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GENERAL PRINCIPLES AND INVESTIGATION OF FORMULÆ.

In making excavations through earth, it is customary to give some inclination or slope to the sides of the cuts to prevent the banks from sliding in and filling the roadway. The degree of inclination is always indicated by the distance the slope recedes from a perpendicular in a height one.

Thus, if the deviation from the perpendicular is equal to the depth of the cut, (or the inclination is 45°,) the side banks are said to have a slope of 1, or, as it is frequently expressed, of 1 to 1. If the deviation is ½ the depth, the slope is ½ to 1.

In excavations through rock, or very hard clay, a slope of ½ to 1 is generally used; common earth stands at a slope of 1 to 1, but very sandy soil requires a slope of 1½ to 1. The section of an embankment is precisely similar to that of an excavation inverted, and therefore all the rules, formulæ and tables are alike applicable to both descriptions of work.

In embankments it is not considered prudent ever to adopt a less slope than 1½ to 1, unless the earth is supported by side walls.

In explaining the methods we use for the calculation of the solid contents of earth work, we shall first consider those cases where there is no slope in the ground transversely, or at right angles to the direction of the centre line of the road.

Let D be the depth of an excavation at any point,
B the width of the base,
m the slope of the side banks or distance they recede from the perpendicular in a height one.

Then $B + 2\,m\,D =$ width of excavation on top,
$B + m\,D =$ average width,
and $(B + m\,D)\,D =$ area of the cross section.

Hence if the depth were uniform throughout a length L the content would be

$$(B + m\,D)\,D\,L \qquad \text{(A)}$$

From this expression the tables of average depths are calculated.

We will now suppose D and d to be the depths at the two extremities of an excavation, the surface being understood to vary uniformly between these points. Then the content of the included solid will be found by multiplying the sum of the end areas and four times the area of a middle section by one-sixth of the length. (See page 141 Bonnycastle Mensuration.)

The end areas are $(B + m\ D)\ D,$

and $(B + m\ d)\ d,$

four times the area of middle section $2\ B\ (D + d) + m\ (D + d)^2.$

Hence the content is

$$\left\{ 3\ B\ (D + d) + m\ D^2 + m\ d^2 + m\ (D + d)^2 \right\} \frac{L}{6}$$

$$= \left\{ 6\ B\ (D + d) + 4\ m\ D^2 + 4\ m\ D\,d + 4\ m\ d^2 \right\} \frac{L}{12} \quad - \quad - \quad (B)$$

Now the content of a cut of an uniform depth throughout of $\frac{1}{2}\ (D + d)$, found by substituting $\frac{1}{2}\ (D + d)$ for D in equation (A) will be

$$\left\{ B + \tfrac{1}{2}\ m\ (D + d) \right\} \frac{D + d}{2} \times L$$

$$= \left\{ 6\ B\ (D + d) + 3\ m\ D^2 + 6\ m\ D\,d + 3\ m\ d^2 \right\} \frac{L}{12}.$$

The difference between this content for the average depth of $\frac{1}{2}\ (D + d)$, and the content of a cut the depth of which is D at one end, and d at the other, as given in formula (B,) is

$$(m\ D^2 - 2\ m\ D\,d + m\ d^2)\ \frac{L}{12},$$

or $$(D - d)^2\ \frac{m\ L}{12}. \quad - \quad - \quad - \quad - \quad (C)$$

It appears from this, that the correction to be added to the content obtained from the average depth, varies as the square of the difference of the depths at the two extremities of the excavation; and that, therefore, if a table is calculated expressing the values of equation (C) for different values of $(D - d)$ we can readily ascertain the content of any excavation, by addition of the numbers taken from this table to the content found in the table of average depths and corresponding to a depth of $\frac{1}{2}\ (D + d)$.

The tables numbered VII, XIV and XXI, and headed "*Corrections for Differences*," are computed from formula (C), and adapted to this purpose.

It is customary with many engineers to multiply the half sum of the end areas by the length for the content. The half sum of the end areas multiplied by the length is

$$(B\ D + B\ d + m\ D^2 + m\ d^2)\ \frac{L}{2}$$

$$= \left\{ 6\ B\ (D + d) + 6\ m\ D^2 + 6\ m\ d^2 \right\} \frac{L}{12}$$

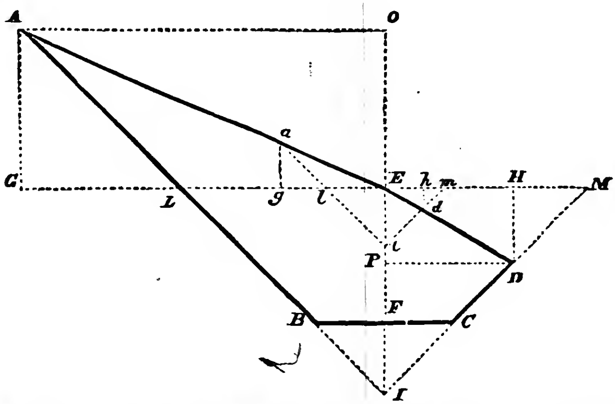
from which deduct the true content as in equation (B), and there remains

$$(2\ m\ D^2 - 4\ m\ D\,d + 2\ m\ d^2)\ \frac{L}{12} = (D - d)^2\ \frac{m\ L}{6}.$$

It will be perceived that the amount of error is exactly double the whole "correction for differences." In a cut 100 feet long, 30 feet deep at one end, and 3 feet at the other, having a slope of 1½ to 1, there would be an excess in the return of work thus estimated on this short distance, of 675 cubic yards.

We will now consider those cases where there is an inclination in the natural surface of the ground in a direction at right angles to the centre line of the road.

Fig. 1.



Let A B C D E (fig. 1) be a transverse vertical section of an excavation, where B C is the base, A B and C D the sloping sides, E F the centre cutting, and A E D the natural surface. Draw L E M parallel to B C (cutting the side slopes at L and M), and A G and D H perpendicular to it. Since the area A B C D = L B C M + A E L — D E M, the content of a prism whose base is A B C D, and length L, may be found by adding to the content of the prism having the base L B C M, (which will be taken from the table of averages,) the difference of the prisms whose bases are the triangles A E L and D E M respectively. But area A E L = ½ E L × A G and area E D M = ½ E M × D H. Hence $\frac{AG - DH}{2} \times EL \times L$ is the correction for the transverse slope, which must be added to the average content to give the true content of the solid whose section is the figure A C. When the depth of cutting at the points A and D has been ascertained, A G and D H are known, being the difference of elevation of the points A and D and the centre E. We may also remark that E L or E M is equal to B F + *m* × E F. Where the inclination of the ground is not very great, it will be found sufficiently accurate for all purposes, and much more expeditious, after having run the centre line to take the transverse slope in degrees right and left of the centre. Wm. J. Young, of Philadelphia, has made a very neat little slope instrument expressly for this purpose.

When the transverse slopes have been ascertained in degrees, the corrections will be found by means of a table which will now be explained.

Produce A B, E F and D C until they meet in I. On E I lay off E i = 1 and draw a i, i m parallel to A I and D I cutting A E, E L, E D and E M in a, l, d, and m; and draw a g and d h perpendicular to G M. Then the areas a i E, E d m are equal respectively to $\frac{1}{2}$ a g × E i and $\frac{1}{2}$ d h × E m, and are to be found under the head of greater and lesser areas in tables XXIII, XXIV, XXV and XXVI, for every degree of slope from 1° upwards. In the same tables under the heads of greater and lesser distances, will be found the values of a E, and E d also for every degree.

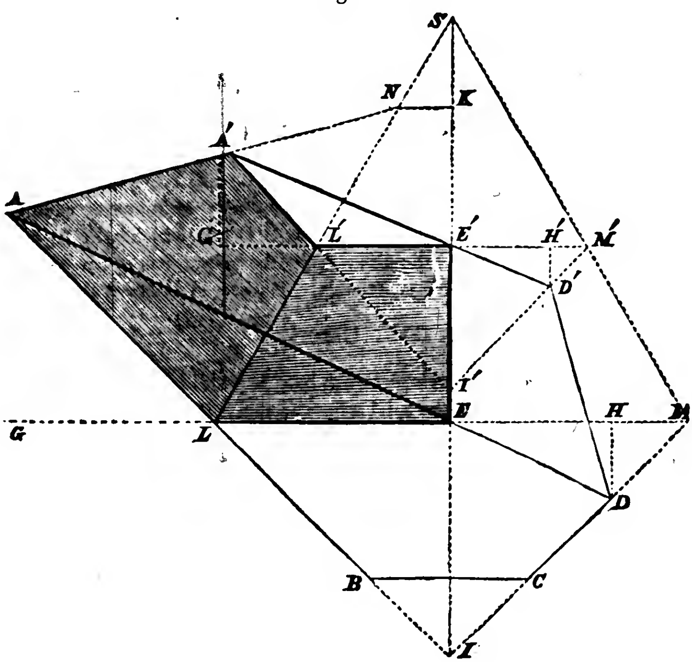
$$\text{Now,}\quad E\,i\,(=1) : E\,I :: E\,a : E\,A = E\,a \times E\,I$$
$$E\,i : E\,I :: E\,d : E\,D = E\,d \times E\,I.$$

Hence the side distances E A and E D are found by multiplying E I by the numbers in the table opposite the given slope and under the greater and lesser distances.

Again, $(E\,i)^2\,(=1) : (E\,I)^2 :: (E\,l)^2 : (E\,L)^2 ::$ area l a E : area L A E = area l a E × $(E\,I)^2$.

$(E\,i)^2 : (E\,I)^2 :: (E\,m)^2 : (E\,M)^2 ::$ area E d m : area E D M = area E d m × $(E\,I)^2$.

Fig. 2.



Hence the true correction for a length L is $(l\, a\, E - E\, d\, m) \times E\, I^2 \times L$.

Now, $E\, I^2 \times L$ is the content of a square prism, whose base is E I, and length L; and table XXII shows the content in cubic yards of prisms 100 feet long for square bases from 1 to 200 feet. Hence the value of $E\, I^2 \times L$ reduced to cubic yards may be taken from this table.

It will generally be found sufficiently accurate to consider the average slope in degrees as the uniform slope, and the average depth as the uniform depth throughout the cut. But as this is not always the case, it is desirable to have a true expression for the correction where the depths of cutting (and consequently the width on top) and the transverse slopes are variable. We will then see how far a mean depth and slope may be used without introducing material errors into the results of our calculation.

Let A L E (Fig. 2) represent a vertical section of that part of an excavation which rises above the centre E, A L being the sloping side of the cut, and A E a section of the natural surface. Let A′ L′ E′ be a similar and parallel section situated at a distance E E′ from the plane A L E. On E L and E′ L′ produced, let fall the perpendiculars A G and A′ G′; produce E E′ and A A′ to meet L L′ produced in S and N and draw K N parallel to E L or E′ L′.

Put $E\,L = T,\ E'\,L' = T',\ A\,G = P,\ A'\,G' = P'$
$E\,E' = x,\ E\,S = M$ and $E\,K = M'$.

Then $E\,S : E'\,S :: E\,L : E'\,L'$,

or $M : M - x :: T : T' = T - \dfrac{T\,x}{M}$.

and $E\,K : E'\,K\ (:: L\,N : L'\,N) :: A\,G : A'\,G'$,

that is $M' : M' - x :: P : P' = P - \dfrac{P\,x}{M'}$.

Now the area $A'\,L'\,E' = \frac{1}{2}\,T'\,P' = \frac{1}{2}\left(T\,P - \dfrac{T\,P\,x}{M'} - \dfrac{T\,P\,x}{M} + \dfrac{T\,P\,x^2}{M'\,M}\right)$

But if S = content of the solid E A′ the differential of 2 S = 2 area A′ L′ E′ $\times\, d\,x = T\,P\,d\,x - \dfrac{T\,P\,x}{M'}\,d\,x - \dfrac{T\,P\,x}{M}\,d\,x + \dfrac{T\,P\,x^2}{M\,M'}\,d\,x$.

Hence by integrating this equation we have

$$2\,S = T\,P\,x - \frac{T\,P\,x^2}{2\,M'} - \frac{T\,P\,x^2}{2\,M} + \frac{T\,P\,x^3}{3\,M\,M}.$$

Substituting for M and M′ in this equation their values $\dfrac{T\,x}{T - T'}$ and $\dfrac{P\,x}{P - P'}$ and putting L for x we have

$$S = (2\,T\,P + 2\,T'\,P' + T'\,P + T\,P')\,\frac{L}{12} \quad \cdot \quad \cdot \quad \cdot \qquad (D)$$

This is a general expression for the content of a solid bounded on two sides by planes, and on the third by a warped surface.

If B C (fig 2) represents the base B, $I\,F = \dfrac{B}{2\,m}$, $E\,I = D + \dfrac{B}{2\,m} = H$

and E′ I′ = H′, then T = E L = $m \times$ H and T′ = E′ L′ = $m \times$ H′. These values of T and T′ substituted in the last equation give us for the content

$$(2\,H\,P + 2\,H'\,P' + H'\,P + H\,P')\,\frac{m\,L}{12},$$

which is the excess in cutting caused by the slope of the ground rising above the centre line of the excavation; and if H D and H′ D′ (fig. 2) be put = p and p', the deficiency caused by the slope falling below the centre will be

$$(2\,H\,p + 2\,H'\,p' + H'\,p + H\,p')\,\frac{m\,L}{12},$$

and the true correction is evidently equal to the difference of these expressions, or

$$\left\{ (2\,H + H')\,(P - p) + (H + 2\,H')\,(P' - p') \right\} \frac{m\,L}{12} \quad \cdot \quad (E).$$

Had we taken $\frac{P + P'}{2}$ in place of P and P′, and $\frac{p + p'}{2}$ for p and p', or the mean of the perpendiculars P, p, P′ and p′, the correction would have been

$$(H + H')\,(P - p + P' - p')\,\frac{m\,L}{8} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad F,$$

which if substracted from equation (E) leaves a second correction

$$(H - H')\,(P - p - P' + p')\,\frac{m\,L}{24} \quad \cdot \quad \cdot \quad \cdot \quad (G).$$

These are in a more convenient form than equation (E), as (G) may, when of little importance, be omitted.

When $P - p = P' - p'$ equation (E) becomes

$$(H + H')\,(P - p)\,\frac{m\,L}{4} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad (H).$$

When the depth is uniform but not the slope we have

$$H\,(P - p + P' - p')\,\frac{m\,L}{4} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad (I).$$

And finally, when slope and depth are both uniform.

$$H\,(P - p)\,\frac{m\,L}{2} \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad (K).$$

These expressions for "corrections for transverse slopes" are in the most convenient form, if the heights of the points A and D (figures 1 and 2) are found without the use of the slope instrument, and they do not require the use of the tables.

Let $P = \frac{2\,A\,H}{m}$, $p = \frac{2\,a\,H}{m}$, $P' = \frac{2\,A'\,H'}{m}$ and $p' = \frac{2\,a'\,H'}{m}$, (where A, a, A′ and a' are the areas A L E, E D M, A′ L′ E′ and E′ D′ M′ (fig. 2) when H and H′ are each = 1) then expression (E) becomes

$$\left\{ 2\,H^2\,(A - a) + 2\,H'^2\,(A' - a') + H\,H'\,(A - a + A' - a') \right\} \frac{L}{6},$$

which, if we assume the slope uniform throughout the excavation, becomes

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A - a + A' - a') \frac{L}{12}, \quad \cdot \quad (L)$$

and this subtracted from the above equation leaves us a second correction

$$(H^2 - H'^2)(A - a - A' + a') \frac{L}{6}. \quad - \quad - \quad - \quad - \quad (M)$$

When the slope is uniform throughout, our expression becomes

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A - a) \frac{L}{6}. \quad - \quad - \quad - \quad (N)$$

But if we had taken the mean depth $\frac{H + H'}{2}$ as the uniform depth we should have had for the correction

$$(H + H')^2 (A - a) \frac{L}{4},$$

which subtracted from equation (N) leaves a remainder

$$(H - H')^2 (A - a) \frac{L}{12}. \quad - \quad - \quad - \quad - \quad (O)$$

When the depth is uniform, but not the slope, we have

$$H^2 (A - a + A' - a') \frac{L}{2}. \quad - \quad - \quad - \quad (P)$$

And when the slope and depth are both uniform

$$H^2 (A - a) L. \quad - \quad - \quad - \quad - \quad - \quad - \quad (Q)$$

These expressions for "corrections for transverse slopes" are useful when the slopes are taken in degrees, and their values can readily be found by means of the tables of areas and table XXII.

There is another method of calculating the contents of excavation and embankment, which is more convenient when the slopes are very great and the depths variable, which will now be explained.

In fig. 1, draw A O and D P parallel to B C, meeting I E and I E produced in O and P. Put E I = H, A O = W, and D P = w, and let the corresponding dimensions of a parallel section situated at a distance L from A D I be represented by H′ W′ and w' respectively.

By substituting H and W for T and P, and H′ and W′ for T′ and P′ in equation (D), we have for the content of the solid included between A E I and its corresponding section

$$(2\,H\,W + 2\,H'\,W' + H'\,W + H\,W') \frac{L}{12},$$

and the content of the solid formed on D E I is

$$(2\,H\,w + 2\,H'\,w' + H'\,w + H\,w') \frac{L}{12}.$$

From the sum of these contents subtract the content of the prism having for a base the triangle B C I and we have for the content of the solid formed on A B C D.

$$\left\{ (2\,H + H')(W + w) + (H + 2\,H')(W' + w') \right. \frac{L}{12} - \frac{B^2\,L}{4\,m}. \quad - \quad (R)$$

Let Y, y and Y′ y' represent the ratio of W. w, and W′, w' to H and H′ respectively on the values of W, w and W′, w' when H and H′ are each = 1. Then by substitution the above equation for the content becomes

$$\left\{ 2\,H^2(Y+y) + 2\,H'^2(Y'+y') + H\,H'(Y+y+Y'+y') \right\} \frac{L}{12} - \frac{B^2\,L}{4\,m}.$$

If we assume the slope as uniform we have for the content

$$\left\{ H^2 + H'^2 + (H+H')^2 \right\} (Y+y+Y'+y') \frac{L}{24} - \frac{B^2\,L}{4\,m}, \quad \text{(S)}$$

which subtracted from the above equation leaves a remainder

$$(H^2 - H'^2)(Y+y-Y'-y') \frac{L}{12}. \quad \text{(T)}$$

When the transverse slope is constant the content is

$$\left\{ H^2 + H'^2 + (H+H')^2 \right\} (Y+y) \frac{L}{12} - \frac{B^2\,L}{4\,m}. \quad \text{(V)}$$

If the depth is uniform but not the slope the content is

$$H^2 (Y+y+Y'+y') \frac{L}{4} - \frac{B^2\,L}{4\,m}. \quad \text{(W)}$$

When the slope and depth are both uniform

$$H^2 (Y+y) \frac{L}{2} - \frac{B^2\,L}{4\,m}. \quad \text{(X)}$$

The values of Y y Y′ and y' for every degree of slope from 1° upwards are given in tables XXIII, XXIV, XXV and XXVI under the head of greater and lesser horizontal distances and by means of these and table XXII the values of these equations can easily be ascertained.

If there is no transverse slope we will have

$$\left\{ \frac{(H+H')^2}{2} + \frac{(H-H')^2}{12} \right\} m\,L - \frac{B^2\,L}{4\,m}. \quad \text{(Y)}$$

Here it may be observed that the value of $\frac{(H-H')^2}{12}\,m\,L$ is given in the table of "corrections for differences No. XIV * and that the other terms of the equation are found in table XXII.

Finally, if there is no slope and no variation in depth the equation becomes

$$H^2\,m\,L - \frac{B^2\,L}{4\,m}. \quad \text{(Z)}$$

Note. If H^2 or H'^2 is substituted for $(H - H')^2$, this remark will apply to all the formulæ in which L is divided by 12. The numbers in table XIV are $\frac{1}{12}$ of those in table XXII. If $m = \frac{1}{2}$ or $= 1\frac{1}{2}$ the expression $\frac{(H-H')}{12}$ m L will be found in table VII or XXI, but if m is any other number, the expression must be found in table XIV and multiplied by m.

ON THE CALCULATION OF THE TABLES.

The labor of forming tables for calculating earth work may be very much abridged, by obtaining the first and second differences.

In any expression of the form $a\,x + b\,x^2 = n$, let x be increased by a constant quantity y and become $x + y$, $x + 2\,y$, $x + 3\,y$, $x + 4\,y$, etc.: then the successive values of n will be

$$a\,x + b\,x^2$$
$$a\,x + a\,y + b\,x^2 + 2\,b\,x\,y + b\,y^2$$
$$a\,x + 2\,a\,y + b\,x^2 + 4\,b\,x\,y + 4\,b\,y^2$$
$$a\,x + 3\,a\,y + b\,x^2 + 6\,b\,x\,y + 9\,b\,y^2$$
$$a\,x + 4\,a\,y + b\,x^2 + 8\,b\,x\,y + 16\,b\,y^2, \text{ etc.}$$

Take the difference between each of these expressions and the following one, and we have

$$a\,y + 2\,b\,x\,y + b\,y^2$$
$$a\,y + 2\,b\,x\,y + 3\,b\,y^2$$
$$a\,y + 2\,b\,x\,y + 5\,b\,y^2$$
$$a\,y + 2\,b\,x\,y + 7\,b\,y^2$$

These are called the first differences and the difference of these differences

$$2\,b^2\,y$$

is called the second difference.

Hence commencing with the first of the first differences, the continued addition of the second diffenence produces the several first differences, and these added in order to the first value of n will give the successive values of n. If the equation is of the form $b\,x^2 = n$, or a becomes o, then the first difference is $2\,b\,x\,y + b\,y^2$, and the second difference is $2\,b\,y^2$, as before found.

Let us apply this method to the calculation of the tables of contents for average depths. The expression for the content is (equation A)

$$(\text{B} + m\ \text{D})\ \text{D L} = \text{B L D} + m\ \text{L D}^2.$$

Hence if we suppose D to be increased constantly by a quantity d, the 1st first-difference, found by substituting D and d for x and y, and B L and m L for a and b will be

$$(\text{B}\ d + 2\,m\ \text{D}\ d + m\ d^2)\ \text{L},$$

and by a similar substitution we shall find for the second difference

$$2\,m\ d^2\ \text{L}.$$

Let it be required to calculate the contents answering to every foot in depth for a length of 100 feet, base of 25 feet, and slope of ½ to 1.

Here B = 25, L = 100, $m = \frac{1}{2}$, D = 1, and $d = 1$, and since these quantities are given in feet, our several results must be divided by 27 to reduce them to cubic yards.

$$\text{Now } (\text{B} + m\ \text{D})\ \text{D L} = \frac{25{\cdot}5 \times 100}{27} = 94{\cdot}444 = \text{content for one foot.}$$

$$(\text{B}\ d + 2\,m\ \text{D}\ d + m\ d^2)\ \text{L} = \frac{26{\cdot}5 \times 100}{27} = 98{\cdot}148 = \text{1st first difference.}$$

And $2\,m\,d^2\,L = \frac{100}{27} = 3{\cdot}7037$ = second difference.

