stage carries sixteen passengers sixty-nine miles, for $3.50; while on the Syracuse and Oswego road the stage carries fifteen passengers thirty-five miles in four hours for 75 cents, while the railroad charges one dollar.

It is, therefore, evident, that travelling at the rate of seven to nine miles per hour, is performed on the plank road at three cents per mile.

We have then these results:

The cost of the railroad is at least twelve times as great as that of the plank road.

That travel for short distances can be done for less on the plank road than on the railroad.

In average distances, the fare on the plank road is three cents per mile, while on the railroad the fare is from* two to two and a half cents per mile:—nevertheless, in one instance the stage fare has been less than on the railroad.

Time is the only strong point of view favourable to the railroad, and it is found that the distance can be performed in one-third the time on the railroad to what it can be made on the plank road.

Whether to gain this advantage such an additional expense ought to be incurred, cannot be considered by the writer, abstractedly; but one fact is certain, that in an agricultural country it is manifestly to the greatest benefit of the farmer to have a well-laid causeway on which he can use his own motive power in bringing his produce to market.

Plank roads are the feeders of railroads and canals, and are not inferior to either in their particular uses. In some instances, indeed generally in manufacturing districts, speed is indispensable. But economy of transport, in an agricultural section of country, is the main point. In a former part of this work it was shown that the farmer can successfully compete with a railroad within one hundred miles of the market; therefore, it would seem that the plank road is of more utility to him. And it has this influence upon his property, that it raises it considerably in value—a remark which does not apply to the same extent to railroads.

There are a class of travellers who turn aside from the railroad. The Erie Canal statistics prove this sufficiently. Men of quiet temperament who dislike the bustle and excitement, and not being in great haste to arrive at their destination, take other conveyances.

That this class will increase when plank roads have been longer established, there is reason to believe.

CONSTRUCTION.

Where there is only a single track required, it is not the custom to lay the plank in the centre of the causeway; generally, the left-hand side of the road leading from the city is selected, by which arrangement loaded vehicles coming into the city have the right of way. Running parallel to the planks the road is carefully made, and the name by which it is now known indicates

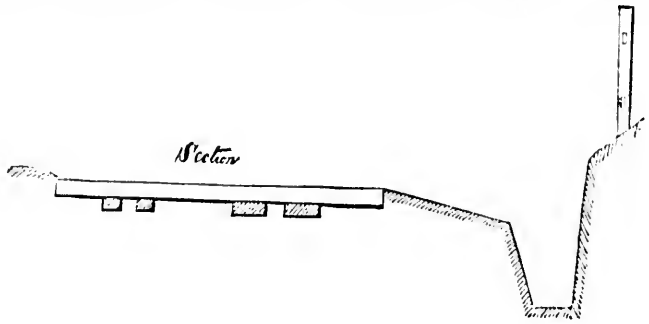
* It must be recollected that the grades on these roads vary from two hundred and fifty to three hundred and fifty feet in a mile, and, therefore, cannot be taken as a minimum price at which travel can be performed. It is possible, if the grades of the roads were reduced to a maximum of one hundred and fifty in the mile, that the expense of transporting passengers and merchandise would be from one-half to two-thirds the present price.

its use. It is called the "turn-off." Necessarily, it ought to be kept in sufficient repair—since vehicles going in either direction take the plank, and those not having the right of way, abandon it when meeting a vehicle which has.

For ordinary travel, a single plank track is sufficient—an assertion fully proved by very few roads having a double track. But if the press of business renders a double track necessary, it ought to be laid down in two tracks of eight feet, not in a single track of sixteen feet. The best mode is first to lay down a single track, and if found insufficient in any particular locality, such as the immediate approach to a city, another one can, of course, be added.

The cost of the several roads varies. This is attributable to the difference of the amount paid for surveying, right of way, grading and laying plank—the prices of lumber, and the expense of bridging, &c. The lumber which has been principally used is hemlock and white pine, until within the last few months, when hard wood has somewhat come into use, with a fair expectation of proving more suitable. On the Salina and Syracuse road, beech and maple have been laid, and on the Rochester road some elm—the latter not exceeding twelve inches in width. The principal experiments have been made with hemlock, and it has been proved that it is not the best fitted for the purpose. It is loose grained and knotty—consequently, the plank soon wears away, stringing off from friction, leaving hard knots standing erect. Independently of the rugged surface which these knots present, they may be classed among the principal causes which lead to the destruction of the road, for as the shoe of the horse strikes the knot it slips from it, and a cavity is made. White pine, which has been used, has the advantage of being free from knots. But it is argued that this wood is liable to decay. All lumber used on a road will undoubtedly decay of itself—even should it remain without any traffic passing over it. Two influences work upon the plank: the damp from below causing mildew, while the upper part is alternately drenched with water, and exposed to the burning heat of the sun. An examination of a plank long in use, is sufficient evidence of this fact. Against some of the influences it is not possible to guard, and they come under the head of wear and tear. But good construction will do much to obviate others. In the advertisements for the plank-road timber, great care has been taken to specify that the plank has to be sawed out of sound timber, free from wane sap, rottenness, knot holes, and excessive knottiness. Still these precautions are valueless where the timber is naturally imperfect, and in spite of the fears that pine becomes "dosy," yellow pine is a durable wood, free from knots, and is, therefore, preferable to hemlock, as it will keep longer sound.

The most important point in the construction of plank roads is drainage. Without drainage, however well a road may be otherwise laid, it cannot remain in good order. And a sufficient ditch should be cut, at least two feet



below the crown of road. The road should be well crowned up, so that the water would readily flow from it, with a firm bed made for the stringers. Where the soil has been made, a heavy roller (which can be formed with a portion of the trunk of a large green oak) should be passed over the roadway, till it is perfectly firm, and the sleeper should be imbedded in the soil, till the top is on a level with the earth. The planks then, laid transversely, require to be well mauled, until firmly settled; care being taken to drive each home to the one laid behind it. (See cut page 21.)

The mode of laying down stringers varies with the soil; and on this point there is some difference of opinion. It is generally conceded, however, that sand does not require so heavy a stringer as clay. On the Salina and Syracuse road, in order to ensure thorough and effective drainage, a transverse fall of two inches has been given to the planks. With such a declivity, (as is here shown,*) the load is unequally divided, and the weight

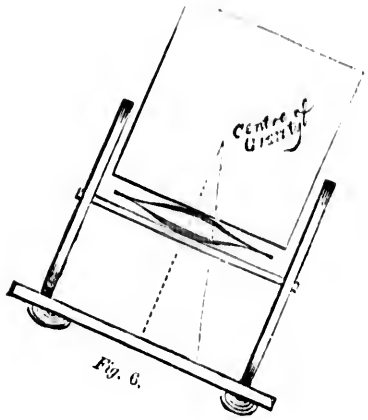


Fig. 6.