Hence the table will be calculated as exhibited below; the first differences being severally formed by addition of the second difference to the preceding one, and the table of contents by the addition of the corresponding first difference to the preceding content.

Depth feet.	First Dif. cub. yds.	Content. cub. yds.
1		94·444
2	98·148	192·592
3	101·852	294·444
4	105·556	400·000
5	109·529	509·259
6	112·963	622·222
7	116·667	738·889
8	120·731	859·260
9	124·074	983·333
10	127·778	1111·111

Let us apply this method to the calculation of a table of corrections for differences and in the equation (C) $(D - d)^2 \times \frac{m\,L}{12}$ put D' for $D - d$ and let it be constantly increased by a given quantity d'. Then

$$(2\,D'\,d' + d'^2)\,\frac{m\,L}{12} = \text{1st first difference,}$$

$$\text{and} \quad \frac{d'^2\,m\,L}{6} = \text{second difference.}$$

If $L = 100$, $D' = 1$, $d' = 1$, and $m = 1$, the 1st first difference reduced to cubic yards is ·92593, and the second difference reduced also to cubic yards is ·61728. Hence the table will be calculated as follows:

Dif. of depth in feet.	First dif. cub. yds.	Correction cub. yds.
1		·30864
2	·92593	1·23457
3	1·54321	2·77778
4	2·16049	4·93827
5	2·77778	7·71605
6	3·39506	11·11111
7	4·01234	15·12345
8	4·62963	19·75308
9	5·24692	25·00000
10	5·86420	30·86420

For the American Railroad Journal and Mechanics' Magazine.

BEAR MOUNTAIN RAILROAD.

Having completed the location of the Bear Mountain railroad, and the work being now under contract, and in progress of construction, I have thought that a statement of our operations thus far, and a brief description of the general features of the road, might be interesting to the readers of the Journal.

This road is intended for the transportation of the Bear valley coal from the mines to the canal, and, as originally chartered, was to extend from Rausch Gap, in Schuylkill county, through Lykens valley, to the head of the Wiscinisco canal, (unfinished) nineteen miles above Dauphin. Previous to my taking charge of the survey, some instrumental examinations had been made to ascertain the feasibility and probable cost of the road through Lykens valley, and from these examinations, it was ascertained that a route could be obtained through this valley, with grades either level or descending from the mines to the canal, and with a maximum grade of 36 feet per mile.

The principal business which this road would probably transact, consists in the transportation of coal and iron in one direction, and the great rivalry now existing between the parties interested in the several coal regions, renders it necessary that the cost of this transportation should be as low as possible. In order to ascertain the practicability of obtaining a less objectionable route for the road than the one originally contemplated through Lykens valley, I was induced to give a most rigid and thorough examination to the several valleys which head near the western extremity of this coal field; and as the result of these examinations, we have adopted a route wholly different from the one originally contemplated, by which a saving of 14 miles of transportation is effected, with a termination at Dauphin, 19 miles lower down on the canal, and but 8 miles above Harrisburgh. In addition to this the road, as now located, has for its entire length (upwards of 30 miles) *a continuous descending grade of not less than 16¼, nor more than 17½ feet per mile, with but two points on the line where the grade changes, and the minimum radius of curvature is* 1910 *feet.*

I am not aware that there is any railroad in the United States, or in the world, which, either for the whole, or any considerable portion of its length, is so admirably adapted for the cheap transportation of freight in one direction, and in fact, as far as the grades of a railroad affect the cost of transportation, I consider that our road is so located as to reduce this sum to a minimum.

It is difficult to say what is the greatest load that a locomotive could take down our road, but the average loads of an engine will of course be limited by the number or weight of empty cars with which it could return to the mines, ascending a grade of 17½ feet per mile.

It will readily be seen that our facilities for transacting a heavy freight business are greater than upon any railroad yet constructed. and that for the peculiar kind of transportation, this road is over 40 per cent. better than a perfectly level road.

Our road has several other distinctive features; and is, in many other respects, of a most extraordinary character.

My business engagements at present, however, will not permit me to enter more into detail; but as soon as I have leisure, I shall be happy to furnish the Journal with sketches and drawings of several of our works of art, together with a more full description of the road and machinery.

J. Spaulding,

Dauphin, April 18, 1844. *Chief Engineer B. M. Railroad.*

COAL TRADE.

We have received a pamphlet of some 70 pages on the "Reading railroad company," by "Examiner;" being "a series of articles published in the Pennsylvanian in January, February and March, 1844." The object is to counteract the "incendiary publications" issued in 1839 and 1840, by the Reading railroad company. The speedy downfall of this company is predicted with great confidence, and an elaborate demonstration is gone into—one of the main arguments being the rapid wear of the iron rails, a subject on which much has been written for this Journal. The pamphlet reiterates the old story about the "refuse rails" of the South Carolina railway, which has been positively contradicted by our correspondent "Q," in whose statements every confidence may be placed.

There is quite enough of the "incendiary" spirit in both of these rivals for the coal trade. If the capital of the railway be eight millions of dollars, then will it require 1,280,000 tons, netting 50 cents per ton, to pay the moderate interest of 8 per cent. The Schuylkill and other works will of course continue their contributions, and thus in order to make the Reading railway a successful work the consumption must be doubled at once.

The tolls on the Schuylkill canal are now 36 cents per ton, or 3 mills per ton per mile; the capital is about 3½ millions of dollars. To pay 8 per cent. on this sum, will require about 700,000 tons of coal per annum, exclusive of other sources of income. The Schuylkill canal carried last year 447,058 tons of coal, and "Examiner" estimates "the coal business of the Schuylkill field in 1844" at 800,000 tons. (p. 60). This is little more than enough for the canal, and only two-thirds of the quantity required by the railroad.

The pamphlet of the Baltimore and Ohio railroad company, published in this Journal, gives detailed estimates of the cost of transporting coal; the aggregate of all expenses being very nearly 9½ mills per ton per mile, exclusive of interest. They show that 1½ cent per ton per mile will yield a fair profit.

On the other hand, "Examiner," (p. 51) makes the following estimate for the Reading railway, per ton per mile, descending, including taking back the empty cars.

Locomotive power,	·439
Maintenance of way,	·662
Maintenance of cars,	·448
Miscellaneous charges,	·200
Total in cents,	1·739

This is very nearly twice the estimate of the Baltimore and Ohio company, endorsed by Mr. Latrobe. As time will shortly demonstrate which is the more reasonable view, further speculation is at this time useless, and we shall dismiss the subject after drawing attention to the following circumstance. In 1841 the Schuylkill canal brought down 584,000 tons, in 1843 only 447,058 tons which with the 229,015 tons per railroad, gives 676,073 tons from the "Schuylkill field" for that year. The railway was not doing enough to have any influence on the trade till last fall, yet the receipts of the canal fell from $575,000 in 1841 to $315,000 in 1842. The full price might have been maintained till late in 1843, and it looks very much as if the canal company to prevent the completion of the railway had literally thrown away nearly half a million of dollars, which would have paid dividends for 1842 and 1843, and left the company in a better state to compete with the railway. Had those entrusted with the direction of these works been actuated by the proper spirit, there could have been no difficulty in making an arrangement which would have yielded a fair profit to both. However much the public may appear to gain from the sacrifices made to injure each other, it entertains no other feeling than contempt for those who thus squander large sums confided to them by others for the purpose of securing fair dividends from undertakings calculated to advance the prosperity of the country.

In a late number, the statement of the Delaware and Hudson canal company for 1842 was given, and we now give the statement of this flourishing work for 1843.

Statement of the business of the Delaware and Hudson Canal Co. for 1843.

To coal on hand, March 1, 1843,	$124,691 50	By sales of coal,	$804,900 74
" Mining coal,	107,642 93	" Canal and railroad tolls,	30,996 53
" Railroad transportation and repairs,	103,808 02	" Interest received,	23,251 41
" Freight of coal to Rondout,	233,837 68	" Coal on hand,	71,054 25
" Canal repairs and superintendance,	77,700 23		
" Labor and expenses at Rondout,	21,219 50		
" Interest on State stock,	38,325 00		
" Interest on company loan,	2,349 00		
" Rents, salaries, current expenses, etc.	23,927 33		
Balance,	196,701 74		
	$930,202 93		$930,202 93
New York, March 1, 1844.		By balance,	$196,701 74

Hence it will be seen that the cost of transportation on the 108 miles of canal was $233,837, or 9½ mills per ton per mile, and the total cost from the mines, 126 miles, was 14½ mills per ton per mile. Deducting mining, interest, rents, etc., and the total charge may be taken at $2 80 per ton, or $·0222, or nearly 2¼ cents per ton per mile. The dividend amounts to 87½ cents per ton, about 7 mills per ton per mile, or more than twice the gross charges of the Schuylkill canal!

Lastly, it must be remembered that the railway, though only 16 miles long, does one fourth of the work. The coal is mined on the west side of the mountains, and carried over the summit to the canal on the eastern slope, so that though only one-eighth of the entire line, it has to bear the brunt of the fight. In fact this work could scarcely exist without the railway, though we believe that the Schuylkill canal is not equally dependent on that mode of transportation.

The high rates of transportation—as compared with Philadelphia estimates—which coal affords on the works of the Delaware and Hudson canal company, show that that canal has peculiar advantages. The grand, the vital advantage is, that the work is complete in itself. The company owns from the mines to the Hudson, and can now deliver coal at tide water on that river as cheaply as it can be delivered in Philadelphia, if the *Miners' Journal* is correct in stating that the average cost of coal delivered in the cars or boats at Pottsville is, on an average, $2 25 per ton. We believe that no red-ash coal can be reached by any cheaper route than via the Delaware and Raritan canal, though the white-ash of the Wyoming field delivered on the Hudson at $3 50 per ton, yields 10 per cent. to the Delaware and Hudson canal company. Hence we conclude that no inconsiderable part of the coal trade will be from the mines to the Hudson, though we have no idea that the present trade of Philadelphia, or of the Delaware and Hudson canal company, is to be diminished by new avenues skillfully projected, and destined to accommodate the increasing demand, and not merely for the purpose of supplanting a useful flourishing work.

DUTY ON RAILROAD IRON.

The Pottsville Miners' Journal has a long article on *the iron trade*, in which the policy of keeping up the present duty of $25 per ton on railroad iron is warmly advocated. It is said that this article can be produced here for $55 per ton—but where? Can it be delivered in New York or Boston for that price? It is too generally overlooked that railways are, in many instances, more important to the manufacturer than any tariff. The cost of transportation of the materials, ore, coal, lime and manufactured article, is one of the grand items, and many works now abandoned would be in flourishing operation if they had a cheap communication, open throughout the year with the sea board. The immense capital required for the manufacture of railway iron, the uncertainty of the demand, and the very low profit it can afford under this branch of the iron trade the least desirable of all to the American iron master, as well as the very last in which he should engage. By means of railways establish the iron trade in all its most profitable branches, and then, when no other iron is imported, impose any duty on railroad iron which may appear at that time judicious; but do not now cripple the rising energies of this best friend of the farmer and manufacturer for the purpose of inducing enterprizing men to embark in the least profitable and most uncertain branch of the trade, while such enormous quantities of iron are imported for the common purposes of life.

THE SCREW PROPELLER—STEAM NAVIGATION.

At the last meeting of the Liverpool Polytechnic society, the president, John Grantham, Esq., E. C., in the course of his annual address, said, that finding he had but few observations to make on the state and prospects of the society—so even had been the tenor of its way through all the changing scenes of the times—he should introduce to their notice a topic of public interest, suited to the character of their meetings; the subject he alluded to was the present state of steam navigation. After some introductory observations, as to the failure of the science as a profitable mechanical speculation, he called their attention to the screw propeller, as a substitute for paddle wheels—an improvement which he had great hopes would do much to place steam navigation on a firmer foundation. Several short notices of the screw propeller had appeared in scientific publications, [See *Mining Journal* of the 28th October, for a detailed description, with diagram,] but they were very imperfect, and little could be gleaned from them. It had, however, been referred to more satisfactorily, in a paper written by Mr. Elijah Galloway, the patentee of paddle wheels, in an appendix to Tredgold's work on the steam engine. But the author had not formed a decided opinion on the question, and did not establish its superiority. The French claimed to be the original inventors of the screw propeller, and few would dispute with them the honor on this point—though they also claimed the steam engine, which was due to the English. The lecturer here referred to a French paper detailing the performances of the French war steamer *Napoleon*, which were certainly satisfactory; and next noticed a number of instances in which the screw had been employed, even from the year 1699. It was also tried by different parties in 1743 and 1763. In 1802, the *Doncaster* transport, which had been becalmed, was worked into harbor at Malta, at the rate of one and a half mile per hour, by eight men at a spell. She went seven leagues with a screw, and the parties seemed to have contemplated every kind of propeller since patented by others. In 1825, the screw was applied to a vessel in the Thames. In 1828, a patent was taken out for a screw by Mr. Chas. Cummerow. In 1832, M. Sauvage also applied it. In the same year, Mr. Woodcroft, of Manchester, took out his patent; in 1836, Mr. Smith his; and in 1838, Mr. Ericsson also obtained one. Cummerow's and Smith's were much alike. Mr. Grantham then explained the principle of the screw, or inclined plane, and its advantages over the paddle wheel, assuming for argument sake, that simply as a propeller, there was no preference to be given to either. He referred to cross sections of two vessels of the same dimensions, one with the paddles, and the other with the screw; also to longitudinal sections of the same. By pointing to this, he clearly showed the several advantages of screw vessels. There were several kinds of screw propellers, but the principle was the same in all—an inclined plane turned round a spindle, or cylinder. This he showed by wrapping a piece of paper in the form of a right angled triangle round a roller; and the hypothenuse, or slanting edge, of the paper, described the worm of the screw, which might be made of any pitch. And if a screw were made to revolve in a solid, by giving it one revolution, it would move forward or backward, a distance equal to the pitch. There might be several threads in the same screw, but although this constituted a difference in form, the principle remained unaltered. Mr. Smith's first experiments were made with a single thread, or incline, wound round an axis, making an entire revolution, and presenting to the eye, when looking in the direction of the axis, the form of a complete disk. Ericsson's and others consisted of a short portion of the screw, with many threads, or inclines, in some cases appearing to the eye, when placed in the direction of the axis, as a complete disk. [He here described the number of blades on the screw, and how they were formed.] Woodcroft, who obtained his patent in 1832, adopted a slightly different system. Instead of the thread being uniform, and the incline the same at all points, he proposes an increasing pitch at the after end. His object would be understood by considering a fish's tail, more particularly that of the eel. In the evolutions made by its body and tail, they each continued to increase; and, consequently, the rapidity with which it struck the water increased also, and compensated for the loss of effect occasioned to the tail by the motion given to the water by the body. In like manner, by giving this constantly increasing angle to the screw, the same result would follow. This he, Mr. Grantham, conceived to be a very beautiful modification of the original screw propeller. The principle did not escape the attention of others; and it was to be regretted that it had not been tried earlier and made known. He had alluded to the plans of Messrs. Smith, Ericsson and Woodcroft, to the first two as being best known, and because he believed the award of superiority, was, by almost common consent, given to it. Mr. Smith was the originator of a company that built the Archimedes—a vessel that circumnavigated England, and performed other long voyages. She first drew public attention to the subject. Great credit was due to that spirited company, and to Mr. Smith, for these experiments, which were conducted on a liberal scale; but this was not the first vessel that had been propelled by a screw. Ericsson had previously done much, and displayed great originality of thought. The form of his propeller, although not the subject of this patent, had never yet been surpassed, and it required only the elongated pitch to make it the most efficient yet constructed. He, the lecturer, was influenced by this opinion, when recently called upon to construct the small vessel called the *Liverpool Screw*, which had been at work on the Mersey. He had taken care not to infringe any patent on the screw he adopted, and was surprised to find, on looking over the list, that these valuable plans have been overlooked. Several experiments had been made by Messrs. Brunel, Claxton and Guppy at Bristol, under the superintendance of the latter, upon various forms of screw in the Archimedes. In these some curious facts were observed, and it was then suggested that it was possible to propel a vessel faster by the screw, than the screw itself would have gone, had it worked in a solid medium. He at first conceived that there was an error in the calculations, but subsequent observation induced him to believe it possible to obtain such a result, and that all vessels having the screw in the dead wood, or run, have a tendency to go faster than the theoretical calculation would lead us to expect—though if this tendency were increased, it would be at a loss of power. He accounted for it by the manner in which water fell into the vacancy left as the vessel passed onward. A similar operation might be observed in watching the eddy formed by the pier of a bridge, in which case the body was stationary, and the water moved, but their relative positions were the same in both. The conclusion, therefore, was, that though the relative effect between the screw and the vessel appeared to be favorable, yet that being obtained at a great sacrifice of power, such a result might arise from defects in the form of the vessel, and was, therefore, no good indication, and that the utmost efficiency would be obtained, when the speed of the screw was from one-fifteenth to one-twentieth part greater than that of the vessel. The lecturer then noticed some of the most remarkable screw vessels that had yet appeared, and the forms of the propellers employed, and considered the difficulties that opposed the general introduction of the screw, and showed that some of the objections to it were groundless. He showed, by diagrams of two vessels of equal size, that where paddle wheel vessels could not easily have any beams over the engine room, on the plane of the lower deck, as the engine, etc., rose to the deck above, beams might be introduced in screw vessels at that point, not only greatly strengthening the vessel where she most wanted it, but admiting of a clear range of saloons, or cabins, fore and aft, with little or no interruption.

A short, interesting discussion took place, in the course of which the chairman ably and convincingly replied to the questions propounded, on the supposed lateral pressure of the screw.—*Mining Journal.*

COST OF TRANSFORTATION ON RAILROADS.

The cost of transportation on railways is the most important engineering topic at this time before the public. Hence every circumstance in any way elucidating the subject, even in a very small degree, is worthy of attention. In 1843, the freight on the Western railroad was equal to 60,350 tons carried 156 miles, or 9,414,621 tons carried one mile, the average load being 47⅝ tons per train, *nett.* The passenger trains ran 216,139 miles, the merchandize trains 197,603 miles, miscellaneous trains 27,866, in all 441,608 miles. The total cost was $283,826 43, or 64¼ cents per mile run. If we assume the cost of all the trains to be equal, this would give 1·34 cents per ton per mile with trains averaging about half the power of the engines, and overcoming grades of 84 feet per mile, at an average velocity of 15 miles per hour. With a speed of 8 miles per hour, and grades of from 35 to 40 feet per mile, twice the load would be taken without any additional expense than the loading, unloading and wear of cars, say 3 mills per ton per mile, making the total cost 96 mills per ton per mile, exclusive of renewal of track. If the engine can take 150 tons, all expenses including repairs and renewals would not exceed one cent per ton per mile, which is about the estimate of the Baltimore and Ohio railroad company as given in our last number. As the cost of the freight trains is not given separately, we have assumed the cost to be equal.

The receipts for merchandize were $275,606 19, or $4 57 per ton, or $·0299, say 3 cents per ton per mile, and this "exceeded the entire expense of conducting the business of the road." The total amount paid for transportation on the Erie canal is estimated at from 4½ to 5 millions of dollars for carrying nearly 400,000 tons a distance of 363 miles. This gives very nearly 3 cents per ton (of 2000 pounds) per mile. Again, the statement of the Delaware and Hudson canal company gave 2¾ cents per ton per mile as the amount received in 1843. Could the Western railroad run with full trains at a low rate of speed, and be sure of 200,000 tons of freight per annum, it does appear to us that it could carry quite as cheaply as any canal in the State of New York, supposing both to yield not less than 8 per cent on their capital. Where dividends are passed by, as on the public, and, we are sorry to say, on some of the private works of Pennsylvania, they can of course carry more cheaply than those who do not choose "to work for nothing and find themselves."

SPARK ARRESTER.

We have in our office a very neat model of Messrs. French and Baird's patent "Spark Arrester." In the accompanying wood cut, (fig. 1,) is a vertical section through the axis, in which P is the smoke-pipe, from which the steam and the sparks pass through the "volutes" *v*, (figs. 1 and 2) into the chamber C, in the manner represented by the arrows. The centrifugal force generated by the "volutes," forces the sparks against the outer side of the chamber C, in which are numerous openings *o*, through which they fall down between the smoke-pipe and the outer casing. The steam escapes through the perforated plates *d*, which, from their arrangement present a very large surface for that object. The peculiarities of this arrangement are the application of the centrifugal force as above described, and the mode of increasing the surface of the wire-cloth, or perforated sheets of metal, without increasing the diameter of the pipe, by means of joining the rings at their upper and lower edges alternately, as seen in fig. 1, *d*.

Fig. 1.

Fig. 2.

It has been in use for some time on the Georgia, Philadelphia, Germantown and Norristown, Wilmington and Baltimore, Lexington and Ohio railways, and we have seen flattering testimonials from the superintendants of all these works. The very best workmanship is indispensable; and experience has shown that certain parts require the material to be of peculiar strength and quality. When in perfect order, it has been stated to us, that, in running in the night, there is scarcely ever a spark to be seen.

The cut gives only a general idea of the "modus operandi," and numerous views and sections would be necessary to give a working plan. Messrs. French and Baird are established in Philadelphia.

RAILWAY COMMUNICATION THROUGH FRANCE.

We find in the April number of the "London Polytecnic Magazine and Journal of Science," the following article in relation to railways in France, by William Bridges.

On the 27th of December, 1841, after two years of legislative talk in the French chambers, in the course of which, sometimes the principle of leaving everything to private enterprize, sometimes the necessity of government control and supervision, sometimes the advantages of both methods was insisted on, discussed and negatived, the speech of the French king led France to expect that something would finally be done to put France, as respects railway communication, on a level with the rest of Europe. And it was full time; Belgium had already completed 80 leagues; Germany 180; England 1400 miles; France nothing. And even in April, 1842, it is stated in part IV of the commercial tariffs and regulations, presented to the British parliament, that French railroad communication embraced a very bad line from St. Etienne to Lyons, one from Paris to St. Germain, and two from Paris to Versailles. In the royal speech referred to, several important lines were announced as under consideration; among others, a line connecting Paris with Lille and Calais. It was fairly anticipated that such a line, forming a connecting link not only between Paris and London, but also between England and Belgium by way of Lille, and by means of the Belgian railways, with the Rhine, would be most valuable to English interests; while another proposed to Lyons would facilitate the overland passage to the east, as this one to Berlin and the north of Europe.