* The transverse fall of the road is here shown exaggerated, to obtain a diagram. It is evident that the load may be viewed as the resultant of two forces, represented by the sleepers. Dropping from the centre of gravity, lines perpendicular to the road and to the horizon, we form a triangle, the apex of which, it is almost a work of supererogation to say, is equal to the angle of declivity of the road. One line of the triangle, that perpendicular to the horizon, (the direction in which the weight of the load falls,) divides the space between the wheels into two unequal parts —the greater being half that distance, *plus* a length equal to a fraction of the distance which the centre of gravity is from the roadway. This fraction is of course equal to the ratio of declivity of the road.

It is therefore plain, that the load falls in the proportion of these unequal distances. Supposing the declivity 2 inches in 8 feet=2 inches in 96 inches, we have a fall of 1 in 48.

Let b be half breadth between wheels.
h height of centre of gravity.
a load.
x and y the two parts of the load.

$$x : y :: b + \tfrac{1}{48} h : b - \tfrac{1}{48} h$$

$$x + y = a$$

$$y = a - x$$

$$x\,(b - \tfrac{1}{48} h) = a\,(b + \tfrac{1}{48} h) - x\,(b + \tfrac{1}{48} h)$$

$$x = \frac{a\,(b + \tfrac{1}{48} h)}{2\,b}$$

$$y = a - \frac{a\,(b + \tfrac{1}{48} h)}{2\,b}$$

Supposing distance between wheels=5 feet.
Height of centre of gravity=4 feet.
Load 3 tons=60.

$$x = 3099.6$$
$$y = 2900.4$$

falls heavier on the lower, in the proportion of 3100 lbs. to 2900 lbs. in a load of three tons. Independently of this pressure against the lower lynch-pin and hub of the wheel, it is urged, that it is advisable to make the lower scantling (or stringer) double that of the upper, in order to guard against the increased pressure on the lower side of the road.

The accompanying sketch, fig. 2, will better explain the intention. The stringers are placed under the wheels—the two upper being 4" × 3", the two lower, 8" × 3"; an interval of 1 ft. 6" is left from the end of the plank to the stringer, with a space of six inches between the stringers, care being taken that the ends of no two stringers meet at the same point, so as to "break points"—as the joints in masonry are broken.

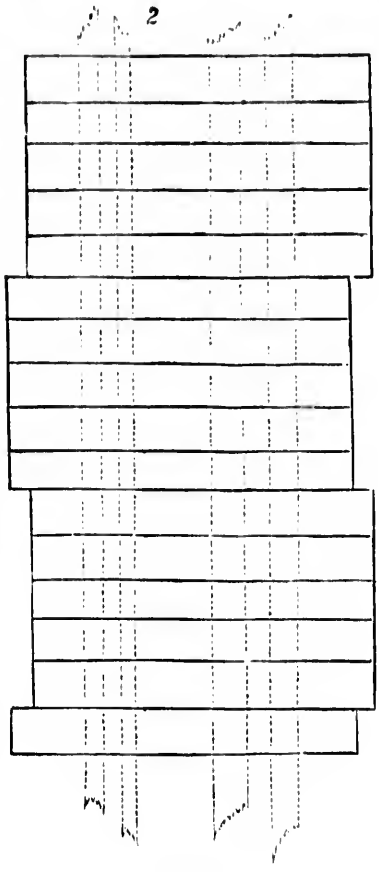


Fig. 2.

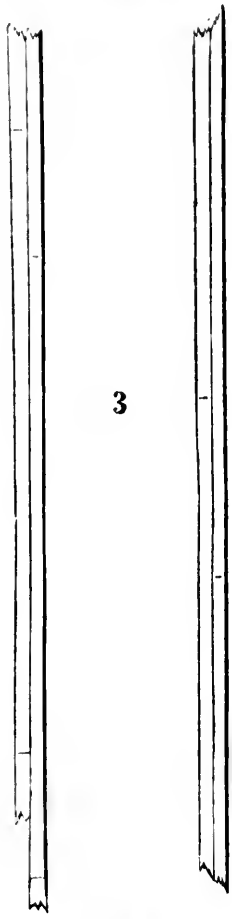


Fig. 3.

Others, again, think the difference of weight not a matter for consideration; and urge that the destruction of the axle is the only important point, and therefore, that the stringers should be equal in strength, in both positions,

placed together, 4″× 3″, with the joints broken, as in sketch fig. 3. This has been done on the Albany Road.

On the Allans' Creek Road, Rochester, the stringers are also laid double, but the scantling is 2″× 6″.

In some parts of Canada the stringers are altogether dispensed with, and the planks have been laid on the bare ground; the experiment was not fortunate. But an essay made with one inch boards is considered successful. These boards are laid longitudinally, about three inches apart, and the planks are exposed only to one influence of the two which act perniciously—that of the rain and sun—the mildew being prevented by the lower plank.

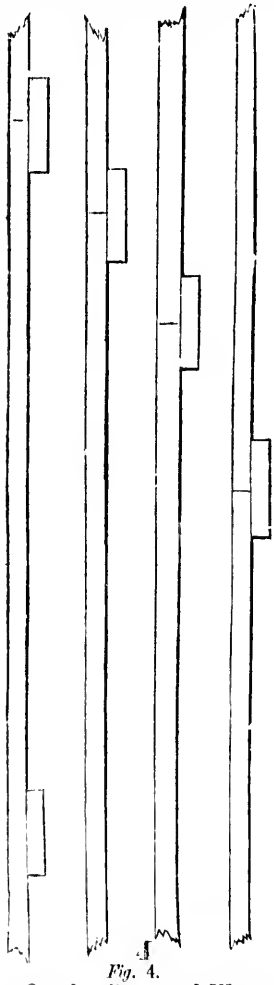


Fig. 4.

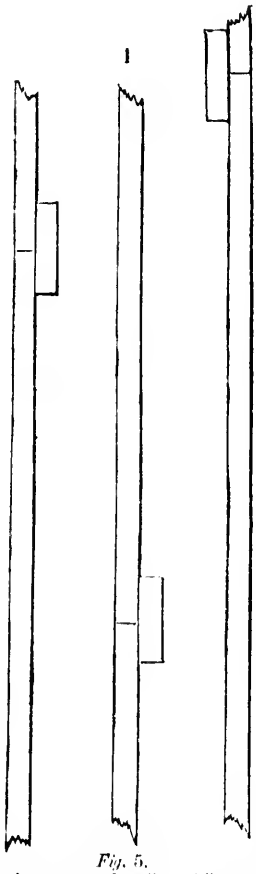


Fig. 5.

On the Rome and Western road, the four stringers, each 3″ × 5″, are divided as per sketch fig. 4, being 16 inches apart.

Most people agree in the main fact, that the stringers require breadth,

rather than thickness. For this reason, experienced engineers have reduced the number of stringers to three, each of 6 inches in width. One being placed in the centre, 6″ × 1″, and two others 6″ × 2″, laid 2 ft. from it, as at fig. 5.