A few months after the announcement by the king of the intention on the part of government to bring in a measure for the encouragement of railway undertakings, a bill was submitted, and after some discussion became law on the 11th of June, 1842. By this law it was resolved to establish a national system of railways, to unite France with Belgium, England, Germany, the Mediterranean and Spain; and to give a stimulus to internal traffic. The mode proposed to give effect to these objects was one unsuitable, perhaps, to the English commercial spirit, but rendered absolutely necessary in France, from the difficulties which had been experienced, and the fearful jobbing which had taken place in the prosecution of the few private railway speculations which had been already entered into. The French government, seeing that hitherto a few great millionaires had engrossed every undertaking of this character, undertook now to provide the land, and execute all the earth works, tunnels, bridges, etc.; the portion left to private enterprize being less precarious, extending only to the laying on of the ballast, the formation of the permanent way, with the supply of locomotive power, carriages and *material* for working. The valuation of all lands for which compensation was required was to be left to a jury; a most wise regulation, and one which this country would do well to imitate. One-third of this compensation was to be borne by the State, the remainder by the departments and parishes whose interests were affected by the line.

Under this law a very important line has been completed to Rouen, and is now in further progress towards Havre; so that we may speedily expect to be put within a twelve hours' journey to Paris. We perceive now that an extension of the line eastward is in contemplation, to the very banks of the Rhine, to connect London, Havre, Paris and Strasburg; and as the last of these cities forming the terminus of a direct line across the richest and most industrious districts of France, is also the intended point of convergence for all the national railroads of Germany, the national and international benefits of such a line can hardly be over estimated. The distance from Havre to Paris is 144 miles, from Paris to Strasburg 286 miles, almost exactly double; the aggregate length of the journey is therefore 430 miles, one *railway hour* further than from London to Edinburgh. To traverse this route under present means of intercommunication, to transport the wines and grain and innumerable herds of La Brie and the Moselle, or the produce of the growing factories of Alsace, the continental Lancashire, between and among the various towns and cities of Paris and Strasburg, Chateau

Thierry, Nancy and the valleys of the Marne and the Saverne, is a work, which, to the Englishman, accustomed to the comfort and expedition of his Great Westerns and Midland Counties, and other railway facilities, would be appalling enough, considering that the actual traffic extends to upwards of 100,000 French tons per annum, and an aggregate of 200,000 passengers via Strasburg to and from the Germanic provinces.

The country, commencing at the Strasburg end of this great "thorougfare," is the continental United States—the provinces of Zollverein, containing nearly 30,000,000 of inhabitants, and nearly 200,000 square miles of fertile territory. The high duties of that league—or rather its vexatious and unequal duties—that on cotton alone varying from 3 to 120 per cent. on the value, being levied on the same principle as that upon tea in England, favoring the rich at the expense of the poorer classes, taken in conjunction with our restrictive commercial policy, have had the effect of unduly diverting capital in an agricultural country to commercial and manufacturing enterprize; the factories of Baden, now 300 in number, more than doubled in the course of seven or eight years, while the Saxon spinning establishments and stocking frames advanced more rapidly in three years towards 1840, than in thirty years previous. Seeing that England now sends 100,000 cwts. of cotton wool to this wool growing country, we may be convinced that there is something "rotten in the State of Denmark," which, perhaps, is to be corrected more by such facilitation of social intercourse as we here discuss, than by a modification of our tariffs. At the Leipsic fair, at least, we know that the market is inundated with smuggled English manufactures. A new facility to smuggling will lead to such measures of policy as will substitute honest and open national traffic for contraband dealing. It is in this manner that the healthy interchange of the agricultural products of France and Germany and the manufactures of England will alone be restored; or if it is now too late to look to the German States for a market for our cottons and calicos, let us even, if we can transport nothing else, be glad to find a ready and ever open conveyance for our machinery to supply the looms of Alsace, and the spinning establishments of Prussia.

SHIP CANAL.

Through the politeness of Col. Abert, of the bureau of topographical engineers, Washington, who will please accept our thanks, we have received several reports; and, among others, one in relation to the construction of a ship canal around the falls of St. Mary, in Michigan, which we give entire, except the map.

Report of the secretary of war, communicating an estimate of the cost of constructing a ship canal round the falls of St. Mary.

War Department, Jan. 4, 1844.

Sir: In pursuance of the resolution of the Senate passed on the 27th ult., I transmit, herewith, a report from the bureau of topographical engineers, with an estimate of the cost of connecting lakes Huron and Superior by means of a canal round the falls of St. Mary, adapted to navigation by steam vessels.

As the resolution calls for any estimates of the cost of this work in the possession of the department, the colonel of the corps of topographical engineers has given the plan and estimate of Mr. Almy, made in 1837, for the description of canal therein contemplated. But, deeming the resolution to look to a canal of larger dimensions, he has added his own plan and estimate for a canal "adapted to navigation by steam vessels," based on the best information which he could obtain in relation to the subject.

Very respectfully, your obedient servant,

J. M. PORTER.

Hon. W. P. MANGUM, *President of the Senate.*

Bureau of Topographical Engineers.
Washington. Jan. 3, 1844.

SIR: In obedience to your direction, I have the honor to submit an estimate for a canal, "connecting lake Huron and lake Superior, adapted to navigation by steam vessels," called for by a resolution of the Senate of the 27th instant.

As there has never been a survey of that locality for such a purpose by this office, I am without those elements for an estimate upon which the office usually relies.

In the absence of such information, resort has been had to a survey made by Mr. J. Almy, in 1837. Mr. Almy was an engineer in the employ of the State of Michigan. Also, in anticipation that information of the kind now called for would probably be required during the present session, a letter was addressed to Capt. Johnston, at Fort Brady, in July last, proposing certain queries having reference to this canal, which he was desired to have investigated and answered. His answer of last September is hereto annexed, together with the information asked for, which was collected with much care by Lieut. Handy, of the 5th infantry.

This information, together with the survey of Mr. Almy, will enable me to submit an estimate upon which reliance may be placed.

Mr. Almy's survey, report and estimate are hereto annexed. His estimate amounts to $112,544, which would probably be sufficient for the construction of a canal of the kind and dimensions contemplated in his report.

But the resolution of the Senate contemplates a canal "adapted to navigation by steam vessels." A canal for such a purpose involves considerations that will much enhance the cost beyond the estimate of Mr. Almy. The government steamer, Michigan is 167 feet long, 47 feet wide, draws 8 feet water, and is of 600 tons burden. Freight vessels of these dimensions would draw more water, as they are generally more heavily laden; and, from the best information I have been able to collect, a draught of ten feet is the least which can with safety be adopted for the largest class of lake steamers. Nor can less than two feet of water below the bottom of the boat be adopted for the canal. These dimensions give data for the size of the canal and of the locks, viz: for the canal, 100 feet wide and 12 feet deep; for the locks, 200 feet long and 50 feet wide.

The difference of level (according to the survey) between lake Superior and lake Huron is about 21 feet, which is supposed to divide into three lifts. The locks should be collected together at the lower end, in steps, without intervening basins, as exhibited in red lines upon the plan, and should be in double sets; one set for the ascending and one for the descending trade. The towing path to be three feet above the water line, and where this path is upon the embankment it should be twelve feet wide; the berm upon the opposite side to be six feet wide; the canal to be without lateral slope, but to have the same width, except as to batter of side walls, at bottom as at the water surface; the sides of the canal to be maintained or reveted with dry stone walls. The dry masonry of these walls to be three feet wide at top, and five feet wide at bottom; but where the excavation exhibits a sufficiently firm rock facing, these dimensions may be reduced. The extension of the work into lake Superior will have to be about 800 feet, before a sufficient depth is obtained, and there will probably have to be some excavation under water at the lower end of the canal, although the profile of Mr. Almy does not exhibit its necessity.

The total length of the canal line from water to water, exclusive of the extension of work into the lake, is about 4,400 feet, throughout a part of which an embankment will have to be raised, as exhibited in the profile. A pier to protect the entrance, of the canal, supplied with belaying posts, will have to be extended for about 800 feet into lake Superior, upon the southern side of the canal.

As lake Superior has, from various causes, a difference in its level of about four feet, it will be necessary to construct a guard lock at the junction of the canal with that lake; and, also, in order that the water may be occasionally shut off for purposes of cleaning and repairing the canal. And in consequence of variations of level in the water below the falls, the last set of locks in the series at the lower end of the canal may have in their construction to embrace the considerations due to lift and guard locks.

The prices for the excavation are taken from Mr. Almy's estimate; those for the embankment and dry walling from data in this office; those for the locks from a report of Capt. Williams for a canal to overcome the falls at Niagara, as it is not supposed that works of this kind can be done for less at St. Mary's than at Niagara.

The difference between the estimates (that of Mr. Almy and that now submitted) arises principally from differences of dimensions in the two plans, and from those considerations which belong to a canal adapted to steam navigation, and to the active trade which the canal will have to accommodate.

In works of this kind we should avoid the mistake committed at Louisville, which already, in the judgment of so many, renders the construction of a second canal at that locality necessary.

The cost of constructing this canal would be very much reduced if the U. States troops were employed upon it. A detachment of about five hundred men would accomplish the object by the usual roster details, and the difference of cost would be in the difference between the usual price of labor, and the allowance of 15 cents per day to the soldier when so employed. The employment of the army upon such works, in times of peace, is customary with all other nations, and I can see no sound objection to the adoption of the practice in our service. Such occupation is no injury to the discipline, while it preserves the bodily health and mental vigor of the men, and increases their efficiency and usefulness for their ordinary duties. These considerations are, however, not involved in the estimate.

ESTIMATE.

Guard lock at lake Superior, - - -	$27,897 00
For cutting 18,500 cubic yards of rock under water, at $1 50 per yard,	27,750 00
For cutting 89,920 cubic yards of rock, at $1 per yard, -	89,920 00
For excavating 8,647 cubic yards of sandy loam and vegetable mould on top of the rock, at 20 cents per yard, - - -	1,729 40
Do. do. 113,607 c. yds. loam, gravel, vegetable mould, etc., at 25 cts. per yd.,	28,401 75
For embanking 15,600 cubic yards, at 12 cents per yard, -	1,872 00
For 11,555 cubic yards of dry masonry wall, at $2 per yard, -	23,110 00
For three double locks, at $66,715 each, - - -	200,145 00
For a pier 800 feet long and 12 feet wide, - - -	12,000 00
Contingencies, 10 per cent., - - - -	41,282 51
Total, - - - - - -	454,107 66

Respectfully submitted by, sir, your ob't. serv't, J. J. Abert,
Col. Corps Topographical Engineers.

Hon. J. M. Porter, *Secretary of War.*

Fort Brady, Michigan, Sept. 29, 1843.

SIR: I have the honor to enclose, herewith, answers to your queries of July 25th.

The necessary examinations have been made by Lieutenant Handy, 5th infantry.

As far as I can judge, having been over part of the ground, and from reports of others, I think he is as correct as he assumes to be; wanting, as he mentions, instruments necessary to exactness.

Permit me to add, that Lieut. Handy, besides willingly undertaking this duty, has, I think, shown both diligence and skill in the performance of it.

I am, sir, with respect, your obedient servant, A. JOHNSTON,
Capt. 5th Infantry, commanding Fort Brady.

Col. ABERT, *Chief Topographical Engineer, Washington.*

Fort Brady, Michigan, Sept. 8, 1843.

SIR: In conformity with instructions contained in your letter of July 25th, requesting information in reference to the practicability of a canal route in the vicinity of the Saut de Ste. Marie, Michigan, I have the honor to lay before you the result of my observations, having been detailed for this duty by Capt. Johnston, commanding Fort Brady. You desire to know,

1st. "What kind of soil does the projected canal pass over?"

From the upper or western extremity of the canal line to the mill race, (a distance equal to about half of its length,) the soil consists of vegetable mould, underlaid by a bed of red sandstone rock, of a very soft nature, and very thinly stratified—the strata, in many instances, not exceeding an inch in thickness. The adhesion between the strata, in many places along the canal line, is so slight that they can be easily removed with the hand. From the mill race to the lower or eastern extremity of the line, the soil consists generally of sand and loam, interspersed with boulders of granite, gneiss, etc., varying in size from two to four feet diameter. Most of these boulders are of a very good material for building, and would be serviceable in the construction of locks, etc. In many places along the line, the soil is of a very permeable nature, so much so, that upon breaking ground, the water makes rapidly.

2d. "Is the rock near the surface, or what distance from the surface, generally, in the extent of the line?"

The average depth of the rock below the surface, for the distance above mentioned, is about one foot. In some places, it is only six inches; in others, more than five feet below it—the strata dipping in a direction parallel to the line of the canal.

3d. "What is the depth of the water near the shore, at each end of the canal line, and what distance from the shore before a depth of fifteen feet is attained?"

The average depth of water at the lower end of the line, for a distance of about 60 feet from the shore, is 2½ feet, when it suddenly deepens to 6 or 8 feet. The shortest distance from the shore at which a depth of 15 feet is attained, is 52 yards. At the upper end of the line, the average depth of water is from 2½ to 4 feet. To attain a depth of 15 feet, it is necessary to go about 226 yards from the shore, in a line forming an angle of about forty degrees with the canal line. Following the direct line of the canal, it would be necessary to proceed up the river several miles before a depth of 15 feet could be attained, for the water continues at a uniform depth of about one fathom for a very considerable distance along the American side of the river, so that it is necessary to proceed out some distance in a direction at right angles with the line of the shore to strike the channel. Upon reaching the channel, the water suddenly deepens to several fathoms; the bed of the river, at this point, sloping off very abruptly, at an angle of about 30 degrees.

5th. "Is the bottom at both ends mud or rock?"

The bottom at the lower end of the line consists generally of sand, underlaid by a stratum of hard clay, with here and there a bed of sandstone rock of trifling extent.

At the upper end the bottom consists of an extended bed of sandstone rock; being a continuation of the bed before described as underlaying the canal line for about half of its extent. This rock extends to a distance of several hundred feet from the shore, and is overlaid by a stratum of sand, averaging about one foot and a half in thickness.

6th. "Are there any shoal places below Fort Brady sufficient to obstruct first class lake steamers, in a passage up to near the lower end of the canal?"

About 20 miles below Fort Brady, at a widening of the river known as lake George, there is a bar of very hard clay, underlaid by a substance resembling quicksand in its properties. As this bar extends completely across the lake, all vessels navigating the river are compelled to pass over it. The depth of water upon it is very variable; sometimes exceeding nine feet, and sometimes, though rarely, not exceeding six. The average depth may be laid down at seven feet. It has frequently been crossed by the largest class of steamers at present navigating the lakes. This is the only obstruction of importance between Fort Brady and the mouth of the river, though the channel is very winding, rendering the navigation rather intricate.

It would perhaps be as well to state that the water in the St. Mary's river is much higher at some seasons than at others; and it is at present higher, by upwards of two feet, than it has been for some years past. In ascertaining the distance to which it is necessary to go from each end of the canal for a depth of fifteen feet, I have therefore made some allowance for this unusual rise of the water.

I would also remark, that owing to a want of proper instruments, my observations, respecting distances, etc., are not made with that accuracy with which I should otherwise have been enabled to make them; but I trust they will prove sufficiently accurate for all practical purposes.

I have the honor to be, very respct.'y, your ob't serv't, J. O Handy,

Brevet 2d Lieut. 5th Infantry.

Col. J. J. Abert, *Chief of the Topographical Bureau.*

September, 1837.

Sir: In pursuance of my appointment from you as engineer, and in pursuance of an act of the legislature, I have the honor to transmit, herewith, the survey and estimate of the expense of constructing a ship canal around the falls of St. Mary; also, maps and profiles showing the location of the proposed line of canal, together with the depth, quantity and quality of the excavation.

Having had the honor of being one of a special committee to whom was submitted for consideration, at the last session of the legislature, the project of uniting the water of lake Superior with lake Huron by a ship canal, and having been also identified with all the subsequent proceedings as the friend and advocate of the proposed work, yet I hope that neither of these circumstances has had any influence with me in making up and presenting a more favorable report than is warranted from a careful survey and examination of the proposed line of communication.

I do not deem it necessary, before entering into a topographical description of the country in the immediate vicinity of the proposed improvement, although it might not be out of place, neither is there required at the hands of the engineer, any speculations or statements in regard to what would be the effect on commercial operations by removing the barrier to navigation between lakes Huron and Superior.

If, however, any information on this subject should be deemed indispensable, there are sources from which, I apprehend, the most convincing and satisfactory evidence can be obtained of the importance and utility of the work in question.

By reference to the map and profile of the canal proposed, it will be perceived that no difficulties of a serious nature interpose or are to be apprehended in the event of its construction. Even that portion of the line where rock is indicated will not, owing to its peculiar quality and position, require blasting.

The total length of the proposed canal, from the deep water at the head of the falls to its termination at the foot, is 4,560 feet; and the portion which may be estimated the most difficult and expensive to excavate, embraces a distance of about 700 feet, from the head of the canal to the deep water in the river; yet, in the excavation of this part of the work, no very extraordinary expense will be involved.

As the project under contemplation comprehends a ship canal, it becomes necessary to define the capacity and dimensions and proportions of both canal and locks, as I believe will accommodate the larger class of sail vessels now used on any of our lakes, and for whose accommodation and use I make no doubt this work was originally designed and projected. I would, however, remark that the only part of the work where the expense would be increased by constructing the same to accommodate the largest class of steamboats, will consist in the increased magnitude of the locks, which, on investigation, will be found no small item.

The dimensions of the canal and locks, and upon which the dimensions have been based, are as follows: all that portion of the line where the profile indicates rock, I propose to execute by a cut affording a width of 75 feet on the surface of the water, with 10 feet depth, giving the side a slope corresponding to a bottom of 50 feet. The residue of the canal, not occupied by the locks, will have a width on the surface of the water of 100 feet.

To the locks I propose to give the following dimensions and proportions, viz: 100 feet in the clear for length, and 32 feet for width; and as the whole amount of fall to be overcome by lockage is 18 feet, I have deemed it prudent, on the ground of avoiding great hydraulic pressure on the side walls and gates, to divide the same into three lifts of six feet each.

In regard to the facilities afforded for the construction of such parts of the works as may require the use of stone, I would remark that nature seems to have left no room for complaint. The surface of the ground immediately on a line with the proposed work, and where it becomes necessary to locate the locks, is covered with large detached masses of granite, of sufficient magnitude for lock stone. And we shall duly appreciate the advantages and conveniences of having this material so near at hand, when we take into consideration the great expense of fitting and transporting this indispensable article, so necessary for the permanent and durable construction of such works, from quarries remote from the place where the same is required to be used.

With these remarks, I submit the following estimate of expense of constructing the said canal:

ESTIMATE.

Excavating 8,750 cubic yards of rock under water, between station No. 1, and deep water in river, (see profile) being a distance of about 700 feet, at $1 50 per yard, - -	$13,125 00
(This rock is red sandstone, lying in strata from two to four inches thick, easily separated.)	
Excavating 23,709 cubic yards of rock of the same quality as above, embracing a distance of 1,300 feet, from station No. 1 to 13. (see profile) at $1 per yard, - - -	23,709 00
Excavating 8,589 cubic yards of earth, consisting of sandy lime and muck on the top of the rocks, between stations No. 1 and 13, at 20 cents, - - - - -	1,717 80
Excavating 28,802 cubic yards, consisting of loam, gravel and muck, from station No. 13 to 29, at 25 cents, - -	7,200 50
Excavating 21,442 cubic yards of excavation for locks, (quality of earth, as above,) at 25 cents, - - -	5,360 50
	$51,112 80

ESTIMATE FOR LOCKS. (See map and profile for its location.)

Lock No. 1.

1,322 yards of stone masonry, in water cement, at $5 50,	$7,271 00
68 feet of quarry stone at $8,	544 00
Gates and iron,	1,500 00
Foundation for locks, sills, etc.,	1,200 00
3000 yds. embankment, at 25 cts.,	750 00
Coping stone and incidental work,	800 00
Contingencies,	1,200 00
	$13,265 00

Lock No. 2.

1,322 c. yds. of stone masonry, in water cement, at $5 50,	$7,271 00
68 feet of quarry stone, at $8,	544 00
Gates and iron,	1,500 00
Foundation for locks, mitres, etc.,	1,200 00
3000 c. yds. embankment, at 25 cts.,	750 00
Coping stone, etc.,	800 00
Pumping and keeping lock pit free from water,	1,500 00
Contingencies,	1,350 00
	14,915 00

Lock No. 3.

1,322 c. yds. of stone masonry in water cement, at $5 50,	$7,271 00
76 ft. quarry stone, at $8 per ft.,	608 00
Gates and iron,	1,500 00
Foundation for locks, sills, etc.,	1,200 00
Coping stone, etc.,	800 00
200 yds. of stone masonry, wing walls, etc., at $5 50,	1,100 00
Estimated expense of coffer dam and pumping out pit,	1,500 00
Contingencies,	1,397 00
	15,376 00

RECAPITULATION.

Cost of rock and earth excavation,	51,112 80
Cost of lock No. 1,	13,265 00
Cost of lock No. 2,	14,915 00
Cost of lock No. 3,	15,376 00
Contingencies,	9,376 00
	104,044 80

In order to include every possible item of expense, I have thought proper to add a further estimate for a pier and guard gate at the head of the canal although I do not deem them absolutely necessary, and which are estimated as follows:

Laying down and filling 700 feet of pier, - - - - - - -	6,500 00
Guard gates, - - - - - - - - - -	2,000 00
	8,500 00

This amount, added to the above, will make the sum total of $112,544 80. as the cost of constructing the proposed canal.

The above is respectfully submitted by your obedient servant,

J. ALMY, *Civil Engineer.*

His Excellency STEVENS T. MASON,
Governor of the State of Michigan.

True copy: A. CANFIELD, *Capt. Top. Engineers.*

RAILROAD RECEIPTS.

We find in the Journal of Commerce the following comparative statement of the receipts for four months on the Utica and Schenectady, Syracuse and Utica, and New York and Erie railroads. The result is highly satisfactory —showing, as it does, the regular and certain increase of business, and, of course, the extension of the railroad system.

NEW YORK AND ERIE RAILROAD.

The earnings on this road during the month of April, 1844, were

From freight,	$6,612 77
From milk,	2,166 87
From passengers and mail,	5,075 41
	$13,855 05
The earnings for the same period last year, since when the road has been extended seven miles, were,	8,946 62
	4,908 43

SYRACUSE AND UTICA RAILROAD.

Comparative receipts for four months.

	1843.	1844.
January,	$4,910 43	$5,169 39
February,	4,093 05	5,259 50
March,	4,203 64	7,384 83
April,	10,166 77	19,372 99
	$23,373 87	$37,186 71

UTICA AND SCHENECTADY.

January to May, 1843,	$46,108 47
do. do. 1844,	59,763 83
Gain of	$13,655 36

MISCELLANEOUS NOTICES.

Large quantities of up-freight remained at Albany early in May waiting for boats, though by the end of the month they will scarcely be half employed. The late opening of the Erie canal is becoming every year more injurious to the State and city, and the branches of Philadelphia forwarding houses are consequently very numerous here. It is scarcely necessary to say that this difficulty cannot be in any way affected by the enlargement—it is the want of boats, not of capacity of canal, which keeps these goods back, and if larger boats were used, there would of course be fewer of them. The spring trade—if free—would commence early in March; now it is delayed to the end of April, via the Erie canal, all the early freight going via Philadelphia, when its destination can be reached by that route, the additional cost of transportation being a small item on merchandize.