The reason assigned for this distribution, is to give some support to the tread of the horse. In order to guard against any settling of the plank, the joints of the stringers are so laid, as to be made never at the same point. And in order to obviate any derangement of the joint, a lapping piece of two feet, extending one foot on each side of it, is placed close to the point of junction, giving firmness to the stringer in its bed, and making it the more incapable of being disturbed by the motion passing over it.

Where the stringers are laid singly, this lapping piece is paramount, and ought always to be introduced. The planks ought to be laid at right angles to the stringer. On this point there is but one opinion.

The transverse declivity, which some recommend for drainage, is named at one inch for the eight feet, in sandy soils, where the water is rapidly absorbed by the *substratum;* but as the contrary result is experienced in clay soils, a fall of two inches in the eight feet has, in such instances, been thought necessary. The ends of the planks, according to one opinion, ought not to be laid together in a straight line. They should, alternately, extend three inches out, presenting the appearance of a toothed slide. See fig. No. 2. The intention is, to prevent a deep rut from being formed along the planks, which, in a single track, is frequently occurring. The ends thus irregularly placed are protected by the soil of the road, which is crowned up sufficiently over them, to aid in keeping the planks in their place on the stringer. Side sluices are cut through the earth to the level of the plank, in the lower side of the declivity, at about a rod interval. The better description would be to make the directions, "where necessary;" for no positive rule can be laid down, and to carry this point out satisfactorily, the road must be often examined during wet weather, and egress must be given for the water to run off, without penetrating between the planks.

But, in order to acquire drainage, other modes of construction are recommended. The transverse declivity is open to some objections; causing additional wear, both to the road and the vehicle. Therefore, it must be apparent, that if thorough drainage can be obtained on the length of the road, without any counterbalancing disadvantages, it is preferable for the plank to be laid transversely on a level.

To gain this drainage, it is evident that, when the road is perfectly level, longitudinal gradients must be formed by art.

It is the opinion of most practical men, that is to say, parties in the habit of driving stage-coaches, and teamsters, that horses travelling over an undulating road suffer less than when passing over a level road. It is somewhat strange that this question has not been the subject of investigation, either in the proceedings of the State Legislatures, or in the parliamentary committees of Great Britain, when inquiries have been made relative to roads. Nor can much be learned on the matter, in the many books treating upon this branch of practical economy, which have been published from time to time on both sides of the Atlantic. With the limited means at the disposal of the writer, he has found but two writers who recur to it. Mr. Gillespie and the *celebrated Mr. Stevenson,—and the former merely adduces the latter as an authority. In the article on roads, in the Edinburgh Cyclopedia, written by Mr. Stevenson, a very cursory notice is made of the comparison. He draws no definite conclusions, though evidently leaning to an opinion in favour of a level—and merely cites the authority of an eminent

* The architect of Skerryvor lighthouse.

comparative anatomist, Dr. Barclay of Edinburgh, which Mr. Gillespie also quotes; the latter remarking:

"It is said that alternations of ascent, descent, and levels, call into play different muscles, allowing some to rest, while the others are exerted; and thus relieving each in turn. Plausible as this speculation appears at first glance, it will be found, on examination, to be untrue.

"'My acquaintance,' writes Dr. Barclay, 'by no means enables me to explain how a horse should be more fatigued by travelling on a road, uniformly level, than by travelling over a like space upon one that crosses heights and hollows; but it is demonstrably a *false idea* that muscles can alternately rest, and come into motion, in cases of this kind. Much is to be ascribed to prejudice, originating with the men continually in quest of variety, rather than with the horse.'"

The inference we may draw from the above is, that horses have not two sets of muscles. An opinion which may be safely said never prevailed among many who argued on the other side. But there is nothing whatever to warrant the inference, that in moderate ascents and descents, the periods of exertion and comparative repose on the single set of muscles, are not less trying than the continued and unvarying exertion which horses put forth on a level.

Still it must be allowed that the practical part of the community explained the result by supplying the horse with two complete sets of muscles. But it is not to follow, that, if the theory by which they accounted for their experience was faulty, their experience was also erroneous. Such, however, has been assumed. For while anatomists have disproved the existence of the causes popularly assigned for the facts, they have denied the facts the theory was intended to explain.

Coach masters and others interested, however, distinctly recognise the difference in the condition of the horse; and the experience of men addicted to field-sports leads to a like conclusion. Mr. Porter, the well known editor of the Spirit of the Times—an authority to command attention in such matters—does not hesitate to record his opinion to the same effect. And anatomists generally assert that relief to the tension upon muscles is imperative to the husbanding of strength, and that a muscle acting in a particular range finds its excitability exhausted; whereas, by occasionally changing the muscular action an effect is produced equivalent to bringing into use another set of muscles. Thus two influences must be sought after as the means of recruiting strength: a change of position, and a relaxation of muscular exertion—for the horse is not a machine, but an animal, which incessant monotonous exertion destroys.

Christian, a French writer upon strength and power applied to machinery, before steam had superseded animal labor, remarks:

"The principal means of obtaining the greatest advantage in any given circumstances from the strength of animals, is to prolong the day of work, and to multiply the intervals of repose." And it is evident that the varied forces exerted have the effect of periodically diminishing the tension upon the muscle, and thus giving intervals of repose. Consequently, to give the road these undulations, while they obtained drainage, would allow the wagon to run with an evenly balanced load, and at the same time relieve the horse from the excessive wear and tear, which coach proprietors assert to be the result of travel on a dead level.*

* The most undulating course in the United States is Lexington, Ky., where the fastest time has been made at mile heats.

It is customary for teamsters to assert, that to draw on the ice is more labour to the horse, than what they undergo with the draught on a longer and hilly road.

But against the introduction of this principle, where the road is naturally level, must be urged the great expense. It is, therefore, a question of cost for the directors of a road to decide. We learn, however, from this inquiry, that where the road is naturally undulating, there is no necessity to lay the planks transversely on a declivity, and that it is only necessary to do so on the level.

The opinion of the writer inclines towards obtaining drainage on a level, by the transverse fall, in preference to paying the great difference of price—more especially where the profile of the road varies in other directions, and the dead level is not continuous. But in cases like these, it is not possible to lay down general rules. The writer has, therefore, put before the reader both views of the question; and the circumstances under which the road is to be constructed, and the judgment of the engineer, must determine the choice of grade.

The following is the amount of lumber required per mile of plank road:

5280′×8′×3″	=126,720 feet board measure for superstructure.
2—5280′×3′×4″	= 10,560
2—5280′×3′×8″	= 21,120
	31,680 feet board measure for sleepers or stringers.
320 rods laying and ditching @ $1.	
Thus the cost of a hard wood road at the rate of $10 per 1000 feet, board measure, cartage included, 126,710 @ $10	1267
32,000 for stringers of hemlock, @ $6.50	208
Construction	320
	$1795

This is quite independent of grubbing and heavy cutting; and where the ground would require much formation to bring it to the road bed, allowance must be made to meet the cost.