The legislature of N. York has at last granted permission to the people to transport freight on the railways between Albany and Buffalo during the suspension of navigation on the Erie canal, but paying canal tolls. By this ingenious arrangement the public will receive the smallest accommodation with the highest charges, and the railway companies can expect but a trifling return from the large additional capital invested, and the greatly increased incidental expenses. If the companies will only unite to give the farmers the greatest facilities, and be well prepared to get hold of as much merchandize as possible before the opening of the canal, the result can be neither distant nor doubtful.

The *Tonawanda railroad company* are about rebuilding their road. In 1837 one of our correspondents undertook to demonstrate that the construction of this road was such as to give the least possible strength with a given quantity of material. The projector, in answer, attempted to show that the effect was a maximum, and the communication was accompanied by drawings which placed the new mode—the "block" system—fairly before the readers of the *Journal*.

DR. FRANKLIN ON ENGINEERING.—*August*, 1772.

"I am glad my canal papers were agreeable to you. If any work of that kind is set on foot in America, I think it would be saving money to engage, by a handsome salary, an engineer from here, who has been accustomed to such business. The many canals on foot here, under different great masters, are daily raising a number of pupils in the art, some of whom may want employment hereafter; and a single mistake through inexperience, in such important works, may cost much more than the expense of salary to an ingenious young man already well acquainted with both principles and practice. This the Irish have learnt at a dear rate, in the first attempt of their great canal, and now are endeavoring to get Smeaton to come and rectify their errors. With regard to your question, whether it is best to make the Schuylkill a part of the navigation to the back country, or whether the difficulty of that river, subject to all the inconveniences of floods, ice, etc., will not be greater than the expense of digging, locks, etc., I can only say, that here they look on the constant practicability of a navigation, allowing boats to pass and repass at all times and season, without hindrance, to be a point of the greatest importance; and, therefore, they seldom, or never, use a river where it can be avoided. Locks in rivers are subject to many more accidents than those in still water canals; and the carrying away a few locks by freshets, or ice, not only creates a great expense, but interrupts business for a long time, till repairs are made, which may soon be destroyed again; and thus the carrying on a course of business, by such a navigation, be discouraged, as subject to frequent interruptions; the toll, too, must be higher to pay for such repairs. Rivers are ungovernable things, especially in hilly countries; canals are quiet, and very manageable: therefore they are often carried on here by the sides of rivers, only on ground above the reach of floods, no other use being made of the rivers than to supply, occasionally, the waste of water in the canals."

Very serious riots occurred in Montreal, owing to the canal laborers taking possession of the polls. We regret these occurrences, as they in some degree throw odium on public works in general. At the same time, however, it is proper to state that they were engaged on government works, that they turned out to support the projectors of these works, and succeeded. All have been since "discharged," and—*re-engaged*, with few exceptions. They are of course ready for the next election. It is difficult to speak of such atrocious occurences in a Journal devoted to the advancement of civil engineering, though nothing can be more hostile to the cause to which our labors are devoted.

The *Louisville, Cincinnati and Charleston railroad company* state, in their report of 29th November, 1843, that in consequence of a diminution in charges, "the quantity transported within the same period has been quadrupled, and, in some instances, tenfold.,"

"Under the new reduced rates, bricks, lumber, wood, and even coal and ice, with most of the articles of domestic produce, hitherto prohibited under the higher rates charged, are becoming important items on the freight lists; and promise, in the future, to greatly augment the profits on the road."

They have added to their stock "three of Baldwin and Whitney's new improved six wheel connected engines. These locomotives, thus far, have fulfilled their promise, not only in the greater power exerted, but in the facility with which they pass the curves; and the little injury, compared with engines of the smallest class, they inflict on the road. Those in possession of our company though of a weight not exceeding 11 1-2 tons, have been found fully equal to the transportation of 1000 bales of cotton; and on an emergency, with the eight wheel platform cars composing their train, each might be made to haul from 12 to 1500 bales of cotton."

They point out also the vast advantages which would result from a connection with the Georgia railroad, realizing all that was anticipated, and far more than could have resulted from the route to Cincinnati, and that, too, with a comparatively small expenditure. They state one—to a friend of railways—distressing fact.

"The most imposing obstructions are still at our own door, in the interval between our depot on the neck, and the wharves in Charleston, and in the expense of the dray charges from one to the other, amounting, in many instances, to 40 per cent. on the railroad freight, on the entire distance from Charleston to Hamburg, and to Columbia!"

The *Baltimore and Susquehanna railroad company*, in their report of December, 1843, refer to new cars invented and patented by their machinist, Mr. J. Millholland.

"Each of these cars has six wheels, weighs in all about 8500 lbs., and will carry 12000 to 14000 lbs. of most descriptions of produce, the full load of an ordinary eight wheeled car. Their cost, averaging less than $450 each, is considerably below that of cars of equal quality with eight wheels."

"During the year, a purchase was made from the patentees, of the right to use what appears to be the most effectual invention which has yet been made, for preventing fires from the escape of sparks from the locomotives." * * "It has now been used for two years and a half, and since its adoption no instance has occurred of fire being communicated by sparks from the locomotives of the company. The cost of this purchase was $2000."

The name of the inventor is not given. Wood is the fuel used on this road. They complain of the late period at which the canals of Pennsylvania open: what would they say of the Erie canal?

"It is to be remarked that the Pittsburg trade over this route was not so great as it would otherwise have been, in consequence of the unusual length of time during which the Pennsylvania canals were closed last winter by the ice. In the year 1841, they were not closed until the 20th of December, and were opened on the 7th of March following, while in the ensuing fall they were closed on the 25th of November, 1842, and were not opened until the 7th of April last. There is good reason for believing that a considerable amount of produce and merchandize was in consequence diverted from this to other routes."

A route has been surveyed for a "*Northern Railroad*" from Concord to Lebanon, N.H., and a report made by Mr. T. J. Carter, engineer, who estimates the cost for a single track at $20,000 per mile, with heavy, rail, cars, engines, etc. The distance is 70 miles; 25·45 miles are level; 15·75 miles are on gradients of 52·80 feet per mile; the remaining distance consists of short planes of from 4 to 47 feet per mile. A good map and profile accompany and illustrate the report.

Hunt's Merchant's Magazine, for May, contains a paper, by W. Beach Lawrence, Esq., of this city, on the *Croton Aqueduct*. He regrets the departure from the plan of Major Douglass "in crossing the Harlem river and Manhattan valley, both of which alterations detract greatly from the magnificence, if not from the utility of the work," (p. 437.) Mr. Lawrence appears to have overlooked the late "dam," which a frequent contributor to our pages has denounced in no measured terms. The dam has been rebuilt, and has four times the capacity of the old dam. To the great cost of construction must be added the damages caused by its giving way, to the amount of about $100,000.

The following remarks of Mr. Lawrence apply with force to only too many of our great public works:

"Unfortunately, owing to collisions between the chief engineer and the commissioners to whom, according to the system prevalent in this country, the superintendence of the work was confided, and who, as is ordinarily the case, whether the enterprize is of a public or a private nature, were selected without reference to scientific qualifications, Major Douglass was, at an early day, obliged to discontinue his connection with the aqueduct, and his successor, educated in a wholly different school, however competent to the mechanical execution of the work, had none of the enlarged views which influenced the engineer with whom the plan originated."

The *Outlet at Black's Eddy* has at length been authorized. This work will ultimately be of importance to the coal trade of Pennsylvania with this city and the north and east generally. It has been strenuously opposed by those interested in the Schuylkill region, and with success till now.

An additional tax has been imposed to meet the liabilities of the canals of New York, to the amount of the interest of the loan authorized, 1,200,000 dollars.

Railway Extension.—The central railway, Michigan, has been extended ten miles to Gridley's station; to which place the cars now run.

Patents—Annual Report of the Commissioner.—We are indebted to C. M. Keller, Esq., of the patent office, for a copy of the report of the commissioner, to which we shall refer more particularly in our next number.

FOREIGN PERIODICALS FOR MAY.

By the Brittania, we have received the *Civil Engineer and Architects' Journal*, and the *London Polytecnic Magazine*, for May; but the number for June is so nearly in type that we have only room for a few extracts from the former.

There is, in this number of the Polytecnic Magazine, Part II of "railway communication through France," which treats of the "metallization of wood," and also a description of the "inclined railway into Liege," which will be given in our next.

Institute of Civil Engineers.—The discussion on the subject of slips in cuttings and embankments of railways was renewed, and extended to such a length as to prevent any papers from being read. Some observations were made by Sir H. T. De la Beche, the Rev. Mr. Clutterbuck, and several members, on the geological features of the slips, whether occurring naturally in cliffs, as at the back of the Isle of Wight, or in the artificial cuttings of railways. It was contended, that in both cases, the reduction of the lower and softer beds to the state of mud, by percolated water, rendered them incapable of bearing the weight of the superincumbent strata, and that the mass, when saturated, slid down by its own gravity; but that slips in railway work, were accelerated by the vibration caused by the passage of the trains. The vibration of the air from the discharge of a gun had been known to cause an avalanche; and the cases were almost analogous. More attention both to surface and bottom drainage of the slopes was much insisted upon; and it was urged, that the back drains, so close to the top of the cuttings, were prejudicial; that in the dry season the bottoms cracked, the rain found its way through, and it had been frequently noticed that the slips commenced at a few feet below the level of these drains. The dry shafts which had been sunk in the slopes of the Eastern Counties railway, by Mr. Braithwaite, with the concurrence of Sir H. T. De la Beche, were instanced as successful in rendering wet and treacherous strata comparatively dry and secure. A section was exhibited of the embankment at Hanwell, on the Great Western railway; this embankment which was of gravel, was 54 feet high; it was laid in a marshy valley traversed by the river Brent; the London clay, upon which it was laid, inclined towards the river, and at one of the numerous fissures with which the stratum abounds, a subsidence occured squeezing up at the same time on the lower side to as great an extent as the embankment sunk, which was stated to be nearly as much in one year as the entire mass of the embankment. This subsidence was stopped by loading the foot of the slope, and thus restoring equilibrium, and it was stated to be at present quite secure. It was urged that in the earthwork of canals, where there was no vibration, the slips generally occurred in the first few months after the formation of the embankments; but that, on railways, they occurred quite as frequently after the lapse of several years. It appeared, therefore, that much was due to vibration."—[C. E. & A. Journal.]

ENGLISH PATENTS.

Railway Wheels.—This invention relates to a mode of so combining iron and steel in the manufacture of tyres for railway and other wheels, that the steel may be at those parts of the surface of the iron most liable to wear, after the steel and iron has been rolled into bars for the purposes above described. In order to carry out this invention the steel and iron are piled together, and then heated to a welding heat, after which they are passed under the hammer and formed into a bloom, and then passed between suitable rollers for forming it into bars adapted for tyres for railway and other wheels; by this means the steel is intimately combined, and is said will possess many advantages over the present mode of applying steel to the face of tyres for railway wheels; the patentee in some cases makes the pile so as to present a surface of iron, with steel underneath, the former being removed when turning up the wheel in the lathe in the construction thereof. The claim is for the mode of manufacturing tyres for railway and other wheels, by rolling them from piles of iron and steel, in such manner that the steel is at the wearing surface.

Axles for Wheels.—This invention consists of forming the axles of two parts or shafts, one solid and the other hollow, whereby greater strength, and less liability to breakage is obtained. In order to carry out this invention the patentee provides a tabular or hollow axle sufficiently long to pass through the bosses of each of the wheels when at the required distance from each other, the calibre or bore of this tube being sufficient to admit the solid axle passing through it, which axle consists of a solid shaft having bearings turned at each end, to fit the steps or journals in the frame side of the carriage. The wheels are firmly fixed upon the ends of the hollow axle by means of keys; the solid axle is then passed through the tabular or hollow one, and fixed therein in like manner, by means of keys. When the bearings are within the wheels it will be found necessary in forming the journals to weld two collars upon the hollow axle, so as to obtain greater strength. The claim is for the construction of axles, by combining together solid and hollow shafts one within the other, as described.—[C. E. & A. Jour.]

Separation of Metals.—The inventor takes copper, in which silver is in combination, and melts it in the usual manner; he then pours into an iron vessel containing lead melted to a red heat, or nearly so, and thereby mixes the argentiferous copper with the lead in proportion to the quantity of silver in combination. After the mixture it will be found that the copper with a portion of silver and lead will, as the mixture cools, rise to the surface, which may afterwards be taken off with a pair of tongs, or other mechanical contrivance; for instance, a perforated plate somewhat less in diameter than the size of the iron vessel in which the compounds are, is placed in the vessel, and near the bottom thereof, so that as the metals are melted it will be found that the copper, with a portion of silver, will rise through the perforations in the plate, and may be lifted out of the vessel together with the plate, which plate is provided with one or more handles for that purpose. The copper with such portion of silver as it may yet contain is then broken into small pieces, and separated by the process of "elequation," which is as follows: the pieces of copper thus obtained, together with a quantity of charcoal, are then put into a retort, or retorts, constructed with an opening at one end, through which the metals ("videlicet" the silver and lead contained in such pieces of copper) flow when in a state of fusion. The retorts, which are fixed in the furnace in a sloping position and closed, so as to exclude all air, are then heated to such a degree as to melt the silver and lead, but not the copper, which former are allowed to pass off through the opening at the lower end of the retort into a suitable vessel, leaving the copper almost free from the silver and lead, which two metals are to be afterwards separated by the ordinary process of cupellation.—[Ibid.]

Ellis' Improved Turn Table.—The objection to placing turn tables of the ordinary construction on the main line of a railway, is, that by the nature of their construction, they are rapidly destroyed, by the frequent passage of heavy trains over them, besides the injury done to the carriages, and the upleasant motion and noise. Mr. Ellis has constructed a turn table, which, when not in use, rests firmly on the curb, and thus allows the train to pass rapidly over it without injury. The iron pintle of the table on which it turns being kept well oiled, works with a loose collar round it in a vertical iron case; which case is supported and kept in its central position by two cross arms of cast iron, at right angles to each other, and attached to the curb. The lower end of the pintle passes through the bottom of the case, below which is a stirrup attached to a cross lever passing at one end through a chase in the circular masonry, or brickwork, supporting the table; attached to the external end of the long lever, is a second lever, working in a vertical direction, and connected with a third, or handle lever, by whidh the table is put in motion or fixed, as required.—[C. E. & A. Jour.]

The "Civil Engineers' Journal," ‸ril 1st, gives a rather discouraging account of the "Great Britain," nicknamed, with some show of reason, the "Great Postponed." It appears that the admiralty has engaged the services of Mr. Brunel, to report on screws, and we hope another year will not elapse without enabling us to form a tolerably correct idea of the comparative merits of the different screws, propellers, etc., now in use. We make the following extracts:

TUBES OF LOCOMOTIVE ENGINES.

Investigation to determine the diameter of the tubes of a locomotive engine boiler to produce a maximum effect.

In treating this subject it appears rational to suppose that the effect of the hot air in passing through the tubes is directly in proportion to the extent of surface in contact therewith, and as the time of contact conjointly: that is, denoting the number of tubes by n, their diameter by d, their aggregate surface by s, their united area by a, and the time of contact by t, supposing the length of the tubes constant, we shall have the following postulates:

$$t : a$$

$$a : n\ d^2 \qquad \text{A.}$$

$$\therefore t : n\ d^2 \qquad \text{B.}$$

$$s : n\ d \qquad \text{C.}$$

$$\therefore ts : n^2\ d^3 \text{ a maximum} \qquad \text{D.}$$

Table of the comparative evaporating power of three different methods of tubing:

Number of tubes,	- -	103	78	45
Internal diameter of tubes,	inches	$1\frac{5}{8}$	2	3
Distance between centres,	"	$2\frac{3}{8}$	3	4
Interval in tube plate,	"	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$
Total circumference of tubes	"	525·82	490·09	424·05
Total sectional area of tubes	"	213·61	245·04	318·08
Product of circumference and area,		112,320	120,091	134,881

Comparison.

A : C : : 100 : 120

B : C : : 100 : 112

It appears from the above, that the boiler which is tubed in the theoretic proportion is from 12 to 20 per cent. superior to the others.

Mr. Buck concludes that with "the preceding theoretic ratio," "the area of the tubes will rather exceed the half of the space."

CONTENTS:

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REMARKS ON THE PROFESSION

In this number we devote a little space to some remarks on the present state and prospects of the profession. Some years since we entered into this question at length, and ascribed the failure of many works to the fact that they were mere political jobs, projected by persons whose education, habits and pursuits rendered them incapable of forming any idea of the grand outline of the most efficient work to accomplish the objects aimed at, and who very naturally selected kindred spirits to execute their crude designs. Whether we then ascribed too much to this cause, and whether all the canals and railways of this country would have been as much better executed by private enterprize, as we then argued, is left to the judgment of the intelligent and candid reader.

The importance of extending the sphere of usefulness of the profession, has been repeatedly alluded to by ourselves, and correspondents, and unless this be done, a large portion of those who still cling to the hope of employment cannot too soon give up all idea of engineering as a means of support. The works we more especially allude to are roads, bridges, docks, dams and the *general* arrangement of the buildings and power of large manufacturing establishments. Still with every exertion, time will be required, and some years must elapse before the community will discover that the advice and assistance of an experienced engineer may be useful to them in other works than canals and railways. Indeed some of our railways even are entrusted to persons suddenly taken from other pursuits, and the repairs of superstructure, bridges, engines, etc., are left to the discretion of the subordinate hands. Such persons are unable to enter into the details which form the amount of annual expenses, and, though quite competent to strike the balance of profit and loss, are unable to show where the main difficulties lie, far less to suggest any mode of remedying the evil. Without going so far as to attribute the failure of some works to this cause, we feel confident that we may safely ascribe to it the smallness of some dividends, in part at least.

We believe also that the higher walks of the profession have been neglected. The engineer has only too often to execute the designs of some board, without a voice in the general plan; and it is hard to say whether the interests of the stockholders or of the profession suffer most from this cause. It must have struck all familiar with the general mode of proceeding in England, that the opinion of the engineer of the work is either closely adhered to, or at least forms the basis of discression among the directors; in many instances the opinions of numerous other engineers are taken also, not merely with reference to some mechanical detail, but as to location and general plan of the work. Now it is very easy to make preliminary surveys and reports in which all appears very smooth until submitted to the stern tests of construction and active operation. Then is seen by all with what degree of judgment the work has been adapted to its objects, both as regards the general plan and mechanical details. Then the cost, capabilities and income necessarily indicate the degree of judgment evinced in projection and execution, and that which, when the first line was traced, was a mystery to all or nearly all, becomes notorious to the casual observer. But the highest aim of the engineer is to determine, *a priori*, within reasonable limits, what the effect of any projected undertaking will be, and to take measures accordingly. This, however, requires something more than the use of the level and goniometer. It requires a thorough acquaintance with the wants of the community, as far as they are likely to be affected by the contemplated undertaking, as well as a knowledge of the various engineering means by which these wants may be best satisfied. Such information is obtained with no little labor, and to sift the mass of evidence in all such investigations, and to lay down the "projet" of the work by which these new facilities can be afforded with the least outlay, and in the best manner, is a problem to be mastered only by the union of character and liberal acquirements with the mechanical skill which forms the basis of the profession, and which is regarded by only too many as the sole requisite.

For example, suppose the enlargement of the Erie canal, the construction of the Chenango, Black river and Genessee valley canals had been submitted to such men as Brunel, Rennie, Stephenson, etc., does any one doubt that they would have condemned them? We name foreign engineers for obvious reasons, and not because we are without men whose verdict would have been equally just and decided. Indeed it is not long since the failure of the Reading railway and of the canals of Canada were predicted by two of our contributors, who went into elaborate investigations in support of their views, with what reason time will very soon show. But what we desire is to see these thorough examinations gone into before the work is commenced —nay, more, before the general plan of operations has been decided on. If this be done, we shall meet with no failures, though all that was anticipated may not be realized.

But, as already remarked, this can only be done by men of enlarged views who can take in at once the nature and extent of the engineering accommodation required, and the probability of these accommodations yielding an income sufficient to warrant their being carried into execution. And this is not all: when the result is not favorable in the opinion of the engineer, he must report decidedly against it. Unless this be done, the profession must suffer; for, in that case, the highest engineering considerations are thrown on the directors and stockholders, who, though the proper judges of the various plans submitted, are by no means the most suitable persons to project original designs. Yet the leading features of the State works of New York were left to commissioners, men appointed with reference to their politics, and the taxes levied to meet the debts of the canals attest their capacity, in one way at least, that of running up a large debt in a very short time.

It is, however, of little consequence that the engineers have an influence in these questions, if they know nothing beyond the field work, and we have heard experienced and educated engineers complain that the younger members of the profession, who were well versed in the practice, did so little to acquire that information which is indispensable to every one who aspires to succeed in the execution of great works—we do not mean the mere expenditure of large sums. In looking over the pages of this *Journal* and that of the Franklin Institute, for the last ten years, we find a large portion of the contributions from the same writers; and although we are far from intimating that all who can contribute have done so, it must still be allowed that these Journals give some tolerable idea of the practical, scientific and even literary attainments of the profession in the United States. The objects attained by the meetings of the Institute of Civil Engineers in London must be reached here by other means, which have been well pointed out by Mr. Latrobe in the *Journal*. We are even inclined to think that the plan there proposed, that of each and every member contributing his mite to some Journal taken by all, promises more important results than could be expected from any society in so extensive a country as this.

Impressed with these views, we beg leave to remind our readers of Mr. Latrobe's suggestion, more especially that part in which he alludes to those who, seldom writing, are averse to appearing in print because they fear their style may be inferior to the matter of their productions. Now the style—provided it be tolerably clear—is of exceedingly little importance, and we will venture to say that any striking improvement or original suggestion in any of the mechanical arts connected with engineering, will be immediately seized on and appreciated by the educated engineer, be the language ever so crude. More than this, it will be found that the most accomplished members of the profession will be the very last to regard the mere style of a contribution of a practical man on a practical subject.

In this number we conclude the explanation of the very extensive tables of excavation and embankment already published, and remain as ever desirous of making our columns the medium of conveying as much practical and definite engineering information as possible. Now it appears to us that this might be easily accomplished if engineers in different parts of the country would contribute their views on various points, not in elaborate essays, but in "Notes," as leisure or inclination may permit. This mode of communicating is attended with this advantage, that many minor but still important subjects which are not considered sufficient for a formal paper, may be easily treated in the familiar form of "Notes." We know that the gentleman to whom we are indebted for the "Notes on Practical Engineering," is not without hopes that others will also give their views on those points to which they have devoted particular attention, or in treating which they differ from the ordinary course.

There appears to be at this time a probability that public works will soon be extensively undertaken, and their steady continuance would be certain if engineers generally would decidedly report against all extravagant and injudicious projects which sink the money of the stockholder, ruin his confidence in the profession, and, of course, destroy the prospects of the engineer: in one word—character, united with skill, are required to give the profession anything like the standing and influence it has in England, the results of which the world is familiar with.

We should have remarked above that Smeaton and Telford, both self-made men, as well as all the first engineers in England at the present day, have written much and well. Brindley is an exception, and a most dangerous precedent for any man not gifted with his extraordinary natural abilities. The habit of writing leads to very close investigations, and necessarily induces habits of exactness and accuracy, than which nothing is more important to the engineer; and we close these remarks, which have grown upon our hands, with observing that, in our widely extended country, a general habit on the part of engineers of contributing papers, notes or memoranda on various appropriate topics, offers the best—certainly the surest mode of raising the standard of the profession, as well as of rendering it more useful and honorable to the country and to its members.

CANADIAN WORKS.

It appears that £300,000 of the Canadian loan, the interest of which—4 per cent.—is guaranteed by the British government, has been taken at 112. We regret exceedingly that no portion of the loan has been devoted to railways, cheaply constructed and adapted to the immediate wants of the community, instead of being nearly all laid out on canals, which *may* be required some century hence at soonest. The following extract is from a late Montreal paper. It appears that these—as we believe—most unfortunate undertakings are as fruitful of immediate suffering and disgrace as of permanent injury to the country; for the tide of emigration is not more rapidly turned by the cholera itself than by taxation. The land was taken about two years since!

"By letter in the *Melanges Religieux*, we see that the farmers along the line of the Beauharnois canal are all complaining of delay in receiving payment of the indemnity due to them for land taken up by the canal, as well as for damage done to their property, and even for labor performed as far back as last season. This is not right."

EXPLANATION AND ARRANGEMENT OF THE TABLES.

Tables I to XXI, with exception of tables VII, XIV and XXI, are contents for average depths, bases 15, 18, 25, 28, 30 and 34 feet for each of the side slopes ½ to 1, 1 to 1 and 1½ to 1.

Tables VII, XIV and XXI, are corrections for differences of depths for the same slopes.

Table XXII, contents of prisms with square bases.

These tables are all calculated for a length of 100 feet, the depths being supposed given in feet, and the contents are expressed in cubic yards.

The remainder of the tables, XXIII, XXIV, XXV and XXVI, are greater and lesser areas, horizontal and side distances for the side slopes ½ to 1, 1 to 1, 1½ to 1 and 2 to 1. Column first contains the inclination of the surface of the ground in degrees. The second and fourth columns, marked A and *a*, contain the greater and lesser areas A L E, E D M, (fig. 1) when E I or H is one. The sixth column, marked (A — *a*), contains the difference between the second and fourth, to be used when the degree of inclination is the same on both sides of the centre line of the road. When the inclination is not the same on both sides, the areas must be taken out separately for each side, and afterwards subtracted. The third, fifth and seventh columns are half the difference of the numbers in the preceding columns. The other columns in these tables are the greater and lesser horizontal and side distances, arranged in a similar manner to the columns of areas.

The greater areas, horizontal and side distances, are used when these dimensions rise above the centre line of an excavation, and the lesser areas, horizontal and side distances, when below the centre. In embankment the reverse obtains. The prism, of which the greater area is the base, must always be added to the content in excavation or embankment, and the prism, of which the lesser area is the base, must always be subtracted.

EXAMPLES, SHOWING THE MANNER OF USING THE TABLES.

First. Cases where the natural surface is level transversely.

EXAMPLE 1. A cut, the base of which is 25 feet, side slope 1½ to 1, depth 10·5 feet throughout, is 100 feet in length, required the content.

Turn to table XVII, and opposite 10 feet, and under ·5, will be found the required content: 1585 cubic yards.

EXAMPLE 2. An excavation, having the same base and side slope, is 19 feet deep at one end, 2 feet at the other, and 100 feet in length, the content is required.

The average depth (or ½ sum of the depths at the ends) is 10·5 feet, and the difference of the depths is 17.

The content for a depth of 10·5 feet is - -	1585 cub. yds.
And the correction for a difference of 17 feet is found in table XXI, - - - - - -	134 "
Hence the true content is - - - -	1719 "

When the length is not 100 feet, multiply the result obtained from the tables by the given length, and divide by 100 for the true content.

EXAMPLE 3. A cut, the base of which is 15 feet, side slope ½ to 1, and length 300 feet, is 10 feet deep throughout, required the content.

The content for a depth of 10 feet and length 100 feet is found by table I to be 741 cubic yards.

$$\text{Hence, } \frac{741 \times 300}{100} = 2223 \text{ cubic yards.}$$

It will be observed that when the excavation or embankment runs to nothing at one end, the same method is applicable; ½ the depth at the other end being the average, and the depth itself being the difference of depths.

EXAMPLE 4. An embankment is 25 feet wide on top, has a side slope of 1½ to 1, is 6 feet deep at one end, and runs out in a length of 30 feet, required the content.

The content for the average depth, 3 feet, is, by table XVII,	328 c. yds
The correction for difference of 6 feet, is, by table XXI,	17 "
The content for a length of 100 feet is,	345 "

$$\text{Hence, } \frac{345 \times 30}{100} = 103{\cdot}5 \text{ cubic yards.}$$

When there is excavation at one station and embankment at the succeeding one, the length of excavation will be found by multiplying the depth of excavation by the whole distance between the stations, and dividing by the sum of the depths of excavation and embankment.

EXAMPLE 5. Let there be 7 feet depth of excavation at one station, and 3 feet embankment at another, 100 feet distant from the former.

$$\text{Then, } \frac{7 + 100}{7 \times 33} = 70 \text{ feet length of excavation,}$$

$$\text{and } 100 - 70 = 30 \text{ feet length of embankment.}$$

Hence the content of each can be found as in 4th example. When the base is different from that for which any of the tables are calculated, the content can be found by equation (Y), in which it will be observed that H and H′ are the sums of the depths and $\frac{1}{2m}$th the base. Find the number in table XXII, for prisms 100 feet in length, corresponding to square bases whose sides are $\frac{H + H'}{2}$, H — H′ and $\frac{B}{2m}$ respectively. Then from the sum of the first and $\frac{1}{12}$ the second subtract the third, and multiply the remainder by the slope (m) for the content of a length of 100 feet.

As we have already explained the mode of proceeding when the length is not 100 feet, it is unnecessary to introduce instances of uneven distances, and in the following examples, the length of excavation and embankment must be considered always 100 feet, unless some other distance is specified.

Example 6. In an excavation the base is 14 feet, slope 1 to 1, and depths at the ends 10 and 2 feet.

Here $H = 17$, $H' = 9$, $\frac{H + H'}{2} = 13$, $H - H' = 8$, $m = 1$ and $\frac{B}{2m} = 7$.

$\frac{H + H'}{2} = 13$ corresponding number for table XXII,			626 cub. yds.
$H - H' = 8$	"	" table XIV,	20 "
			646 cub. yds.
$\frac{B}{2m} = 7$,	"	" "	181 cub. yds.
Content,	-	- -	465 cub. yds.

When it is only required to ascertain the whole content of an excavation or embankment, and the stations have been taken at uniform distances from each other, the labor of the calculation may be somewhat abridged by the adoption of the mode pursued in the next example.

Example 7. Let the base of an excavation be 40 feet in width, the side slopes 2 to 1, and the depths of cut at intervals of 100 feet, as stated in the left hand column of the following table; required the content of the excavation.

Depth in feet.	H + H'* in feet.	Cor. No. from table xxii c. y.	H — H' in feet.	Cor. number table xiv c. y.
0·0				
2·0	42·0	6533	2·0	1
3·6	45·6	7701	1·6	0
8·9	52·5	10208	5·3	9
12·4	61·3	13917	3·5	4
14·0	66·4	16329	1·6	1
9·0	63·0	14700	5·0	8
6·0	55·0	11204	3·0	3
4·2	50·2	9333	1·8	1
2·1	46·3	7940	2·1	1
0·0	42·1	6564	2·1	1
		4)104,429		29
		26,107		
		29		

26,136; now $\frac{B}{2m} = 10$ cor. No. tab. 370;

hence, $\frac{370 \times L\,(=1000)}{100} = 3700$

22426.

Hence 6725 × m (= 2) = 44,872 cubic yards is the total content of the excavation.

Note. Double the depth gives four times the content.

Second. Cases where the natural surface of the ground has an inclination at right angles to the line of the road.

EXAMPLE 8. An excavation, the base of which is 28 feet, side slope 1 to 1, and depth throughout 10 feet, has a transverse slope right and left of 12°; required the content.

First Method. Here (area $a\ l$ E — area E $d\ m$) for 12° in table XXIV is ·0473, and $\left(10 + \frac{B}{2\,m}\right)^2 L = (24)^2\,\frac{100}{27} = H^2 L$ in table XXII is 2133 cubic yards.

Consequently - - - - -	2133 c. yds
	3740 "
multiplied by ·0473 - - - - -	853 "
	149 "
	6 "
gives the correction - - - - -	100 8 c. yds
which added to average content from table XI -	1407·0 "
makes the total content - - - - -	1507·8 c. yds.

Second Method, (by equation X). Here,

$$H^2\,(Y + y)\,\frac{L}{2} - \frac{B^2\,L}{4\,m} \text{ equal the content.}$$

$H^2 \times L = (24)^2 \times \frac{100}{27}$ is found in table XXII opposite 24,	2133 c. yds,
	3740·1 "
$\frac{1}{2}\,(Y + y)$ in table XXIV is $\frac{2{\cdot}0946}{2} = 1{\cdot}0473$	2133·0 "
	85·3 "
	14·9 "
	·6 "
	2233·8 "
Subtract $\frac{B^2\,L}{4\,m}$ (table XXII) - - -	726·0 "
and we have for the true content as before	1507·8 "

EXAMPLE 9. An embankment, 25 feet wide on top, having a side slope of $1\frac{1}{2}$ to 1, is 12 feet deep at one end and 4 at the other, and has a transverse slope right and left of the centre at both ends of 12°; required the content

First Method, (by formula N)

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A - a)\,\frac{L}{6} = \text{correction for transverse slope.}$$

$H^2 \times L = (20{\cdot}3)^2\,\frac{100}{27}$ = No. cor. to 20·3 in tab. XXII is	1526 c. yds.
$H'^2 \times L = (12{\cdot}3)^2\,\frac{100}{27}$ = " 12·3 " "	560 "
$(H + H')^2 \times L = (20{\cdot}3 + 12{\cdot}3)^2\,\frac{100}{27}$ No. cor. to 32·7 "	3960 "
	6046 "

$\frac{1}{6}$ area (A -- a) for 12° in table XXV col. 6 is $\frac{\cdot 1698}{6} = \cdot 0283$, 3820 c. yds.

	1209	"
	484	"
	18	"
Therefore the correction for transverse slope is	171·1	c. yds.
Content for average depth 8 feet in table XVII,	1096·	"
Correction for difference " " XXI,	30	"
Total content,	1297·	"

We might have found the above correction for transverse slope by adding the value of equation (O) to the correction for a uniform depth $\frac{H + H'}{2} =$ 16 3.

$$(H - H')^2 (A - a) \frac{L}{12} = \frac{8^2}{12} \times \frac{100}{27} \times \cdot 1698 = 3 \text{ cubic yards.}$$

We see that in this case it would have been sufficiently accurate for all practical purposes in obtaining the correction for transverse slopes to have supposed the depth uniform throughout.

The following table shows the difference of depths answering to given values of A — a when the value of equation (O) becomes 10 cubic yards.

A — a	H — H′	A — a	H — H′	A — a	H — H′
·1	18·0	·6	7·4	1·1	5·4
·2	12·6	·7	6·8	1·2	5·2
·3	10·4	·8	6·4	1·3	5·0
·4	9·0	·9	6·0	1·4	4·8
·5	8·1	1·0	5·7	1·5	4·6

By comparing the values of A — a above given with the difference of areas as exhibited in tables XXIII, XXIV, XXV and XXVI, it will be seen that there will but few cases occur where equation (O) need be considered.

Second Method, by equation (V),

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (Y + y) \frac{L}{12} - \frac{B^2 L}{4m} = \text{content},$$

$\left\{ H + H'^2 + (H + H')^2 \right\}$ L as before,	6046	c. yds.
	3872	"
$\frac{1}{12}$ $(Y + y)$, (table XXV, column 12), $\frac{3 \cdot 3397}{12} = \cdot 2783$	12092	
	4232	
	484	
	18	
	1683·	"
Deduct $\frac{B^2 L}{4m}$, ...	386·	"
And there remains the content of embankment,	1297·	"

the same as before.

EXAMPLE 10. The transverse slopes and depths at the two extremities of an excavation, the base of which is 28 feet, and the side slope 1 to 1, are as represented in the following statement; required the content.

Depth at centre.	Slope to right.	Slope to left.
14 feet	+ 12°	— 6°
6 "	+ 4°	— 9°

The sign + prefixed to the right slope indicates that the ground is higher on the right of the centre, and the sign — before the left slope, shows that the natural surface falls from the centre on the left.

Examples of this kind will be solved most conveniently by equations (S) and (T). Here we have

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (Y + y + Y' + y') \frac{L}{24} - \frac{B^2 L}{4\,m} = \text{content},$$

$$\text{and } (H^2 - H'^2)(Y + y - Y' - y') \frac{L}{12} = \text{correction}.$$

From table XXIV we have

Y for 12°	1·2699	and Y' for 4°	1·0752
y for 6°	·9049	y' for 9°	8633
$Y + y$	2·1748	$Y' + y'$	1·9385
	1·9385		2·1748
	24)4·1133		12) ·2363
$\frac{1}{24}(Y + y + Y' + y') =$	·1714	$\frac{1}{12}(Y + y - Y' - y') =$	·0197

$H^2 \times L = (28)^2 \times \frac{100}{27}$, (table XXII), . . 2904 c. yds.

$H'^2 \times L = (20)^2 \times \frac{100}{27}$ " . . . 1481 "

$(H + H')^2 \times L = (48)^2 \times \frac{100}{27}$ " . . 8533 "

12918

Multiplied by $\frac{1}{24}(Y + y + Y' + y') = \cdot 1714$, . . 4171

12918
9043
129
52

And we have for content, ... 2214 c. yds.

$(H^2 - H'^2)$ L . . . 1423 c. yds.

7910

Multiplied by $\frac{1}{12}(Y + y - Y' - y') = \cdot 0197$, 142

128
10

28· c. yds.

2242· "

Subtract $\frac{B^2 L}{4\,m} = \left(\frac{28}{2\,m}\right)^2 L\,m$ . . 726 "

And we have for the true content, . . . 1516· "

Another Method, by equations (L) and (M).

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A - a + A' - a) \frac{L}{12} = \text{1st correction.}$$

$$(H^2 - H'^2) \left\{ (A - a) - (A' - a) \right\} \frac{L}{6} = \text{2d correction.}$$

From table XXIV we get,

under A and opposite	12°	·1350	and under A′ and opposite	4°	·0376
" a "	6°	·0476	" a′ "	9°	·0684
A — a		+ ·0874	A′ — a′		— ·0308
		— ·0308			+ ·0874
		12)+ ·0566			6)+ ·1182

$\frac{1}{12}$ (A — a + A′ — a′) ·0047 $\frac{1}{6}\left\{(A - a) - (A' - a')\right\}$ ·0197

$\left\{ H^2 + H'^2 + (H + H')^2 \right\}$ L as before, - 12918 c. yds.

	7400	
multiplied by $\frac{1}{12}$ (A — a + A′ — a′) = ·0047	517	
	90	
gives us for the 1st correction, - -		61 c. yds.
and (H² — H′²) L - -	1423 c. yds.	
	7910	
multiplied by $\frac{1}{6}\left\{(A - a) - (A' - a')\right\}$ = ·0197	142	
	128	
	10	
gives us the 2d correction, - -		28 c. yds.
Content for average depth 10 feet (table XI), - -		1407 "
Correction for difference of depths 8 feet (table XIV), -		20 "
Total content, - - - -		1516 "

EXAMPLE 11. The base of an excavation is 18 feet wide, side slopes 1 to 1, and depth at centre 8· feet, depth at right slope 13· ft., depth at left slope 4· ft.,
" " " 21· " " " " 30· " " " 14· ft;
required the content.

First Method, by equation (E).

Here, H = 17, H′ = 30, P = 5, p = 4 P′ = 9 and p′ = 7.

Hence, $\left\{ (2H + H')(P - p) + (H + 2H')(P' - p') \right\} \frac{mL}{12} = 67$ c. yds.

Content for average depth 14·5 feet (table IX) = -	1745 "
Correction for difference of depths 13· feet (table XIV) =	52 "
Total content, - - - -	1864 "

Or by equations (F) and (G),

$(H + H')(P - p + P' - p') \frac{mL}{8}$ = 1st cor. transverse slope = 65 c. yds.

$(H - H')\left\{(P - p) - (P' - p')\right\}\frac{mL}{24}$ = 2d " " " 2 "

Total correction for transverse slope same as before, 67 "

Here we might have omitted the 2d correction for transverse slope, as it only amounted to two cubic yards.

Second Method, by equation (R).

Here, $H = 17$, $H' = 30$, $W = 22$, $w = 13$, $W' = 39$ and $w' = 23$.

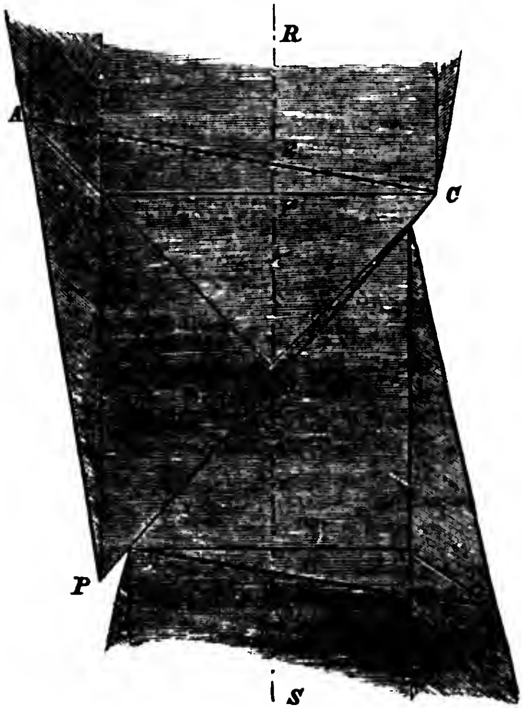
Hence, $\left\{(2H + H')(W + w) + (H + 2H')(W' + w')\right\}\dfrac{L}{12} = 2164$ c. y.

Deduct $\dfrac{B^2 L}{4m} =$ . . . . 300 c. y.

And we have as before, ... 1864 c. y.

When the work changes from excavation to embankment in sloping ground, the content will be found by the method which will now be explained.

Fig. 3.



Let R S (fig 3) represent the centre line of the road, C P the line in which the plane A C P of the natural surface of the ground intersects the base of the excavation, A B C a perpendicular plane at right angles to R S passing through C, A B P will be the side slope of the excavation, B C the base and E F the depth at the centre. The content for the distance R F is found by formula ( ) as in example 10, and the content of figure A B C P is found by formula (L). When the pyramid A B C P is of importance, the depth and transverse slope at F and the length B P must be measured on the ground, but as this may not always be convenient it will be proper to indicate a method of finding them approximately by calculation.

The transverse slope may be assumed as varying uniformly from R to S; the distance from R to O is found as in example 5; then as depth at station R is to that at F, so is length R O to F O, and B P is equal to 2 F O.

EXAMPLE 12. There is 12 feet excavation at one station and 8 feet embankment at the next, transverse slopes 12·° and 14·°, side slope 1 to 1, base 30 feet and length 100. Required the quantity of excavation and embankment, the base of embankment being 25 feet and side slope $1\frac{1}{2}$ to 1?

$$\text{Here, } 12 + 8 : 100 :: 12 : 60 = \text{R O},$$

and taking 13° as the transverse slope at O we have $\frac{B}{2} \times \tan. 13° =$ depth at F = 3·5, then, 12 : 60 : : 3·5 : 17·5 = F O and B P = 2 × F O = 35·0, formula (L), for a pyramid reduces to $H^2 \times A \times \frac{L}{3}$.

H′, A′, *a* and *a*′ being each = 0· which is the common rule for the solid content of a pyramid.

Here, $H^2 = \left(\frac{B}{m}\right)^2 = (30)^2$, L = 35 and A from table XXIV = ·1501.

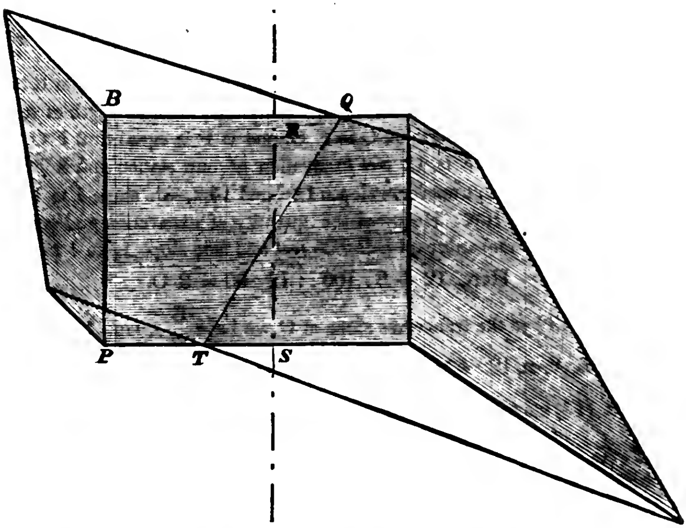
$H^2 \times \frac{100}{27} = (30)^2 \frac{100}{27}$ from table XXII, . .	3333· c. yds.
	5710
$A \times \frac{L}{3} = \frac{\cdot 1601 \times 35}{3 \times 100} = \cdot 05 \times \cdot 35 = \cdot 0175$, . .	333
	233
	17
Content of pyramid, ...	58·3 "
Content for length R F calculated as in example 10, .	512· "
Total excavation, ...	570· "

The transverse slope for the pyramid of embankment will be nearly $13\frac{1}{2}$° and the content calculated in the same way as for the pyramid of excavation is . . . . . . 44· c. yds.

And the embankment for the remainder of the distance, .	215· "
Total embankment, ...	259· "

When the transverse slopes at R and S (fig. 4) cut the base, so as to make one side of the roadbed in excavation and the other in embankment, the distances of these points from the centre line Q R and S T can always easily be measured on the ground, or they may readily be obtained by multiplying the natural cotangent of the transverse slope by the depth at the centre; whence the widths in excavation and in embankment are found, and the contents calculated by equations (L and M) as in example 10.

Fig. 4.