Sand or fine gravel should be strewn over the road sufficiently to save the calks of the horse's shoes from cutting the plank, and the tire of the wheel from wearing it. All agree that the saving of wear is from 40 to 50 per cent.; for the grit, independently of preventing the shoe from cutting the wood, pene-

The writer has been assured, by a personal friend and a gentleman of extended experience, that a pair of his horses, remarkable for their great powers of endurance, tested severely on several occasions, were never off their feet, except in one instance, when driven from Hudson to Poughkeepsie on the ice, which for them was a moderate day's work.

The same gentleman also adds another instance of his experience: and, certainly, if the preference must ever be given to the level road, it must be for the saddle horse.

"In the fall of 1848, on account of ill health, I rode from Albany to Niagara and back—a distance of about eight hundred miles. During that ride I invariably found my horse seemed the freshest when his preceding day's work had not been done on a level road. He appeared more tired, I remember, after thirty-five miles travelled on the tow-path of the canal, than after much longer rides over an ordinary line of country.

"Since that time I have had occasion to take several long and hard rides, and have always observed the same result.

"The day succeeding a hard drive, is the best for observing its effect: and I think it will generally be found that horses are then more apt to be stiff or dull if they have been driven chiefly on a uniformly graded road, during the previous day."

[As Postmaster of Baltimore, and Assistant Postmaster General, the publisher of this Essay—the editor of the Plough, the Loom, and the Anvil—had, for many years, much intercourse with old stage proprietors, and often learned from them that stage horses always working on level roads would break down sooner than if working on undulating roads. Long before the railroad was constructed between Baltimore and Washington, the celebrated "Fuller's line" of stages was put on in opposition to the old line, and the rate of travel was so much increased as to make a still well-remembered *epoch* in stage travelling between the two cities. The first time we travelled in the New England line, these differences were noticed in its favour: The "ribbons"

trates into the grain and forms a protective coat, which the travel indurates, and, penetrating between the interstices, it in some measure prevents the passage of the water in wet weather. It is not possible to keep the water entirely out; but good drainage and careful construction can so form the road, that only the water which falls upon it passes over it. Thus, on a road well kept up, with efficient drainage, water will flow off without causing damage.

The law which governs the higher grades is alike in all cases; but when the consideration of their effect, with regard to plank roads, is entered upon, it is not irrelevant to mention that farmers affirm they pass over a grade of 1 in 20 with an average load, apparently with the ease they travel on a level; 1 in 16, even, is not regarded as objectionable either by teamsters or stage-coach proprietors. If such be the case in practice, it is opposed to the established theory, and can only be accounted for by supposing that even with the additional resistance caused by the ascent, the ease of draught is so great, that the horse has to put forth little additional strength.

But it has been found that the steeper the grade the heavier has been the wear on the planks; and in places where the grade has ranged from 1 in 12 to 1 in 16, the increased wear is apparent in the ratio of double what it is on a level. The Oswego and Hastings road, although newly laid, has so much deteriorated on its acclivities, that it is proposed to take up the plank and relay them with less grades before they are totally destroyed.

It is, therefore, considered an economy to reduce heavy grades even at the expense of some cutting to 1 in 20—the saving in the wear of plank paying for the extra expense; consequently, it follows that the less the acclivity the less the wear, until it reaches the angle at which horses can ascend by putting forth little additional power beyond what is called for on a level. On plank roads this may be assumed proximately at 1 in 40.

The writer here concludes his remarks, believing that he has established the moderate cost and the great benefits of plank roads. As yet they are but an experiment in the United States, and novelty may have aided to obtain the support they have received. It is to be hoped that permanent good will result, and that careful construction and good management will prove the extent to which they are adapted to advance the great problem of civilization—Progress.

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were put in the *gloved hands* of well-dressed, polite, well-behaved, "smart" men, and the team driven at speed down each hill, so as, by the impetus, to be thrown, without effort, nearly up the next ascent, more or less, according to its grade and length. This arrangement with northern men and *horses* shortened the route of thirty-eight miles by an hour, or more.]

APPENDIX.—*Schedule of Roads, showing Cost of Construction.*

Date since road has been in operation.	Road	Length.	Where laid down.	What paid for right of way.	Description of timber used.	Price paid for lumber per 1000 feet B.M.	Cost per mile.
Nov. 1849	Great Western, Albany	11	On old highway	0	1″ hemlock	$9.87	Timber 200,640 ft. B.M. per M. $9.87=1980.32; construction 575: total $2555.32
Nov. 1849	Fonda and Carogo	18½	Opened out	$2000	3″ do	$6.50	Inclusive all cost $1850
Sept. 1849	Fultonville and Johnstowne	5	Opened out	$1800, and for bridge across Mohawk $5800.	3″ do		Total cost 24.000
Sept. 1848	Rome and Utica	15	Old highway	0	3″ do	$6.00	Including toll-houses and all cost single track $1713.50; Double $3427
Sept. 1848	Northern Road, Utica	22	Old turnpike road, and continued on	$8000 for old turnpike road right of way, $4000	3″ do	$5 to $6.50	$1800
Sept. 1849	Utica and Burlington	5½	On old highway	0	3″ do	$6.00	$2100
Fall 1847	Rome and Oswego	60	Old highway	0	3″ do	$5 to $6.00	$1500
1849	Rome and Western	11	Opened out	$1500	3″ do	$6.00	Inclusive all expenses $1500
1849	Rome and Taberg	9	Old highway	0	3″ do		$1500
1849	Rome and Madison	22	do	0	3″ do		Contract taken per running mile $1250
1847	Salina and Central Square	16	do	0	4″ do		Inclusive all expenses $1500
1849	Syracuse and Manlius Centre	8	do	0	3″ do	$7.00	$1200
1849	Syracuse and Bridgeport	12	do	0	3″ do	$6.00	$1400
1849	Syracuse and Oswego	32	do	0	3″ do	$6.44	$1300
1849	Salina, Liverpool, and Clay	11	do	0	3″ do	$5.38	$1400
Oct. 1848	Syracuse and Tully	18¼	do	0	3″ do	$6.00	$1500
	This road is to be continued	7¾		0			Contracted for $1150
	Split Rock Road		On old railroad	0	3″ hemlock; 3″ elm; 3″ beach; and maple	$6.00; $7.00; $9.50	$1600
Nov. 1848	Hannibal and Oswego	11	Old county road	0	3″ hemlock and pine		$2000
Nov. 1849	Hastings and Oswego	5	do	0	3″ hemlock	$6 to $6.50	$1300

ON ROADS IN GENERAL.

BY F. G. SKINNER.

FIRST LESSON.

THERE are few things that indicate more truly the degree of prosperity in a district or neighbourhood than the condition of its public roads. There is no greater labour-saving invention than that of good roads, and among those that are in existence, the difference as to ease, rapidity, and economy of transportation, caused by the various degrees of skill and labour bestowed upon them, is much greater than is usually imagined, particularly by farmers, whom they most concern.