Example 13. Given at one station 2 feet cutting and transverse slope 12°, at the next 1 foot filling and transverse slope 14°, length 100 feet, in excavation base 30 feet, and side slope 1 to 1, and in embankment base 25 feet and side slope $1\frac{1}{2}$ to 1; required the contents?

Here a and a' being nothing, equations (L and M) become*

$$\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A + A') \frac{L}{12} = \text{content.}$$

$$(H^2 - H'^2)(A - A') \frac{L}{6} = \text{correction.}$$

$$H = \frac{1}{m}\left(\frac{B}{2} + 2 \times \cot. 12°\right) = 15 + 9{\cdot}4 = 24{\cdot}4$$

$$H' = \frac{1}{m}\left(\frac{B}{2} - 1 \times \cot. 14°\right) = 15 - 4{\cdot}0 = 11{\cdot}0$$

$\left\{ H^2 + H'^2 + (H + H')^2 \right\} \frac{L}{12}$ from table XIV, . . . 608 c. yds.

1103

$A + A' = {\cdot}1350 + {\cdot}1661$ from table XXIV, . . . 1824

6

Content, ... 183· c. yds.

$(H^2 - H'^2)(A - A') \frac{L}{6}$ = correction, . . . —9 "

Total excavation, ... 174 c. yds.

For the embankment,

$$H = \frac{1}{m}\left(\frac{B}{2} - 2 \times \cot. 12^\circ\right) = \frac{12{\cdot}5 - 9{\cdot}4}{1{\cdot}5} = 2{\cdot}1$$

$$H' = \frac{1}{m}\left(\frac{B}{2} + 1 \times \cot. 14^\circ\right) = \frac{12{\cdot}5 + 4{\cdot}0}{1{\cdot}5} = 11{\cdot}0.$$

Then, $\left\{ H^2 + H'^2 + (H + H')^2 \right\} (A + A')\frac{L}{12}$. 72·7 c. yds.

$(H^2 - H'^2)(A - A')\frac{L}{6}$ . . . . . 3·5 "

Total embankment, ... 76·2 "

When the ground is so uneven that the transverse slope cannot be accurately taken in degrees, and it becomes necessary to take the depths at several points in the cross section, the following method will sometimes be found a convenient approximation.

To the area of the cross section of the excavation add $\frac{B^2}{4\,m}$ and divide by m, then, from a table of square roots, take the square root of this quantity for the depth on H, and calculate the content from table XXII as in example 6.

Or the content may be calculated by the following general rule which is to be found in any treatise on mensuration.

Multiply the sum of the end areas and four times the middle area by one-sixth of the length for the content.

MEMORANDUM—CUBICAL QUANTITIES.

At the time the "Notes" on this subject were written, I had not seen the paper of Mr. E. Morris, C. E., in the Franklin Journal, in which he shows the application of the "prismoidal formula', to all cases; more especially to determining the quantities for final estimates where the ground is very difficult. This able paper well deserves the attention of the engineer; and, together with the published tables, will give all desirable assistance in the rough estimates from preliminary surveys, as well as in the careful and often tedious calculations for putting the work under contract.

In the paper on "Bridges," there is a typographical error, (p. 9,) I wish to correct. For "screwed in" read covered in. Also at the close of Notes on "Wharves," for "filling" read piling

New York, May, 1844. W. R. C.

NEW ROTARY ENGINE.

The inventor, Mr. Peter Borrie, says:

"I am aware that many patents have been taken out for revolving engines, and have successively failed, owing chiefly to defects in their construction; these failures have prejudiced the public mind against all engines on that principle, but from the long experience I have had (both practically and theoretically) with steam engines of every description, I flatter myself that I have entirely remedied the defects common to revolving engines; and from the lightness, compactness, small amount of wear and tear, and greater economy of fuel in my engine, I have no doubt that it will surpass all others hitherto in use." * *

"Among the advantages which render this improved steam engine so peculiarly well adapted for locomotive and marine purposes, may be mentioned the following, viz: small cost of construction, great economy of fuel, the space occupied by it is very little in proportion to its power, and also its comparative lightness, the weight of the engine being only about 2 cwt., per horse power, and that of the boilers only about 2 3-4 cwt., per horse power, so that the whole weight will only be about one-half of the lightest engine hitherto constructed."

He then goes into an elaborate calculation of the power of this as compared with the ordinary engine, and concludes with the following startling announcement:

"Consequently only about one-third of the fuel would be required for the revolving engine as would be required for a common reciprocating condensing engine of the same power."

The general plan of the engine appears to us exceedingly ingenious, and likely to be effective. The patentee truly observes, "that the principle of expansion is carried out to its fullest extent, without the aid of expansion valves and gear." But the best reciprocating engines give us two-thirds of the total power of the steam at the "working point;" and we do not very clearly see how any engine can give three times as much power as those which only lose one-third of the whole. An efficient and simple rotary engine would, however, be of such vast importance to railways, by simplifying the machinery, as well as by enabling us to obtain the adhesion of any number of wheels, that we regard with interest every attempt to effect so desirable an object. We hope to hear soon something more of this revolving engine, and shall be happy to lay before our readers a full description and illustrations as soon as we learn that it has stood the test of experiment.

We copy from the "Civil Engineer," for May, the following admirable review of a letter on "Railway Administration." We should be pleased to see the letter itself, but this is more than doubtful, and indeed we regret it the less as the subject has been so well handled by the editor of that leading Journal of the profession. It was our intention to have omitted some passages uninteresting to the American reader, but we find them so few that we give the article entire. It furnishes matter for deep and serious reflection, and incidentally though very ably illustrates some points we endeavored to establish in our "Remarks on the Profession." We allude to our views with regard to general information, and the necessity of a high moral tone in all engineers entrusted in any way with the projection of works. The railway cause generally is well sustained, and last though not least to us, the creation of a railway press, and its powerful effects on the extension of public works are forcibly dwelt on. We trust we shall be pardoned for observing that we were the first to take the field under the railway banner, and though occasionally hard pressed during the last few years, we still continue to aid—to the best of our ability—the development and extension of an improvement—we may say an invention—second to few in the bearing it is likely to have in the welfare and advancement of the human family.

RAILWAY ADMINISTRATION.

"We have seldom seen a more masterly exposition on the subject of railways than is to be found in this brief pamphlet; if, therefore, we dissent from its reasonings and the remedies it proposes, it is because we draw different conclusions from the same premises, and regard premises upon which our author has not argued. At a time when rant and cant are so prevalent with regard to railways, and a pretext is earnestly sought to hunt them down, it is matter of great consolation to find an advocate so staunch come forward to defend them, one earnest to do them due justice, at the same time too impartial to defend their errors. Those, however, who have deeply studied the subject, and been intimately connected with them as our author has been, know that railway bodies have been much more sinned against than sinning, and will feel cautious in what way they interfere with an institution which has shown and possesses such elements of good. The railway system of England is both a moral and physical phenomenon of the age. A connected chain of public ways extending over 1800 miles, and in the construction of which 60 millions sterling have been embarked, the largest sum ever yet applied in any country in bulk to any other purpose than that of war, naturally excites attention to the colossal magnitude of the enterprize, but the moral features are still more deeply interesting. Not only has this vast sum been raised by private means, and expended under private direction, but difficulties of the most serious character have had to be contended with. At every step experience had to be acquired, invention exerted to overcome difficulties and establish new precedents, the immense amount of money required and expended, enhanced the cost of procuring it, and the price of every kind of labor and material. No colony, no new political institution, was ever formed with such difficulties and such success as the railway system; financiers, engineers and contractors had to be created, while, as we have said, the very vastness of the works have enhanced the cost of their execution. It is well, at the present time, and with our present experience, to turn round and say the railways could have been executed for less. It is true, if, as our author says, there had been no parliamentary contests, no law, no extravagant landed compensation, that much might have been saved, but we are not quite so sure as he is that the future lines to be executed will cost only the present moderate rate, and we deny, therefore, the propriety of measuring things by the present standard. At this time money is abundant and interest low, so is the price of labor and materials, and as many contractors have been ruined, and none have too much work, a line can be let at a very low price. Prices are however rising, and will rise; labor will cost more, timber will get up, iron double in price, to say nothing of a crisis by and bye, and the serious consequences of depression in the money market, which it is in the nature of events to bring about from time to time. We would not have contractors or engineers blind to these facts, for it was to such facts that many difficulties were owing at a previous period. The much vilified estimates of Stephenson, Brunel, Rastrick, Braithwaite, etc., were founded upon works actually executed, but, in the interval, a most serious difference in prices was created by the number of contracts in the field. While, however, we expect prices to rise as a matter of course, we do not anticipate the serious excesses of the old system, because many of the difficulties have been overcome. In the infancy of the railway system, as the development of traffic was not foreseen, so neither was the cost of stations duly provided for, then it must be remembered that in those days contractors were not used to works so gigantic, and were not so competent to undertake them. Now, the weight of locomotives is ascertained, and the rails will not have to be increased in weight 50 per cent. above the estimate, as was the case previously in consequence of the experience gained in the course of the working. Now many and economical arrangements are well known, people are not afraid to lay down timber bridges, as to which formerly much prejudice prevailed.

"We say that this experience, now so advantageous, had then to be gained and to be bought at every step, and that the old system instead of being chargeable with blame, is deserving of the highest degree of praise and admiration. Few know the burden which weighed on the minds of railway managers in those days, and rarely have exertions so great been made, and received so little appreciation. Our author graphically describes the difficulties of the panic.

"'Still worse was the condition of some other lines two years later. The commercial embarrassments that weighed so heavily upon the country bent them to the ground. The proprietors were totally unable to answer the calls upon them. No credit could be given, no money could be obtained. Contractors failed, works were stoped, loans were raised at usurious interest, capital was provided at a sacrifice of one-third of its amount. Whatever censure boards of directors deserved in other matters, at this time they stood forward manfully to face the storm. Many of them supplied large sums from their individual resources, and pledged their credit to a frightful extent. They risked ruin for the benefit of their fellow proprietors, which they never would have hazarded for their own. Few know the perilous state of some of these now flourishing concerns, or of the anxious days and sleepless nights of those who had to provide the sinews of war, to uphold a sinking credit, and ward off impending bankruptcy and ruin.'

"We disagree with him, however, as to railway directors pushing on the works at any cost, *because* they were deeply imbued with the gambling spirit of the day. They pushed on the works as a matter of financial necessity, to which they were in the strongest degree urged by their proprietors. To the bulk of the then holders on the realization of a traffic and a dividend depended the tenure of their property, often whether they were to be rich men or beggars. When the panic came, the resources of many became inadequate to meet the heavy calls; they had to borrow or to hold on by any means. To go into the market and sell was ruin, to hold was their only chance, until the opening of some portions of the line made their shares a better security, or until the subscription of two-thirds of the capital enabled the companies to postpone the calls, and raise money on debentures. Any sacrifice of capital to gain time was preferable to throwing shares on the market, where scarcely any description of property was at par, while the perils of forfeiting everything by non-compliance with the act of parliament made shares without a traffic totally unavailable as a security for raising money. When all these circumstances are taken into consideration, railway managers will not be censured for excesses of estimates, which circumstances alone produced.

"The evils produced by the legislature the pamphlet before us well shows, it particularly dwells on the legalized extortions of land owners, and the prohibitions of level crossing of common roads, which, of course, it proposes to remedy.

"We have now, therefore, to consider the present state of the railway interest. We have so many hundred miles of railway, costing so many millions, and as a new institution has arisen, new public wants have been created, first and foremost of which is cheap travelling. In a national point of view, there can be no question upon this subject; cheap travelling is in the highest degree desirable: how is it to be obtained? Every one has his remedy; and the legislature is called upon by many well meaning individuals to cut the Gordian knot, and to buy up the whole of the railways; others, among whom our author is one, propose modifications of this principle. For our own part, we are most free to admit, that on the leading lines of traffic the charges for travelling are absurdly high, and the accommodation for the laboring classes totally inadequate; still we are inclined to say that it is better to let the matter alone than to legislate upon it. The mischief hitherto has been in legislating for questions of public enterprize, imposing restrictions and giving privileges, which are the fertile sources of mischief, and we anticipate little good therefore from any legislative remedy, the most efficient in such cases being, in our opinion, to legislate as little as possible, but to proceed upon the broad economical principle of leaving industry to regulate itself. Not that we doubt the right of the legislature to interfere in this specific case, or in any similar case. Apart from the question of rails and locomotives, shares and shareholders, the railway system is an institution having the same public relations as a bank, a college, a hospital, or a public house, and in which any rights of private property exist subordinate to the public objects. On the equity of the case, it must be remembered, that if railways have been allowed a maximum fare, it was on the express condition that anybody should be allowed to compete with them on their own lines. This, however, is found to be injurious to the public, and the legislature has, therefore, the equity of requiring some other equivalent security for a reasonable rate of fare. Our ground for letting the railways alone on the subject of fares is, that it is more remunerative for railway companies to charge low fares than it is to charge high fares, and that this principle is making satisfactory progress, and must and will be adopted by all companies. The following observations from a very able article in the Railway Record, will be read with interest.

"'A very large amount of manufacturing business has been created by the railway system, for the supply of railway stock, and this will be ever on the increase, not merely for England alone, but for her colonies, and for foreign lands. We are prepared to see railways rise in value, in the same proportion that canals have risen. For although it be true, that the price of making railways has been reduced very low of late, it is quite certain that, with increasing traffic, those prices will rise. When railways shall commence in the East and West Indies, in Australia and China, English capital will find so many vents, that the intense existing competition will be lessened, and assuredly the value of land will rise as our population thickens. The greater the numbers of the community the more valuable will the roads become. England will be virtually the metropolis of the continent, by means of free communication throughout all lands.

'Nothing can defeat railway prosperity, but, at the same time, nothing can check it so much as injudicious high fares. We cannot too strongly insist on this point. The increase of expenses in railways is great in proportion to the diminution of traffic, and the increase of traffic is followed by a very slight increase of expenses on the annual amount, while the proportionate decrease is very great. People are gradually getting used to travel, the circle continually widening, and as they get used to it, it becomes a necessary of life. They can no more do without it, than they can forego their provisions. But they must be inoculated to it, and this inoculation will not take place while they are frightened by high fares. We are of opinion that it would be a wise thing for railway companies to establish some rule in lowering their fares in proportion to the increase of their passengers. It is the largest number that will pay best, in all cases, and we apprehend that the lowest fares will also pay best, unless where the number of passengers is limited.'

"The author before us certainly does not go far enough for us in his proposed legislation, for he is content to have open third class carriages at ½d.

per mile, attached to all trains. Now we think as a matter of public health it is desirable that all trains should be covered, as in Belgium, and that sufficient distinction in comfort will always exist between the several classes of carriages. Third class carriages should be provided with seats, covered with tarpaulin, and have curtains; and second class carriages be first class carriages without the cushions. In practice this arrangement has worked well, and will work well. On short omnibus lines, however, open stand-up carriages do no harm. On all lines a step remains to be taken, which may be pursued with advantage, we mean the running of slow, cheap trains, going at the rate of some ten miles an hour. Such trains can be worked much cheaper than high speed trains, and there are large classes of the public to whom time is of less importance than money, females in particular. All these things, however, may be safely left to experience, and experience is beginning to show that a high fare is the wrong system for extracting the greatest revenue from a railway. The cheap fare system is satisfactorily progressing, and will establish itself without legislative aid. A great many experiments are also being made as to excursions, return tickets, weekly, monthly, season and yearly subscriptions, the results of which are promulgated by the railway press to the general information. Here, too, we may observe, that it is not one of the least remarkable features of the railway system, that it has created a press, by the competition and energy of the members of which a degree of information is diffused which has been productive of the greatest benefits, and which under no central administration could exist. By the means of this agency upwards of a hundred reports of directors and engineers are yearly brought under the scrutiny of the great body of railway capitalists, while the comments of the shareholders at the meetings are recorded at a length, and with a degree of accuracy only surpassed by the reports of the houses of parliament. This is totally independent of the weekly communication of every kind of intelligence, and the keen investigation of a number of editors experienced on the subject, and solely engaged in such discussions. Indeed it is not one of the smallest marvels of the railway system to see one of these papers with more than thirty of our pages of close type recording the minutest details of railway management, and the most trivial observations of the humblest shareholder or official, for the perusal of many hundred railway directors, secretaries, engineers and functionaries. The loss of such auxiliaries consequent on the centralization of the railways by government, would deprive us of an engine of improvement which no other machinery could supply, even supposing the government to be willing at its own risk to keep up for the benefit of its functionaries a Railway Journal, or Railway Record, for even if it found the money it could not find the materials. Seeing the influence which this press has in the diffusion of intelligence and the propagation of truth, we are quite satisfied that the directors still holding out against low fares will not be for long.

"The grand remedy, however, we think, lies in improving the arrangements for obtaining acts of parliament. This our author has also turned his attention to, but we think he has not struck at the root of the evil. In common with many other individuals he has the customaay horror of projectors and share jobbers, and for the sake of remedying any evil connected with share jobbing, he is willing to sacrifice the interests of the community. We say give every facility for obtaining acts of parliament for railways, harbors, docks, bridges, and all useful works, take no trouble about whether the work will pay, or whether the parties have money to carry it on, leave them to look after that themselves, and do not for the fear of encouraging share jobbing prevent people from carrying out useful works. Let such parties also have the power of raising as much money as they can upon the work, and let the parties lending the money look to their own investigations for the security, and not to the legislature. We know these are views diametrically opposed to the prevailing practice, but let them be canvassed and they will be found to be right. Depend upon it, the more trade is left to regulate itself, and the more it is carried on by private enterprize, the better. The public is very well able to protect itself, and to form its own judgment as to the advisability of an investment without any legislative aid on the score, which after all is totally erroneous—for have not many of the lines, guaranteed by parliament to pay five per cent., been for years without a dividend, and others on the contrary surpassed all parliamentary calculations. As to the bubble companies, we have no fear on that head; West Middlesex swindlers may exist as they have existed, but a whole community is not to be fettered to prevent the perpetration of crime. Give every facility for obtaining railway bills, relax the standing orders, do away with all deposits, and you need entertain no fears about existing lines charging high fares. Here, too, we may observe that nothing could be more absurd than the doctrine lately held in the legislature, that no new line should be authorized to compete with an existing railway, for the more railways the better for the public at large. The idea, too, of the vested interest of a railway in the traffic between particular towns is supremely ridiculous, for it is evident that it did not regard the vested interest of the turnpike road it superceded. No one can have a vested interest in abuse, and it is an abuse to subject the public to a high rate for travelling, when they can be carried more cheaply.

"The suggestions of the author, that the five per cent. government tax on railways might be appropriated as a tax for buying them up, is an exceedingly good one, and we think such a fund might be advantageously applied in the gradual purchase of shares at the market value without involving any great interference with the grand principle of private enterprize, for after all, what we have to look to is not what we shall do with the present railways, but how we shall keep up the national energy, by which such great works have been prosecuted, and by which still greater things can be effected in our own country, and in our vast colonial empire."

COST OF TRANSPORTATION.

The interesting and flattering statements of the Delaware and Hudson canal company, for 1842 and 1843, will be fresh in the recollection of our readers. We allude to them again in order to give some explanations which appear to us important. Since the appearance of these statements in the *Journal*, we have been informed that the amount charged to the railway includes many miles of new line of road, as well as a very different arrangement of the entire "modus operandi" on the eastern side of the mountain. The canal has also been improved, hence the actual cost to the company cannot be stated with the accuracy we should desire, from any data in our possession. It will be seen that the greater quantity brought down in 1843 cost less than the smaller quantity of 1842; and it is probable that the next statement will show a still greater reduction. We have heard also that some portion of the coal was sold at three dollars and a quarter per ton. The account our informant gives us of the style in which the works are carried on, has made us desirous of a detailed account of the operations of the company, as far as they fall within the scope of the *Journal*, and when winter brings a little leisure we hope our wishes may be gratified. The results of the new arrangement are, we understand, highly favorable to the railway cause.

Mr. Nicolls, the superintendent of the Reading railroad, states the actual cost on that work, 93 miles long, to be 46 cents per ton, (*Journal*, March, p. 83,) which is at the rate of 4·95 mills per ton per mile. The average load was 160 tons nett, and the return of the empty cars is included in the 4·95 mills per ton per mile.

The Baltimore and Ohio railroad company estimate the cost at ·941 cents per ton per mile, with loads of 210 tons, and ascending gradients of 26·4 feet per mile. In this estimate the cost of locomotive power is 2·28 mills per ton per mile, and with the gradients of the Reading railway this would be reduced one-half, and the estimate of the Baltimore and Ohio company would be $\cdot941 - \frac{\cdot228}{2} = \cdot827$ cents per ton. This is nearly twice the estimate of Mr. Nicolls, and it is obviously intended to be high enough. Again, the latter gentleman may not include renewals of railway. In that event the account would stand thus—actual expenses, ·495 cents

Renewals of track, bridges, etc.,	·250	"
Contingencies,	·100	"
Total cost on Reading railway,	·845	cts. per ton per mile.

This agrees with the Baltimore and Ohio company's estimates very nearly.

While on this subject, we would observe that the objections to high grades may be carried too far, and that too many imagine that, because an engine on the Reading railway can draw twice as much as on most of our railways, therefore the cost of transportation will be reduced one-half. This investigation, however, to be thorough, requires a complete examination into the details of each peculiar case, and we must refer the reader to Mr. Ellet's papers, to Mr. Casey's paper, (Aug., 1839,) and to the report of Mr. Vignoles' lecture—the two former written for the *Journal*.

It will be remembered that the cost on the Cumberland canal is about the same, and the experience of Pennsylvania shows, that with boats of 70 tons burden, seven mills per ton per mile, even for long distances, yields but a sorry remuneration to the boatmen. Still coal is carried at that rate, and where the business is very great, and where small or nominal dividends only are expected, coal may be carried on some canals for one cent per ton per mile.

ATMOSPHERIC RAILWAYS.

We gave in the January number of this Journal, an article on "Atmospheric Railways," from the Glasgow "Practical Mechanic and Engineers' Journal." We now give further details in relation to this interesting subject, in a letter from one of the patentees, in reply to inquiries made by the South Carolina railroad company, through Messrs. Palmer, Makillop and Co., of

London. In the Railway Times, of May 18th, we find the commencement of a report of an examination before a select committee of parliament, in which Mr. J. Samuda gives a minute description of the construction of the *atmospheric working* apparatus—to which we shall refer hereafter.

In our next number we shall republish most of a "Treatise on the adaptation of *Atmospheric Pressure*, to the purposes of Locomotion on Railways;" with engravings, illustrating the mode of connecting the cars with the atmospheric apparatus; together with a statement of the cost of construction, and expense of working, as compared with the locomotive system—based upon actual operations.

This system, like all *new* theories, especially if of great importance, has to work its way against the prejudices of the community, and in this case against the interests of leading men connected with railroads in England—consequently its progress has been gradual, and mainly at the cost of those immediately interested in it; but if the statements now before us are to be relied on, we are of the opinion that it will at no distant day, *supersede* the present mode of working railways; and that the improvement in *safety*, *economy*, and speed will be *as great over the present system* as that is over the *almost* obsolete stage coaching of former days.