One important difference lies in the grades, or longitudinal slopes of a road. Suppose that a road rises a hundred feet in the distance of two thousand feet. The ascending slope is then one in twenty: that is, in advancing twenty feet, you rise one foot; and, as it can be proved, one-twentieth of the entire load drawn over it in one direction must actually be *lifted up* this entire height of one hundred feet. But upon such a slope a horse can only draw *one-half* as much as he can upon a level road, and two horses will be needed on such a road to do the usual work of one. If the road is skilfully constructed, and made level, by going round hills instead of over them, there will be a saving of one-half of the former expense of carriage on it.

Another great difference in roads lies in the nature of their *surfaces*; one being hard and smooth, the other soft and uneven. On a well-made road of broken stone, a horse can draw *three times* as much as he can upon a gravel road. By making, then, such a road as the former in the place of the latter, the expenses of transportation will be reduced one-third of their former amount. So that two-thirds will be completely saved, and two out of three of all the horses formerly employed can then be dispensed with.

If such an improvement can be made for a sum of money, the interest of which will be less than the total amount of the annual saving of labour, it will be true economy to make it, however great the original outlay; for the decision of all such questions depends on considerations of comparative profit.

The profits of such improvements are not confined to the proprietors of a road, (whether towns, or companies, remunerated for these expenditures by tolls,) but are shared by all who avail themselves of the increased facilities—consumers and producers as well as road owners. If wheat be worth in a city a dollar per bushel, and if it cost 25 cents per bushel to transport it thither from a certain farming district, it will there necessarily command only 75 cents. If now, by improved roads, the cost of carriage is reduced to 10 cents, the surplus—15 cents on each bushel—is so much absolute gain to the community, balanced only by the cost of improving the road. Supposing that a toll of five cents will pay a fair dividend on this, there remains 10 cents per bushel to be divided between the consumer and the producer, enabling the latter to sell his wheat at a higher price than before, while at the same time the latter obtains it at a less cost.

Agriculture is thus directly and likewise indirectly dependent in a great degree upon good roads for its success and rewards. *Directly*, we have just seen these roads carry the productions of the fields to the markets, and bring them in return their bulky and weighty materials of fertilization, at a cost of labour which grows less and less as the roads become better. *Indirectly*, the cities and towns, whose dense population and manufacturing in-

dustry make them the best markets for farming produce, are enabled to grow and extend themselves indefinitely, by roads alone, which supply the place of rivers, to the banks of which these great towns would otherwise be necessarily confined. While, therefore, it would be an inexcusable waste of money to construct a costly road to connect two small towns which had little intercourse, it would be equally wasteful, and is a much more frequent short-sightedness of economy, to leave unimproved, and almost in a state of nature, the communications between a great city and the interior regions from which its daily sustenance is drawn, and into which its own manufactures are conveyed. Among the most remarkable consequences of the improvement of roads, is the rapidly increasing proportion in which their benefits extend and radiate in every direction, as impartially and benignantly as the similarly diverging rays of the sun. Around every town or market-place, we may conceive a number of concentric circles to be drawn, enclosing areas from any part of which certain kinds of produce may be profitably taken to the town, while from any point beyond each circumference, the expense of the carriage of the particular article would exceed its value. Thus the inner circle, at the centre of which is the town, may show the limit in every direction beyond which perishable vegetables, or articles very bulky or heavy in proportion to their value, cannot be profitably brought to market; the next larger circle may show the limit of fruits; and so on. If, now, the roads are improved in any way, so as in any degree to lessen the expense of carriage, the radius of each circle is correspondingly increased, and the area of each is enlarged as the *square* of this ratio of increase. Thus, if the improvement enables a horse to draw twice as much, or to travel twice as fast as he did before, each of the limiting circles is expanded outward to twice its former radius, and embraces *four* times its former area. If the rate of improvement be three-fold, the increase of the area is *nine-fold*; and so on. All the produce, industry, and wealth which by these improvements finds, for the first time, a market, is as it were a new creation.

Supposing that by these improvements the average speed over a whole country be only doubled, the whole population of the country (to borrow a metaphor from an accomplished writer) would have advanced in mass and placed their chairs twice as near to the fire-side of their metropolis, and twice as near to each other. If the speed were again doubled, the process would be repeated; and so on. As distances were thus gradually annihilated, the whole surface of the country would be as it were contracted and condensed, till it was only one immense city: and yet, by one of the modern miracles of science wedded to art, every man's field would be found not only where it always was, but as large as ever it was, and even larger, estimating its size by the increased profits of its productions.

QUESTIONS.

1. Why are good roads a labour-saving invention?
2. Why is the grade of a road a matter of great importance?
3. What is the difference in expense in hauling on a level road and on a road with an inclination of one foot in twenty? and why, then, this difference?
4. What is said of the difference in the surfaces of roads?
5. If a road can be so improved as to enable one horse to draw upon it a load that before required three, what amount of money can with good economy be laid out upon the improvement?
6. Are the profits of a road confined to its actual owners?
7. How do you prove this?
8. How is the agricultural interest directly benefited by good roads?
9. How indirectly benefited?
10. Among the remarkable consequences of the improvement of roads is what?
11. Show how these benefits extend?
12. What is the effect upon a community by doubling the speed of its communications?

SECOND LESSON.

ROADS. (*Continued.*)

As the limits of this work will not admit of an extended treatise on road-making, we must be content with giving such general directions for their construction as every farmer should be acquainted with.

There are five important points to be considered in the construction of all roads—1. Their direction. 2. Their slopes or inclinations. 3. Their cross section. 4. Their surface. 5. Their cost.

IMPORTANCE OF STRAIGHTNESS.

Every road—other things being equal—should be *perfectly straight*, so that its length, and therefore the time and labour expended in travelling upon it, should be the least possible; *i. e.* its *alignments*, or directions, departing from one extremity of it, should constantly tend towards the other.

Any unnecessary excess of length causes a constant three-fold waste: firstly, of the interest of the capital expended in making that unnecessary portion; secondly, of the ever-recurring expense of repairing it; and, thirdly, of the time and labour employed in travelling over it.

ADVANTAGES OF CURVING.

The importance of making the road as *level* as possible, will be explained in the next section. And as a road can in few cases be at the same time straight and level, these two requirements will often conflict. In such cases, *straightness should always be sacrificed to obtain a level or to make the road less steep.* This is one of the most important principles to be observed in laying out or improving a road, and it is the one most often violated.

A *straight* road over an uneven and hilly country, may, at first view, when merely seen upon the map, be pronounced to be a *bad* road; for the straightness must have been obtained either by submitting to steep slopes in ascending the hills and descending into the valleys, or these natural obstacles must have been overcome by incurring a great and unnecessary expense in making deep cuttings and fillings.