We give, in this number, a short extract from this treatise, which, if accurate, places the two systems in a position exceedingly favorable to the atmospheric. We shall be gratified to receive the views of our correspondents on this interesting topic for publication in the Journal.

We are under obligations, for these documents, to J. E. Bloomfield, Esq., who will please accept our thanks.

Mr. D. K. Minor: By the last steamer, I have been favored with a copy of Messrs. Samuda, Brothers' communication, giving the cost of laying down a mile of atmospheric railway, as well as the cost of working the same—being a reply to an application from a railway company in this country, who desire to dispense with stationary power, on an inclination of 360 feet to the mile.

It would appear by Messrs. Samuda's letter, that the atmospheric principle of motive power, costs 5½ pence sterling per train per mile to run 50 miles in the hour—while the *slow* locomotive engine, to run 25 miles per hour, costs 15 pence, or nearly three times as much, to run with half the speed, and with greater risk, as I understand it, to the passenger.

I would claim your notice of the remarks of the editor of the London Railway Times, of the 18th May, as well as the first part of the examination of Mr. J. Samuda before a committee of the house of parliament, also a description of his plan.

"To apply the subject"—allow me to ask, if the atmospheric railroad is what its friends claim for it, why not adopt this plan to make a railway to Albany? The charter of the New York and Albany company will cover the application of this principle, and as the objection heretofore has been that a railway could not compete with the North river steamboats, it is to be hoped that this interesting subject will claim the early attention of our engineers and mechanics. We must not be behind England—in this "*go ahead, age*," particularly, when we have got Professor Morse's magnetic telegraph, to announce in forty seconds that 30 cars, carrying 1500 passengers, in three hours from this city to Albany, after breakfast, desire that the requisite arrangements be made for dinner, so as to be in time to take tea at Buffalo, over 320 miles of intervening railway.

Very respectfully, J. E. B.

Extract of a Letter from a Railway Company at Charleston, to which Messrs. Samuda's Letter is a Reply.

"We have on our railroad an inclined plane of 360 feet to the mile, which at present requires stationary power to overcome, but which we are desirous of dispensing with. From the examinations made, the operation will involve no little expense, and we have been deterred from proceeding by a notice which has appeared in the English Journals on the success of the atmospheric railroad between Dublin and Kingston. We are inclined to the opinion, from what we have read on the subject, and from our own calculations, that this atmospheric power may be applied most advantageously to planes, and particularly where the plane is not to be avoided but by a circuit and increase of distance, involving no ordinary expense—we will, therefore, esteem it a very great favor rendered to our company if you will obtain from General Pasley, R. E., J. Brunel, Esq., M. Mallet, or Mr. Vignoles, or from any other competent source, the real practical results of the experiment now making, with the cost of construction per mile, and the power exerted, with the advantages of this power compared with steam, on the various inclinations of a railroad. We would be pleased to have the arguments both pro and con., so that we shall be the better able to decide on the two questions which present themselves.

"*First.* The expense of reducing the grade of inclination at our plane by a circuit, and

"*Second.* The expense of overcoming the inclination and delay at the plane by the new power."

Copy of Letter from Messrs. Samuda, Brothers.

"*Southwark Iron Works, April* 30, 1844.

"Messrs Palmer, Mackillop & Co.

"Gentlemen: We beg to acknowledge the receipt of your inquiries respecting the atmospheric railway, and in reply beg to hand you the following information which we regret will not, in all probability, be as complete as your friends might wish, owing to the want of some information which their letters do not supply, and which we would feel obliged by your obtaining for us. Thus, the *length* of the inclined planes is not named. We can only, therefore, in the present instance, give them such general information as we hope may be useful.

"The diameter of the vacuum pipe which we recommend in all ordinary cases is 15 inches; this will draw

200 tons on a level,	48 tons up 1 in 80,
80 " up 1 in 160,	44 " " 1 " 70,
65 " " 1 " 120,	39 " " 1 " 60,
58 " " 1 " 100,	33 " " 1 " 50.

"Up such an incline as you name (360 feet per mile, or 1 in 15 about,) it will take 12 tons, which, in all probability, will be too small a load, if so, however, the area of the pipe will require to be increased till it meets the load you deem sufficient—probably 20 to 25 tons will suffice, in which case a pipe of 22 inches diameter will be required on that incline.

"The engine power necessary depends on the speed you require the trains to travel—thus with a pipe 15 inches diameter, (which is capable of drawing any of the loads on the corresponding gradients mentioned in the annexed table,) an engine of 100 horse power will be sufficient for a speed of 50 miles per hour, or 68 horse power for 30 miles per hour.

"The distance apart the engines should be placed will be slightly influenced by local circumstances, but will average 3½ miles from each other. We have subjoined a table showing the working expenses on the atmospheric system on a long line of railway, similar to the London and Birmingham here, and performing the same amount of traffic; from that statement, the cost of haulage on the atmospheric system, travelling at 50 miles per hour, is - - - - - - $5\frac{5}{10}$*d.* per train per mile, while the present cost with locomotives, at the present speed of 25 miles per hour, is 1*s.* 3*d.* " "

"In the maintenance of way there is also a saving on the atmospheric system, for the destruction caused by the locomotive engine to the rails, and the way itself, is entirely avoided, and in its stead, we have only the expense of attending the mains, and which in practice we find fully provided for with one laborer per mile.

"The cost of the atmospheric apparatus will of course be slightly influenced by local causes, the price in London will be as follows:

15 inch vacuum pipes, about 309 lbs. per yd. = 272 tons per mile at £6,		£1632	per mile.
"Continuous valve and fastenings, viz:			
Wrought iron plates and bars, 18½ tons,	£129		
Leather, 42 cwt.,	324		
Bolts and nuts 24 cwt.,	67		
Labor, rivets, oil, tools, etc.,	250—	770	" "
Tallow lining and composition for grove,		250	" "
Planing, drilling and lining with tallow, 3*s.* 4*d.* per yard,		295	" "
Station valves, about		50	" "
Travelling piston and gear,		50	" "
		£3047	" "
Drawings, superintendence, specifications, etc., say 5 per ct.,		153	" "
		£3200	" "

"The cost of a vacuum main, 22 inches diameter, will be £4200 per mile.

"Table of working expenses of the atmospheric system referred to, on a line similar to the London and Birmingham railway, 112½ miles long, and performing a similar traffic.

Coal—each engine burns 500 lbs. per hour, and works for each train - - -	8¼ min.	
Add for waste while standing, 1*s.* 3*d.*, -	2¾ min.	
	11 min. = 92 lbs.	
32 engines × 92 lbs. = 2944 lbs., or 1 ton 6 cwt. 1 qr. 4 lbs., at 9*s.*,		11*s.* 10 *d.*
Wages—33 engine stations, each 2 men at 6*s.* " " " 3*s.* } 18*s.* $\frac{18 \times 33}{30 \text{ trains}}$,		19*s.* 9 *d.*
Repairs to engines, oil, hemp, etc., 5 per cent. on cost, say per year, $\frac{£212\ 10s. \times 33}{30 \text{ trains} \times 365 \text{ days}}$ - - - -		12*s.* 10 *d.*
Piston leather 2*s.*, charcoal 6*d.*, wear and tear of travelling gear 4½*d.*,		2*s.* 10½*d.*
Superintendence, clerks, foremen and office expenses, say £2500 per annum, $\frac{£2500}{33 \times 365}$, - - - - -		4*s.* 6½*d.*
Total haulage = 5$\frac{5}{10}$*d.* per mile, - - -		51*s.* 10 *d.*

"Any other information which your friends may require, we shall at all times be happy to furnish. We are, etc.

[Signed,] "Samuda, Brothers."

Messrs. Samuda, Brothers, having omitted to state the cost of stationary engines, they write on 10th May as follows:

"We regret that we should have omitted the price of the stationary engines in our particulars of the atmospheric apparatus furnished you.

"The price of two 50 horse condensing engines with their vacuum pumps and apparatus complete in every respect, and put on board a vessel in the Thames, will be - - -	£4250
"A pair of 34 horse engines and pumping apparatus as above,	3060."

ON THE ATMOSPHERIC SYSTEM.

"1st. The loss of power occasioned by the locomotive engines having to draw their own weight is entirely avoided, and steep hills may be ascended with no more additional power than that actually due to the acclivity, as there is no weight except the train.

"There is no other known power which can be applied to locomotion without carrying considerable weight and friction with it. The ill effects of locomotive engines have been already pointed out, and the same disadvantages exist in the application of ropes, which must be drawn along with the train, and become an increased incumbrance on inclined planes. The defects of ropes in other respects are too generally known to need comment.

"2d. The weight of the rails and chairs on the new system may be less by one-third than where locomotive engines are employed, as the carriages of the train will be too light to injure them. The annual charge of maintenance of way will, from the same cause, be reduced to a considerable extent.

"3d. The wear and tear of locomotive, compared with stationary engines, is as 18 to 1.

"4th. By the new system the full power of the engines is always obtained; and on an incline the additional quantity of fuel consumed in ascending will be saved in descending, as the trains run down by their own gravity. The expense of fuel will be further decreased, as the expense of using coal is only half that of coke.

"On the new system the velocity depends entirely upon the velocity with which the air is withdrawn from the pipe; therefore, by simply increasing the air pump, any speed may be attained; and with a fixed quantity of traffic per diem, no considerable increase in the fuel consumed or any other expense is incurred for improving speed, further than the small additional power required to overcome the increased atmospheric resistance. An actual saving in the first cost of a railway constructed for high velocities may be effected, because by performing the journey in less time, a greater number of trains may be despatched each day, and their weight diminished; therefore the piston, having less to draw, may be smaller in diameter. The cost of the pipe (which forms the largest item in the first cost of this railway) will thus be reduced in nearly the same proportion as the speed is increased.

"Besides these advantages, the system possesses others of still more importance to the public. No collision between trains can take place, for as the power cannot be applied to more than one piston at a time in the same section of pipe, the trains must ever be the length of a section apart from each other; and if from any cause a train should be stopped in the middle of a section, the train which follows it will be obliged to stop also at the entrance of the pipe, as there will be no power to propel it until the first train is out. It is also impossible for two trains to run in opposite directions on the same line, as the power is only applied at one end of each section. A train cannot get off the rail, as the leading carriage is firmly attached to the piston, which travels in the pipe between the rails, and the luggage and carriages cannot be burnt, as no engines travel with the trains.

"We now come to the comparative cost of the two systems.

"1st. The necessity of having the railway comparatively level causes the present enormous outlay for earth work, viaducts and tunnelling, and increases the cost of land, not only by lengthening the line to save cutting and embankment, but by the quantity wasted on each side of the road wherever such work is required. Thus, if an embankment or cutting has to be made of 30 feet, at least 60 feet of land must be covered on each side of the railway in order to obtain sufficient slope, making a width of 120 feet, besides the road, except where they occur in very favorable ground. The comparative expense of this item, between the two systems can be ascertained by referring to the average cost of forming a turnpike road and that of the principal railroads now in operation.

"Since it is not necessary to make detours to avoid steep gradients, the direction of the road in a straight line may be more nearly preserved."

LOCOMOTIVE SYSTEM.	Per mile.
Taking five of the principal railroads as the basis of our calculation, their average expense of formation has exceeded*	£36,000
And the original stock of locomotives,	1,600
	£37,600

ATMOSPHERIC SYSTEM.	Per mile.
The average expense of forming a turnpike road throughout England has been £3000 per mile, but for our road say	£4,000
Allow extra for road bridges,	2,000
Rails, chairs, sleepers and laying down,	2,500
Main pipe and apparatus complete (on a scale for transporting 360 tons per hour, or 5000 tons per day of fourteen hours, on a road with gradients of 1 in 100),	5,200
Fixed engines, air pumps, and engine houses,	1,400
Travelling pistons,	20
	15,120
Saving per mile in forming and furnishing on the atmospheric system,	22,480
	37,600

Annual expenses of working per mile, when conveying two thousand tons per day. (This is beyond the average quantity conveyed on the Liverpool and Manchester railroad:)

LOCOMOTIVE SYSTEM.	Per mile.
5 per cent. interest on capital invested, £37,600,	£1,880
Maintenance of way,	450
Locomotive department, including coke,	1,800
	4,130

ATMOSPHERIC SYSTEM.	Per mile.
5 per cent. interist on capital invested, viz., £15,120,	£756
Maintenance of way, and attendance on mains,	300
Wear and tear of fixed engines, 5 per cent. of cost,	70
Coal, 0·75 lb. per ton per mile, 214 tons, at 20s.,	214
Wages to enginemen and strokers,	60
	1,400

*Our calculations are founded on the reports of different companies whose railways are complete, or in a forward state.

		1,400	
Wages to train conductors,	-	96	
Renewal of travelling apparatus and composition,	-	50	
Sundries,	-	150	
		1,626	
Annual saving per mile on the atmospheric system,	-	2,504	
		4,130	
Total expenses per ton per mile on the locomotive system,	-		1,54d.
" " " atmospheric "	-		0,06d.

Exclusive of carriages and management, which may be taken as the same on both systems.

MISCELLANEA.

There is a very interesting though somewhat discursive article on "Aqueducts and canals" in the London Quarterly Review, for March last. It will perhaps astonish the advocates of canals to learn that the Duke of Bridgewater regarded with no little uneasiness, and with almost incredible foresight, the ultimate capabilities of the railway, though at that time nothing beyond the common tramroad existed. When congratulated on at length reaping the profits of his perseverance and sacrifices, he replied "Yes, we shall do well enough if we can keep clear of those d—d tramroads."

The Croton aqueduct is also mentioned in these flattering terms: "Till London with all its water companies is as well supplied with accessible water as modern Rome is by only two of the aqueducts, whether fourteen, as some count them, or twenty, which ancient Rome possessed, we must content ourselves, Anglo-Saxons as we are, with resorting to New York for wise saw and modern instance, and must lead our readers to drink at the Croton aqueduct."

The reviewer has got it into his head that there is some doubt as to the work accomplishing its object. The only objections we have heard are that the deviations from the original plan in the Harlem bridge and dam in the Croton have cost the city several hundred thousand dollars, and that architectural effect appears to have been avoided not by an increase, but certainly without any diminution of expenditure. There having been no estimate of income, and the expenditure having been in fact "ad libitum," the Croton water works have escaped the searching and infallible ordeal through which the railway has to pass. But as regards the supply of water with reference to quality and quantity, there can be no doubt as to the excellence of the former, or the abundance of the latter.

The Mohawk and Hudson railroad company having done away with the use of the inclined plane at Schenectady, are now engaged in building an entire new road at Albany, in order to avoid the inclined plane at that city.

The Long Island railroad company are making a tunnel in Atlantic street, Brooklyn, in order to bring the engines near the ferry, and to do away with the use of horses. It will also save time, and thus aid them in competing for the Boston travel. Should this meet the eye of the engineers of the above important works, we would beg leave to intimate that some details as to the annual cost on the old plan, the saving by the new and the outlay by which that saving is effected would be of interest to our readers generally, and, as we have in another part of this number endeavored to show, would be attended with no disadvantage to themselves.

The Central railroad (Michigan) will be opened in July to Marshall, and in the fall to Kalamazoo.

Enlargement of the Lachine Canal.—" In the list of imports by the Lachine canal in this day's Gazette, will be found the cargo of the Quebec forwarding company's barge Shannon, consisting of 1903 barrels of flour. This, we are informed, is the largest cargo ever brought from the upper country to this market, by about 400 barrels."—[Montreal paper.]

Here it will be seen that a wooden canal boat, which passes the old locks of this canal, has actually brought down 190 tons of freight. An iron boat would take 250 tons. Now we know that 100 boats per day can be passed through single locks with ease, and—we quote from memory—the total amount of western produce, via the St. Lawrence, does not exceed 600,000 to 700,000 barrels per annum; and 100 boats with 1900 barrels each, gives 190,000 barrels per day. Hence, the old Lachine canal will easily pass the western freight in 5 or 6 days, and would not require more than 10 or 12 days to pass all the flour and pork which passes over the Erie canal. Yet the former is to be enlarged from 20 × 100, (the size of the present locks,) to 45 × 200, and the channel of the canal in proportion. The " Canals of Canada" have, however, been thoroughly discussed in the Journal, and we only allude to them now to show that the views of the writer are fully borne out by experience, and also to give a practical and striking example of the ruinous consequences which infallibly result from entrusting to political adventurers the management of works, to the success of which that character and skill, which we have strongly insisted on in our opening article, so largely contribute, and without which all is a lottery.

RATES OF FARE AND RATES OF SPEED ON RAILROADS.

In our number for April we presented some considerations on this subject, and cited the case of the line of railroads between New York and Washington, as one on which rates of fare, much higher than could be judicious, were adopted. Our impression is that the prosperity of this route of travel has been much retarded by these rates, which have a tendency to throw off the travel on other routes, and at the same time to prevent the increase which at more reduced rates would take place between the cities which it connects. At the same time, it was evident to us, that the present rates of fare, if continued, must lead to rival lines being gotten up between these cities, of an inferior character perhaps, but at more reduced charges to the traveller, which would carry off much of the aliment pertaining to these works; and as friends of the railroad system, *reluctant to see it retrograde*, we were anxious to see a policy adopted, which, while it was liberal to the public, was *the true policy* for the railroad companies. At a rate of from $2 to $2 50 between New York and Philadelphia, the same between Philadelphia and Baltimore, and from $1 to $1 50, at farthest, between Baltimore and Washington, and with not more than four and a half hours between New York and Philadelphia, and from five to five and a half between Philadelphia and Baltimore, the railroads connecting these towns may monopolize the whole travel between them, and that greatly increased, probably much more than doubled, by such a policy; but we predict if the present high rates of fare, and low rates of speed, on this great line are continued, a year will not elapse before rival lines of steamboats and stages will be established throughout its whole extent; and if established they will be sustained, both because at the present reduced prices of labor, provisions and materials, they will be kept up at a comparatively reduced cost, and because the public, which considers its good nature to have been abused by the railroad companies, will be inclined to support them. We trust that the railroad companies will look calmly at the subject, and see to what they are at present exposed by their too grasping policy, and mistaken views of it, and as we expressed ourselves in our previous number, on the subject, will "act on the principle of the ounce of prevention being worth the pound of cure."

It is apt to be the case that we are not apprehensive of danger where we have been for some time exposed to it, and the companies in question, having so far escaped any direct competition, may perhaps think themselves safe from it. But they should bear in mind that the country is no longer in the prostrate condition in which it has been since the revulsion of 1837, and that a spirit of enterprize is now abroad, which will leave unexplored no avenue to profit. Ericsson boats have been already built, and more are building, for the conveyance of freight and passengers between New York and Philadelphia, New York and Richmond, and Philadelphia and Richmond. These boats may be expected to divert some travel from the railroad lines, but nothing in comparison with what would be taken from them by lines of stages and steamboats at a reduced rate between New York and Philadelphia, and Ericsson steamboats between Philadelphia and Baltimore, by way of the Chesapeake and Delaware canal, or a line of very quick steamboats on the Delaware river, and Chesapeake bay, connected by an expeditious stage line between Newcastle and Frenchtown, or parallel to the Chesapeake and Delaware canal. An *independent* canal line, or a day line of quick, steamboats could not fail to do well at half the present rates of fare charged by the railroad company between Philadelphia and Baltimore.

We say an *independent* canal line, because there is at present a daily line of Ericsson boats between Philadelphia and Baltimore on the canal route, but these it is generally understood are owned by the railroad company, or large stockholders in it, and are now, *not* to make money by the transportation of passengers, but rather to keep travel *from* the canal, and throw it on the railroad, the rates with this view being kept nearly as high by the canal line as on the railroad itself. The fact that few travellers under these circumstances take the canal route, is no evidence that a really effective line on the canal would not carry off a very large travel. On the contrary we are very much mistaken, if a night line on this route would not compete even at the same rate of fare very advantageously with the railroad; and, therefore, if once gotten up and prosperous, there would be no probability of the railroad company putting it down, or buying it up without a great sacrifice.

Instead of adopting a policy which will certainly bring about these results, we would earnestly urge the companies between this and Baltimore to look to the other side of the picture, and see what may be done by diminished rates of fare and increased speed. In the first place their example would be followed by other railroad companies south and west of them, and the whole of that travel which is now diverted to the sea, and passes between the north and south in sloops and schooners, or which passes up the Hudson, and thence around by the great lakes, even to New Orleans, would pass over their railroad and the Baltimore and Ohio railroad to Wheeling, or by the railroads south of Baltimore to the south and south-west. Secondly, the local travel between the large cities would be greatly increased. But, lastly, and what seems to us of much more moment than any other consideration, the companies would establish the prosperity of their works on a more permanent foundation, both by doing away with the temptation which now exists to competition, and by satisfying the public which is at present universally impressed with the opinion that the fares on the great routes in question are *too high*, and their rates of speed *too slow*, and that in other respects *it is not accommodated on them as it ought to be.*

Our thanks are due to the Hon. Asher Tyler, the Hon. Horace Wheaton and the Hon. Hamilton Fish, of the House of Representatives, for public documents—recently received.

Elihu Burritt expresses himself as follows in relation to the "iron horse" of the railroad: how few there are who can do it more eloquently. "I love," says he, "to see one of these huge creatures, with sinews of brass and muscles of iron, strut forth from his smoky stable, and, saluting the long train of cars with a dozen sonorous puffs from his iron nostrils, fall gently back into his harness. There he stands, champing and foaming upon the iron track, his great heart a furnace of glowing coals; his lymphatic blood is boiling in his veins; the strength of a thousand horses is nerving his sinews—he pants to be gone. He would 'snake' St. Peter's across the desert of Sahara, if he could be fairly hitched to it, but there is a little sober eyed, tobacco chewing man in the saddle, who holds him in with one finger, and can take away his breath in a moment, should he grow restive and vicious. I am always deeply interested in this man; for, begrimed as he may be with coal, diluted in oil and steam, I regard him as the genius of the whole machinery, as the physical mind of that huge steam horse."

Fitchburgh Railroad.—The cars on this road made their first appearance at Concord on Thursday, June 6th, and the trains will now run regularly; the track is progressing rapidly towards Vermont, and—Canada? *certainly.*

Since the above, we have received a copy of their report, and shall refer to it in our next.

Railroad Accident—on the Syracuse and Auburn railroad, on Wednesday evening, 5th June, says the Rochester daily Advertiser, without other injury than what was sustained by the "iron horse." Would it have occurred if the cars had been moved on the "atmospheric" principle? *Mr. Samuda,* one of the inventors, says it is impossible.