A good road should wind around these hills instead of running over them, and this it may often do without at all increasing its length. By way of illustration, take an apple, lay it upon a table, and draw a level line from stem to eye, by going round it, and it will not be found one particle longer than if the line were drawn between the same points passing over the top. Precisely so may the curving road around a hill be often no longer than the straight one over it; for the latter road is straight only with reference to the vertical plane which passes through it, and is curved with reference to a horizontal plane; while the former level road, though curved as to the vertical plane, is straight as to a horizontal one. Both lines thus curve, and we call the latter one straight in preference, only because its vertical curvature is less apparent to our eyes.

The difference in length between a straight road and one that is slightly curved, is very small. If a road between two places ten miles apart, were made to curve so that the eye could nowhere see farther than a quarter of a mile of it at once, its length would exceed that of a perfectly straight road between the same points by only about one hundred and fifty yards.

But even if the level and curved road were very much longer than the straight and steep one, it would almost always be better to adopt the former, for on it a horse could safely and rapidly draw his full load, while on the other he could only carry part of his load up the hill, and must diminish his speed in descending it. As a general rule, the horizontal length of a road

may be advantageously increased, to avoid an ascent by at least twenty times the perpendicular height which is to be thus saved; that is, to escape a hill a hundred feet high, it would be proper for the road to make such a circuit as would increase its length two thousand feet. Farmers are too unwilling to allow a road to run through their farms in a winding line. They attach more importance to the squareness of their fields than to the improvement of the lines of their roads; not being aware how much more labour is wasted by them in travelling over these steep roads, than there would be in cultivating an awkward corner of a field.

This feeling is carried to such excess in some of the Western States, that the roads run along the section lines, and as these invariably point north, south, east, or west, it follows that a person wishing to cross the country in any other direction, must do so in rectangular zigzags.

QUESTIONS.

1. What are the important points to be considered in the construction of roads?
2. Why is straightness important?
3. What is the effect of unnecessary length?
4. Straightness should always be sacrificed to what?
5. Why may a straight road merely seen upon the map, be generally pronounced a bad road?
6. How do you prove that a road may wind around a hill without increasing its length?
7. Is there any great difference in the length of a road slightly curved, and one that is straight?
8. What is the difference in the length of two roads between two points ten miles apart, when one road is so curved as to prevent the eye from seeing farther than a quarter of a mile of it at a time, and when the other is straight?
9. What is the general rule by which the horizontal length of a road may be increased to preserve a level?
10. Why should farmers sacrifice the shape of their fields to winding roads?
11. What is the effect of this prejudice among farmers in the West?

THIRD LESSON.

SLOPES.—LOSS OF POWER ON INCLINATIONS.

Every road should be *perfectly level*. If it be not, a large portion of the strength of the horses which travel it will be expended in raising the load up the ascent. When a weight is drawn up an inclined plane, the resistance of the force of gravity, or the weight to be overcome, is such a part of the whole weight as the height of the plane is of its length. If, then, a road rises one foot in every twenty of its length, a horse drawing up it a load of one ton, is compelled to actually lift up one-twentieth of the whole weight—*i. e.* one hundred pounds through the whole height of the ascent, besides overcoming the friction of the entire load.

The power of a horse, owing to its anatomical form and great weight, is much diminished upon an ascent, and in even a greater ratio than that of a man. Though a horse on a level is as strong as five men, yet on a steep hill it is less strong than three; for three men, carrying each one hundred pounds, will ascend faster than a horse with three hundred pounds.

Inclinations being always thus injurious, are particularly so where a single steep slope occurs on a long line of road which is comparatively level. It is in that case especially important to avoid or to lessen this slope, since the load carried over the whole road, even the level portions of it, must be reduced to what can be carried up the ascent. Thus, if a long slope of one in twenty-four occurs on a level road, as a horse can draw up it only one-half of his full load, he can carry over the level parts of the road only half as much as he could and should draw thereon.

The bad effects of this steepness are especially felt in winter, when ice covers the road, for the slippery surface causes danger in descending, as well as increased labour in ascending. The water of rains, also, runs down the road and gulleys it out, destroying its surface, and causing a constant expense for repairs, oftentimes great enough to pay for a permanent improvement.

The loss of power on inclinations being so great as has been shown, it follows that it is very important never to allow a road to ascend or descend a single foot more than is absolutely unavoidable. If a hill is to be ascended, the road up it should nowhere have even the smallest fall or descent, for that would make two hills instead of one; but it should be so located, and have such cuttings and fillings, as will secure a gradual and uninterrupted ascent the whole way.

QUESTIONS.

1. If a road be not perfectly level, how is a portion of the strength of the horse or horses expended?
2. In drawing one ton up a hill that rises one foot in twenty, how much of the load is the horse compelled to lift up the whole height?
3. Is the power of a horse diminished upon an inclined plane?
4. When are inclinations particularly injurious, and why are they so?
5. Why are the bad effects of steepness particularly felt in winter?
6. Why should the ascent of a road be gradual the whole way?

FOURTH LESSON.

EARTH ROADS.

Roads of earth, with the surfaces of the excavation and embankments unimproved by art, are very deficient at all times in the important requisites of smoothness and hardness, and in the spring are almost impassable. But with all their faults, they are almost the only roads in this country, (the scantiness of labour and capital as yet preventing the adoption of better ones,) and therefore no pains should be spared to render them as good as their nature will permit.

The faults of surface being so great, it is especially necessary to lessen all other defects, and to make the road in all other respects as nearly as possible what it ought to be. Its grades should therefore be made, if possible, as easy as 1 in 30, by winding around the hills, or by cutting them down and filling up the valleys. Its shape should be properly formed with a slope of 1 inch in 20 each way from the centre. Its drainage should be made very thorough, by deep and capacious ditches, sloping not less than 1 in 125. Drainage alone will often change a bad road to a good one, and without it no permanent improvement can be effected. Trees should be removed from the borders of the road, as intercepting the sun and wind from its surface.

If the soil be a loose sand, a coating of six inches of clay carted upon it, will be the most effective and cheapest way of improving it, if the clay can be obtained within a moderate distance. Only one-half the width need be covered with clay, thus forming a road for the summer travel, leaving the other sandy portion untouched, to serve for the travel in the rainy season.

If the soil be an adhesive clay, the application of sand in a similar manner will produce equally beneficial results. On a steep hill these improvements will be particularly valuable. When a road is worn down into hollows, and

requires a supply of new material, its selection should be made with great care, so that it may be as gravelly as possible, and entirely free from vegetable earth, muck, or mould.

No sod or turf should ever be allowed to come upon the road, to fill a hole or rut, or in any other way; for, though at first deceptively tough, they soon decay and form the softest mud. Nor should the road-maker run into the other extreme, and fill up the ruts and holes with stones, which will not wear uniformly with the rest of the road, but will produce hard bumps and ridges.

The plough and the scraper should never be used in *repairing* a road. Their work is large in quantity, but very bad in quality. The plough breaks up the compact surface, which time and travel had made tolerable; and the scraper drags upon the road from the side ditches, the soft and alluvial matter which the rains had removed, but which this implement obstinately returns to the road.

A very good substitute for the scraper, in leveling the surface of the road, clearing it of stones, and filling up the ruts, consists of a stick of timber, shod with iron, and attached to its tongue or mass obliquely, so that it is drawn over the road "quartering," and throws all obstructions to one side. The stick may be six feet long, a foot wide, and six inches thick, and have secured to its front side a bar of iron descending half an inch below the wood.

Every hole or rut should at once be filled with good materials, for the wheels fall into them like hammers, deepening them at each stroke, and thus increasing the destructive effect of the next wheel.

The resistance decreases as the *breadth of the tire* increases on compressible roads, as earth, sand, gravel, &c.

QUESTIONS.

1. What is said of the grades of an earth road?
2. How should its shape be formed?
3. How is the drainage performed, and what are its effects?
4. What is done in case the soil is a loose sand or an adhesive clay?
5. How are the ruts and holes in an earth road to be filled up?
6. Why is turf or sod not to be used?
7. What are the objections to stone for filling ruts?
8. Why is the plough to be rejected in repairing roads?
9. What substitute for the scraper is recommended?
10. Why should ruts be filled immediately?
11. What will decrease the distance on dirt roads?

[The Editors are indebted, in a great measure, for what is most useful in these lessons to Professor Gillespie's admirable work on road-making, that ought to be in the hands of every reading farmer.]

ON THE CONSTRUCTION OF PLANK ROADS.

PLAN, MATERIALS, COST, AND DURABILITY.

WASHINGTON, *May* 25, 1850.

J. S. SKINNER, ESQUIRE:

DEAR SIR—In reply to yours of the 8th inst., I have to say that I have seen plank roads constructed, and have rode on them, and am interested in two of considerable extent.

There are three of these roads that touch on my farm, and pass on it over two miles. They are the best roads imaginable—better by far than the best paved or "macadamized" road, pleasanter for the person riding, easier for the animals, and far less destructive to the carriages that roll upon them.

In the State of New York they have adopted, by common consent, a grade of not over one foot in sixteen, and this is rigidly adhered to. A good span of horses will draw, on a road of that grade, a hundred bushels of wheat thirty miles in a day with ease; a smart span of horses will draw forty hundred forty miles a day. I mean horses of good breed, action, bone, muscle, &c., horses that will weigh when in good working order nine hundred each.

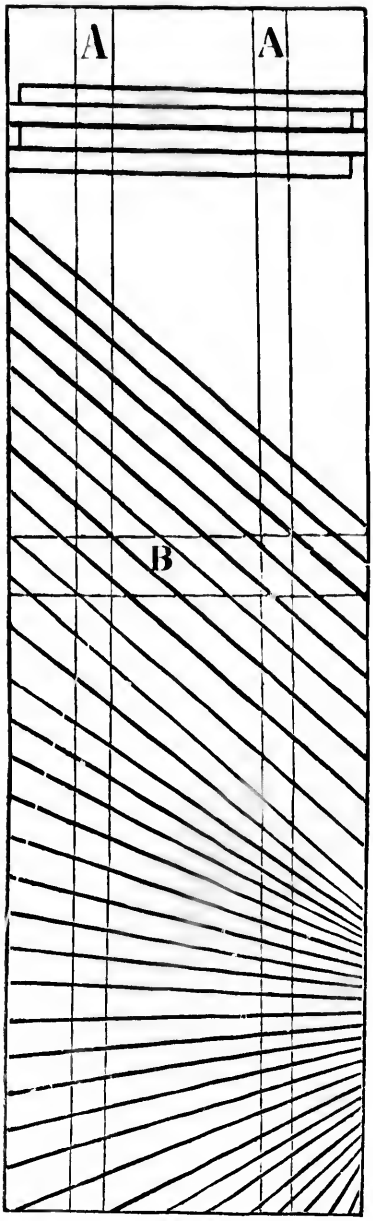
The average motion of the stage on these roads is eight miles an hour.

A very little snow—six inches—is enough to make capital sleighing, and you can drive in the night as well as in the day, for the horses will instinctively keep the road. The roads are usually eighteen feet wide, and the centre of it only is covered with plank eight feet long. In a very sandy soil there is no need of a raised road, as the porous nature of the soil absorbs the water without the aid of any drain.

In other soils the road is formed like a turnpike, with suitable well-formed drains or ditches each side, giving the best chance for the water to run off. The intention is, to have no water standing on the road or by its sides. Your road being thus formed, the first process is, to lay the "*stringers*" as at AA. These should be of two inch plank and not less than one foot wide, and, on every account, are far preferable to square scantling. They should be so imbedded in the road, that the soil or material of the road should be plump up to and even with their upper surface; and at such distance apart, say four feet from centre to centre, as that the wheels of the carriage, with the ordinary length of axle, will travel over the centre of the stringers. These stringers are both to be of the same grade, and the same level.

The stringers being laid for a short distance ahead, the planks are laid on them. To do this with accuracy, two parallel lines are stretched on the outside of the stringers, eight feet and about six inches apart. The first plank that is laid, will, of course, touch the line on one side, while its other end will not quite touch the opposite line. The second plank will touch the line on the opposite side, and leave a space between it, and the line which had been touched by the preceding plank; and so on alternately, so that there will be a *jog* on each side for the outside wheel to catch on, and recover its place on the road, when by any means it has got off, both wheels resting again on the plank instead of cutting a rut in the earth at the end of them.

When the plank is laid, the stringers must have no earth or other matter or material on their surface; and each plank must be settled with a "commander," or large wooden mallet, until it rests flat and plumb on the stringers, and solid on the ground from end to end, no space being left for air beneath them. Each plank should be laid close to the preceding one, and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B

driven up to it with the commander. No pinning is necessary. When the road is thus well laid, it is very difficult to raise a plank. It can hardly be done, except with a lever. The plank being laid, the next business is to embank a little more earth on the sides of the road, so as to raise the road on each side at least three or four inches above the surface of the plank. It will soon pack so as to be on a level, and should not be permitted to be, when packed, lower than the surface of the plank—thus the planks are kept from moving endwise, and it is easy to get the wheel of the wagon on to the plank, when it gets off when one carriage is passing another, or otherwise.

Where there is no heavy grading and not an unusual amount of bridging, and where plank can be delivered on the road for five dollars a thousand, one thousand dollars will pay for making a mile of plank road.

There is some inconvenience and some additional expense in cutting the plank only eight feet long, that length is not suited to the sled on which the plank is brought in winter from the woods to the mill, and it requires a greater number of logs to be loaded and sawed and a greater number of planks to be handled. This inconvenience may be obviated by cutting the logs of any convenient length; say twelve feet, and laying the plank *diagonally* across the sleepers. It is needless to add, that when thus laid, the sluice-ways are covered without the aid of cross pieces. This mode of laying the plank diagonally has not found much favor, but it is thought that planks thus laid will wear longer than if at right angles with the stringers, and that the wheel rolls easier on a plank lengthwise, or partially so.

But if this mode is adopted, it is desirable that there should be, at intervals of half a mile, a change in the direction of the planks, as is illustrated in the diagram, which also shows the position of the stringers, and the mode in which the sluice is carried, as at B. Unless there is this change in the direction of the plank, the wheels of the carriage will crowd and grind on the same shoulder of the axle and the same linch pin all the time. It is a proper precaution to have "washers" against both the shoulder of the axle and the linch pin always covered with some anti-friction composition; otherwise, in fast driving, the hub of the wheel will heat. There is in most axles what is called the "gather," that is an inclination which induces the wheel to run *on*, rather than *off* the axle; there is no inconvenience in this on common roads, for its effect is continually counteracted by the inequality of the road. On the plank road, where the planks are laid at right angles with the stringers, the tendency of the wheel that has a "gather" in its axle, is continually to crowd the shoulder. There is no use in this gather anywhere, and it is particularly injurious on plank roads. There is much saving in sawing the logs through and through, and then edging the plank; and there is no need that the plank should have square and full corners on each side; it is enough if, on the under side of the plank, both bottom edges are straight, for an inch of its width, from end to end. The "*wane*" on the upper side, will immediately fill with dirt; but it is well not to place two waney planks together, and always lay the waney side of the plank up. Waney is a word in common use, as distinguished from straight. As to the durability of these plank roads, the estimate is, that they will require to be covered once in seven or eight years, unless there is so much travel as to wear out the plank sooner, which is an event devoutly to be wished; but the stringers, being continually moist and nearly excluded from the air, will outlast three coverings.

I have no doubt that, in the free use of pulverized charcoal, or some other antiseptic material to imbed the plank in, the means will be devised of saving the plank from rotting; and I have no doubt that a thin coat of hot pitch, on the top of the planks, with gravel sifted on, would in a great degree prevent the planks from wearing out.

In common roads, where lumber is plenty, the plank road is the greatest improvement that has yet been made; and we, who have spent most of our days where, in the spring and fall, the roads were nearly impassable, and in the summer none too good, are impatient when we reflect how much needless toil and expense we have undergone, and how much we have suffered, by being jolted over corduroy roads. I have no doubt that a plank road from Albany to Sackett's Harbor would have saved the government, during the war of 1812, ten millions of dollars.

The toll house should extend across the road, so that when the traveller stops to pay toll, he should be under the shelter of the roof, and it is desirable, that it should be a comfortable dwelling, with cellar and cistern, and well and garden, and then the plank road company will be more likely to obtain the services of a civil, respectable, and honest family, to tend their gate. The gate should "*swing*"—accidents are apt to occur if the gate is made to rise. I have thus, I believe, given an answer, perhaps too tedious and minute, to your inquiries.

I remain, with great respect, your obedient servant,

CHARLES E. CLARKE.

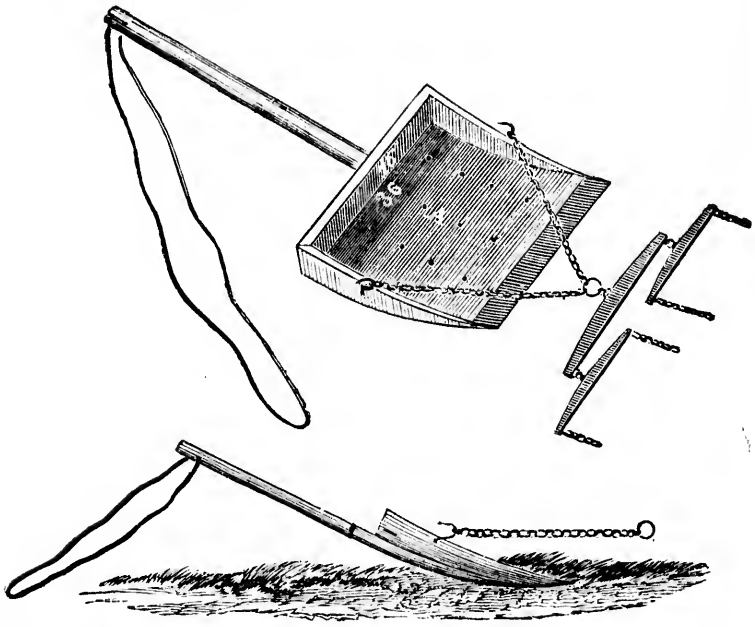
We have deemed it best to add the above to Mr. Kingsford's essay, being desirous that the reader should possess all that is in our possession on the subject. If there be any discrepancy in the suggestions of different writers, he can decide for himself. On the whole, with the statistics and directions here given, any man, or company, may, we apprehend, decide as to the cost and expediency of building a plank road; and with such directions and diagrams, any good carpenter can execute the work.

THE MOULDEBART.

The implement here illustrated, is now more generally known than it was twenty-six years ago, when the present Editor of the Plough, the Loom, and the Anvil, caused it to be engraved for the American Farmer, from a work, then recently published, on Flemish Husbandry.

It seems to have served as a model for scrapers used in the construction of turnpike and other roads, water-ponds for cattle, &c., and it is obvious that such an implement would be highly useful for many purposes, besides making plank and other roads, where loosened earth is to be moved to a short distance. By its means, for example, old dunghills and farm yards, being ploughed up, may be quickly collected in masses, ready for being transported by other conveyances to any distance. It might be used too for constructing rough ditches, and for collecting the ploughed earth on head-lands for making composts.

The author of the work on Flemish Husbandry says, "Too much cannot be said in favour of its efficacy in removing soil from one part of the field to another, in the easiest and most expeditious manner, which has established its general use in Flanders, and ought to recommend it everywhere. The person who drives with long reins, by pressing moderately on the handle as



the horses go forward, collects and transports about five cwt. of earth to the place where it is to be deposited; which is effected in the most summary manner, by his letting go the handle. This causes the front or edge of the machine to dip and catch against the ground, whereby it is at once inverted and emptied of its load. The extremity of the handle, to which a rope is affixed, by this inversion, strikes against and rests on the swingle tree bar, and in this manner the Mouldebart is drawn along towards the accumulated earth, when, by taking up the rope, the driver draws back the handle, collects his load as before, proceeds to the spot which is to receive it, and the horses are never for a moment delayed."

It should be shod with iron on the lower front side, and is drawn by a pair of horses or oxen with swingle trees.

We hope the representation of this implement will not be deemed inappropriate in this connection. To some it may be new even now, though not to the extent that it was when presented to the public eye so many years since.

There is nothing that contributes more to good and efficient management, than to have an abundance of good and efficient implements and machinery: a point in which most farms are sadly deficient; and especially in regions of country where circumstances compel the agriculturist to cultivate only such things as will bear keeping and transporting to distant markets. In such case, so much is extracted and borne away from the land, and so little restored to it, that the land and its owner become poor together, and bad machinery and decay take the place of enterprise and good implements.

THE END.

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