Norwich and Worcester Railroad.—The Norwich Courier, of June 4th, says that the annual meeting of the stockholders of the Norwich and Worcester railroad took place in this city yesterday. The following gentlemen were elected directors for the ensuing year: D. Tyler, W. P. Green, J. A. Rockwell, Norwich; A. DeWitt, Oxford; W. W. Ward, Boston; S. R. Brooks, Jacob Little, Ehhu Townsend, John Rankin, Alfred Brooks, New York; Asa W. H. Clapp, Portland, Me.

It is said that is in contemplation to extend the Long Island railroad seven miles beyond Greenport, bringing its terminus to within fourteen miles of New London. Another project on the taps is to extend the Norwich and Worcester road down the river to a point opposite or below New London, so that the termini of the two roads shall be brought within 13 or 14 miles of each other. Thus this route between Boston and New York would be substantially a land route. If, then, the distance from New York to the eastern terminus of the Long Island road—one hundred and one miles—shall be accomplished in three hours—no more and no less—(and that is what the company confidently expect to do) this route will inevitably be the quickest, surest and most popular route between the two cities. As such, it is sure, also, to become the great mail route.

Boston and Worcester Railroad.—The stockholders, at their annual meeting on Monday, 3d June, says the Bay State Democrat, re-elected Messrs. Nathan Hale, David Henshaw, Daniel Denny Eliphalet Williams, George Morey and Nathaniel Hammond, directors—and chose Messrs John Hathaway, Abraham T Low and Benjamin F. White, in place of Messrs. Moses Williams, Addison Gilmore and Nathaniel F Emmons, who declined a re-election. The annual report was submitted and ordered to be printed.

We have received a copy of the report—from some kind friend, who will please accept our thanks—but have not yet had time to examine it, will do so, however, in time for our next number.

Boston and Providence Railroad.—At the annual meeting of the stock holders of the Boston and Providence railroad, the old board of directors were re-elected. The receipts from January 1st, 1843, to January 1st, 1844, have been $98,821, against $75,620 in the same time of 1843—increase $23,201 The month of June is estimated at $26,000—last year, $23,749. The expenses have been materially less than in 1843, and the nett revenue for the past six months will be nearly equal to what it was when the whole New York business was done by this road. It was voted to subscribe $40,000 in aid of the Stoughton Branch railroad, which insures its being built, and will give a large addition of business to the Providence. The freight has increased this year 96 per cent. to way stations, and 11 per cent. to New York.—[N. Y. American.]

Greenfield and Northampton Railroad.—We learn, says the Greenfield (Mass.) Democrat, that Mr. Hoyt, is making good progress in the survey of this road. From a point a little this side of Northampton, for the distance of about 11 miles, the road can be made in a right line "as straight as an arrow," and perfectly level. The country is so level that the expense of grading that part of it cannot exceed one thousand dollars per mile. So favorable a location for a railroad can scarcely be found in "New England." The distance from Greenfield to Northampton, by the railroad, will be 18 1-2 miles.

Another Railway.—The Hartford papers recommend the construction of a railway from that city to Danbury, for the purpose of forming a direct railway communication from Boston and Hartford to New York; in opposition to the proposed railway from New Haven to Bridgeport. The distance from Hartford to New York via Danbury it is estimated can be performed in four hours. The highest gradients will not exceed 40 feet per mile, and the road will pass through Waterbury and several manufacturing villages.

At an election of directors of the Mohawk and Hudson railroad company, held on the 12th inst, the following persons were elected directors for the ensuing year: George Law, Jacob Little, Edward Mills, Wm. S. Hoyt and John B. Lasala, of New York; Rufus H. King, Augustus James, Herman Pumpelly and John V. L. Pruyn, of Albany. And at a meeting of the board held the same day, George Law was re-elected president and Jacob Little vice president.

CONTENTS:

AMERICAN RAILROAD JOURNAL, AND MECHANICS' MAGAZINE.

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ATMOSPHERIC RAILWAY.

In our July number we published a letter from Messrs. Samuda, Brothers, the patentees of this new mode of working railways, and promised to give in a subsequent number, a further description, with illustrations. In accordance with that promise we now give the main part of a short "treatise on the adaptation of atmospheric pressure to the purposes of locomotion on railways," by M. J. D'A. Samuda, together with several extracts from the examination of Mr. *Cubit*, Mr. *S. K. Brunel*, and Mr. *Robert Stephenson*, engineers of reputation, before a committee of the house of commons, in relation to its advantages as compared with the present locomotive engine system of working railways. Mr. Stephenson appears to take decided ground against the principle, yet he admits that "its safety is nearly perfect if you keep the trains moving in one direction, at the same time"—that is to say there is no danger of running off the track—or the only danger of accident arises from the possibility of two trains meeting, of which it seems to us there is little probability; but the other gentlemen were *decidedly* in its favor, as the extracts from their examination will show; and, "the decision of the committee was unanimously given in favor of the Croydon and Epsom line to be worked by the atmospheric system, to the exclusion of the other."

It is by no means surprising that there should be a diversity of opinion among gentlemen of the profession, as well as others, in relation to an invention which, if it is in reality what its friends claim for it, bids fair to produce a *revolution* in the present mode of railroad locomotion. And even Mr. *Stephenson*, high as he stands as an engineer, and *manufacturer of locomotive engines*, may be as much mistaken, and as honestly so too, as was Dr. *Lardner* in relation to Atlantic steam navigation; but we see no reason to doubt the accuracy of the experiments and the correctness of the observations made by the other gentlemen who were examined by the committee. At all events, we think we see enough in it to warrant us in laying it before our readers, and to request those editors with whom we exchange to do the same to theirs, or to call attention to the Journal containing it.

DESCRIPTION OF CLEGG AND SAMUDA'S ATMOSPHERIC RAILWAY.

Fig. 1.

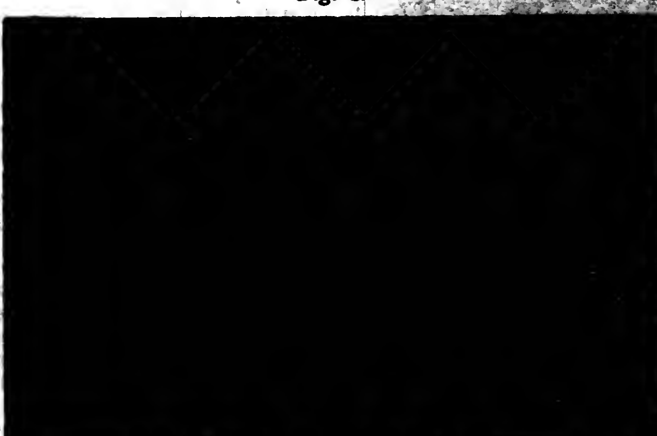
On this system of working railways the moving power is communicated to the train by means of a continuous pipe or main A, laid between the rails, and divided by separating valves into suitable and convenient lengths for exhaustion; a partial vacuum is formed in this pipe either by steam engines and air pumps fixed at intervals along the road, or by water power, if the nature of the country be such as to afford it.—These valves are opened by the train as it advances, without stoppage or reduction of speed. A piston B, which is made to fit air tight by means of a leather packing, is introduced into the main pipe* and connected to the leading carriage of each train by an iron plate C, which travels through a lateral opening the whole length of the pipe. This lateral opening is covered by a valve G, extending the whole length, formed of a strip of leather riveted between iron plates, the top plates are wider than the groove, and serve to prevent the external air forcing the leather into the pipe when the vacuum is formed; the lower plates fit the groove when the valve is shut, and making up the circle of the pipe, prevent the air passing the piston; as shown in figs. 2, 3 and 4. One edge of this valve is securely held down by iron bars *a a*, fastened by screw-bolts *b b* to a longitudinal rib *c*, cast on the pipe on one side of the lateral opening, and the leather between the plates and the bar being flexible, forms a hinge as in a common pump valve; the other edge of the valve falls on the surface of the pipe on the opposite side of the opening, thus forming one side of a trough F, as shown in figs. 2, 3, 4. This trough is filled with a composition of bees' wax and tallow, which substance is solid at the temperature of the atmosphere, and becomes fluid when heated a few degrees above it. This composition adheres to the edge of the valve, which forms one side of the trough, & that part of the pipe which forms the other, & produces perfect contact between them; but as the piston advances, the valve G must be raised to allow the connecting plate C to pass, and this is effected by four wheels H H H H fixed to the piston-rod behind the piston, and the aperture thus formed serves also for the free admission of air to press on the

* When the first division or section is exhausted, the separating valve is opened, and the front of the piston being thus exposed to the exhausted portion of the pipe, the atmospheric air pressing on the back of it propels it forward in the pipe, and with it the train to which it is attached.

back of the piston: by this operation of raising the valve out of the trough, the composition between it and the pipe is broken, and the air-tight contact must be reproduced. To effect this, another steel wheel R is attached to the carriage, regulated by a spring which serves to insure the perfect closing of the valve by running over the top plates immediately after the arm has passed, and a copper tube or heater N about 5 feet long, filled with burning charcoal, is also fixed to the under side of the carriage, and passes over and re-melts the surface of the composition which has been broken by lifting the valve, and which upon cooling becomes solid, hermetically sealing the valve as before.

Fig. 2.

Fig. 3.



Thus each train in passing leaves the pipe in a fit state to receive the next train. A protecting cover, I, formed of thin plates of iron about 5 feet long, hinged with leather, is placed over the valve, and serves to preserve it from snow or rain; the end of each plate underlaps the next in the direction of the piston's motion, thus insuring the lifting of each in succession, which is effected by the wheels D fixed under the carriage.

Fig. 4.

Fig. 5 is the *exit* separating valve, or that at the end of the section nearest to its steam engine; this valve is opened by the compression of air caused by the piston after it has passed the branch which communicates with the air-pump.

Fig. 6 is the equilibrium or *entrance* separating valve. The arrow denotes the direction in which the trains advance. The pipe is exhausted on the side of the valve letered C, and is only prolonged on the other side to allow the piston to enter the pipe before the valve is opened. Attached to one side of the main is a semicircular box B A, divided into two compartments by a partition, of which *a a a* is a sectional view, and thro'

Fig. 5.

which is a circular opening: in the top of the box are two small square holes, one on each side of the partition, furnished with a box slide, by which either or both of them may be covered at pleasure; within the box B A are two valves, *b* and *c*, (of which *b* is the greater,) connected by an arm *d d* to each other, and to a vertical axis *e*, on which they can swing horizontally for about 100 degrees. When the pipe is to be exhausted, the valves are placed by hand or otherwise, in the position represented in the figure; *b* filling the opening in the partition, *c* closing the main. The box slide also covers the hole on the side B of the partition, leaving the other hole open as the exhaustion proceeds; C and B are in vacuum; A and D open to the air. There is then the same pressure on each square inch of *b* and *c*; but *b* being larger than *c* both remain close, for the total pressure on *b* preponderating, will keep *c* against its seat, as will be plain on looking at the figure. But the train on approaching, moves the slide box so as to cover both holes, and a passage is formed thro' which the air in the partition A, rushes into the main C, so that A and B are both in vacuo, and the pressure being removed from *b*, that on *c* forces

Fig. 6.

it back and allows the piston to pass.—The valve, or rather, piston *b*, is a cup leather, riveted between iron plates and shuts *into* the opening in the partition: *c* is a flat leather valve, and shuts *against* a facing in the main.

The main pipe is put together with deep socket joints, in each of which an annular space is left about the middle of the packing, and filled with a semi-fluid; thus any possible leakage of air into the pipe is prevented.

When it is necessary to stop or retard the train, in addition to the use of a common break, a valve in the travelling piston is opened by the conductor by which means the external air is admitted into the exhausted portion of the pipe, and the propelling power destroyed.

In localities where a sufficient quantity and fall of water can be obtained, the atmospheric system can be worked without the assistance of any machinery whatever: by constructing a tank or tanks (of a total capacity double that of the section of pipe they have to exhaust,) filling them with water, and allowing it to run out through a descending perpendicular pipe about 32 feet long (which it will do by its gravity alone,) the whole of the air contained in the pipe will expand itself into the tanks, and by the time they are half emptied of water half a vacuum will be formed in the pipes, as the air will be expanded into twice its bulk, and the other half will run out while the travelling piston and train are advancing, thus increasing the space in the tanks as that in the pipes is diminishing by the approach of the piston, and by this means maintaining the same degree of vacuum during the whole time the train is passing, whatever be its speed.

Workings of the Atmospheric railway on the Birmingham, Bristol and Thames Junction railway.

The system is in operation on part of the above line between the Great Western railway and the Uxbridge road, on an incline, part 1 in 120 and part 1 in 115.

The vacuum pipe is half a mile long, and 9 inches internal diameter.

The exhausting pump is $37\frac{1}{2}$ inches diameter and $22\frac{1}{2}$ inches stroke, worked by a steam engine of 16 horses' power.

For the purpose of experiment a series of posts were fixed along the half mile every two chains, and a barometric gauge was attached at each end of the pipe, for the purpose of ascertaining the degree to which the pipe was exhausted; a vacuum equal to a column of mercury 18 inches high was obtained in about one minute, and both gauges indicated the same extent of vacuum at the same instant.

The following table shows a fair average of the results obtained during six months.

By following out these results, it will be found that a main pipe of 18 inches diameter will be sufficiently large for a traffic of 5000 tons per day, viz., 2500 tons in each direction, supposing the gradients of the road to average 1 in 100.

Note.—A main pipe, 18 inches diameter, will contain a piston of 254 inches area: the usual pressure on this piston, produced by exhausting the pipe, should be 8 lbs. per square inch (as this is the most economical degree of vacuum to work at, and a large margin is left for obtaining higher vacuums to draw trains heavier than usual on emergencies)—a tractive force of 2032 pounds is thus obtained, which will draw a train weighing 45 tons, at 30 miles per hour, up an incline rising 1 in 100. Two and a half miles of this pipe will contain 23,824 cubic feet of air, $\frac{16}{30}$ths of which, or 12,439 cubic feet, must be pumped out to effect a vacuum equal to 8 lbs. per square inch: the air-pump for this purpose should be 5 feet 7 inches diameter, or 24·7 feet area, and its piston should move through 220 feet per minute, thus discharging at the rate of $24{\cdot}7 \times 220 = 5434$ cubic feet per minute at first, and at the rate of 2536 cubic feet per minute when the vacuum has advanced to 16 inches mercury, or 8 lbs. per square inch, the mean quantity discharged being thus 3985 feet per minute: therefore $\frac{12439}{3985} = 3{\cdot}1$ minutes, the time required to exhaust the pipe; and as the area of the pump piston is 14 times as great as that in the pipe, so the velocity of the latter will be 14 times as great as that of the former, or 220 feet per minute $\times 14 = 3080$ feet per minute, or 35 miles per hour: but in consequence of the imperfect action of an air-pump, slight leakages, etc., this velocity will be reduced to 30 miles per hour, and the time requisite to make the vacuum increased to 4 minutes: the train will thus move over the $2\frac{1}{2}$ miles section in 5 minutes, and it can be prepared for the next train in 4 minutes more, together 9 minutes; 15 minutes is therefore ample time to allow between each train, and supposing the working day to consist of 14 hours, 56 trains can be started in each direction, or 2520 tons, making a total of 5000 tons per day. The fixed engine to perform this duty will be 110 horses' power, equivalent to 22 horses' power per mile in each direction.

	Number of passengers.	Total load. tons.	Total load. cwt.	Máxim'm speed in ms. pr. hr.	Vacu'm in inches of mercury.
June 11, 1840	23	8	0	22½	18
	23	8	0	22½	16
	15	7	10	20	19
	21	7	18	22½	19
	44	9	10	22½	20
	58	10	7	22½	19
	57	10	6	18	19
	25	5	9	30	18½
	75	11	10	22½	17
	24	8	2	22½	15
	13	4	12	30	16
	9	7	2	22½	16½
June 29, 1840	28	8	2	30	
	28	5	13	30	
	28	5	13	36	
July 24, 1840	21	7	18	30	22
	15	4	15	30	22
	8	4	6	30	23
	15	5	0	30	21½
Aug. 8, 1840	16	5	1	30	21
	18 and ballast	13	10	18	20½
	18	5	4	30	20½
Aug. 10, 1840	15	5	0	30	20
	17 and ballast	13	10	20	22
	10	4	13	30	22
Aug. 11, 1840	28	5	17	30	20½
	25	5	13	30	20
	14	5	0	30	20
Sept. 24, 1840	23	5	10	36	
Nov, 6, 1840	17	5	3	36	21
	16	5	0	45	23½
Dec. 9, 1840	11	4	14	46	23
Dec. 15, 1840	15	5	0	36	22½
Jan. 6, 1841	10	4	13	36	22½
Feb. 19, 1841	8	4	11	45	23½

By reference to the dates of this table it will be seen that the workings of the system are equally perfect during all seasons; through the height of summer, and in the severest winter that we have known for many years: in no single instance during the whole time has any derangement of the machinery taken place, to prevent, or even to delay for one minute, the starting of the trains. The main pipe and valve have considerably improved by working; the composition for sealing the valve has become so much more firmly bedded in its place, that while in June last we were only able to obtain a vacuum equal to a column of mercury 19 to 20 inches high, we now obtain from 22 to 24 inches, and occasionally 25. The speed, originally from 20 to 30 miles per hour, now ranges from 30 to 45. The whole attendance the valve and main received during this period was that of a single laborer for about one hour every week: the composition now in the valve-groove has never been changed; and 56 lbs. weight only has been added to supply the waste: the cost of this composition, which consists of wax and tallow, is 1*s.* per lb.

We have now procured data from which the economy and advantage of this system can be arrived at with certainty.

It is true that we have heard many objections made; and as these objections, if tenable, would involve the principle of the invention, we cannot do better than notice and comment on them here. We have been told, 1st. That our experiments do not prove the applicability of the system to an extended line of road.

2d. That the number of stationary steam engines and establishments required on this system would be an objection, in point of expense, and liability to accident.

3d. That an accident occurring at one of these stations, or anywhere along the pipes, would interrupt the traffic on the whole line; and so strenuously has this objection been urged, that we have heard it asserted that a hole the size of a pin's head, in the sealing composition, would prevent the action of the invention, and thus the traffic might be stopped for a whole day while making fruitless search to discover it.

In answer to the first objection we would say, in every case where a train has been started the pipe has been first exhausted to 18 inches of mercury or upwards: the time of performing this operation is about one minute, and from the barometric gauges fixed at both ends of the pipe the vacuum is ascertained to be formed to an equal extent throughout the whole length without any appreciable difference of time. The pipe laid down is 9 inches diameter, and half a mile long, and a pressure equal to a column of mercury 18 inches high is obtained in one minute by an air-pump $37\frac{1}{2}$ inches diameter, moving through 165 feet per minute. Now it is obvious that if the transverse section of the pipe be increased to any extent, and the area of the air-pump *proportionately* increased, the result will remain unaltered,—*i. e.* half a mile of pipe will be exhausted in one minute; and supposing the air-pump has to exhaust 3 miles, it will perform the operation in 6 minutes; it is also obvious that if the area of the air-pump be increased in a greater proportion than that of the pipe, the exhaustion will be performed more rapidly, or *vice versa.* These results are matters of absolute certainty, as convincingly clear, as that the power of a steam engine must be regulated by the area of the piston on which the steam acts. No person of scientific attainments will for one moment doubt, that if a steam engine were made with a cylinder twice the area of the *largest* cylinder ever set to work, the power obtained would be in proportion to the increased area: and so with the air-pumps before alluded to; the excess of work is immediately arrived at that an air-pump six feet 3 inches diameter will perform over another of 3 feet $1\frac{1}{2}$ inch diameter, the speed of the pistons being the same in both instances. So plain and self-evident is this result, that we believe the most sceptical will admit it to be correct; and this being granted, the applicability of the system to a line of any length must follow; for whatever the length of railroad be, whether 3 or 30, or 300 miles, no different effects have to be produced. The working a road 30 miles long would be the same thing as working 10 roads each 3 miles long. Every 3 miles an engine and air-pump is fixed, which exhausts its own portion of pipe before the train arrives; thus, as the train advances it receives power from each succeeding engine in turn, and without any stoppage, unless required, until it arrives at its final destination, and the air-pumps continuing to work, after the train has passed, on the section they act upon, re-exhaust it in readiness for the next.

The second objection, as to the complexity and outlay attendant on a number of fixed engines, may perhaps be better answered by taking a review of the number and expense of these engines and the duty they are required to perform. On a line 30 miles long, supposing the average distance between the engines to be three miles, there would be 10 engines and air-pumps with their engine houses; and if the railroad were appointed for transporting 5000 tons per day over the whole distance, (considerably more than double the amount carried daily on any railroad in England,) the expense of one of these stationary engine establishments would cost complete £4200, which, multiplied by 10, will give £42,000—total cost on the whole line. But it is a fact which probably must have escaped the notice of those urging this expense as a drawback to the atmospheric system, if they were ever acquainted with it, that to perform a traffic of only 1700 tons per day upwards of one locomotive engine per mile is necessary; and as each locomotive costs £1500, the total capital required for locomotive power on a railroad 30 miles in length would be £45,000; in first cost, therefore, there would be a saving of £3000 in favor of the stationary power;* but this is far from being the most important saving. Every mill owner in Lancashire and Yorkshire, and any person connected with mining operations, will readily admit that his outlay being once incurred for a steam engine to drive his machinery or drain his mine, and his engine being once fixed on *terra firma*, its deterioration, uncertainty of action, or annual expense of maintenance, is not a source of annoyance or anxiety to him. Five per cent. per annum on the cost will more than cover all repairs necessary to be performed to it, and all oil, hemp and tallow used in working it. It is the exception, and not the rule, if a stationary engine once fixed meet with a derangement to render a stoppage necessary.

The annual expenses will be for repairs at 5 per cent. on £42,000	£2,100
For coal for these engines (when transporting 2000 tons per day,)	
6420 tons per year, at 20*s*. per ton	6420
Wages to engine-men and stokers	1800
	£10,320

The Liverpool and Manchester railway is 30 miles long, and is the only railway that transports as much as 1700 tons per day over its whole distance; and the annual expense of its locomotive department, including coke, is about £50,000 a year.

Need we make any further comment, when the annual expense of power for the atmospheric system is £10,320, and for performing the same traffic on the locomotive system upwards of £50,000 is found necessary? Great

* This saving is in engines only, but it should be recollected that there are many other items, and by reference to the comparative expense of the two systems (page 238, R. R. J.,) it will be seen that the total outlay on the locomotive system is £37,600 per mile, and on the atmospheric £15,120.

as the pecuniary advantages have been shown to be, we must not forget to correct the third objection; viz., the erroneous opinion that the system is faulty because an accident occurring at one of these stations would interrupt the traffic on the whole line. *Prima facie*, this argument is correct, but we have already shown how small the chance of accident is to a stationary steam engine; hundreds are employed day and night without interruption, draining mines; if any derangement in their action were to take place, these valuable properties would be overflowed, and it would require no difficulty to point out many establishments where engines have been in action for years together.* But to make assurance doubly sure, a pair of engines and a pair of air-pumps, each of half the requisite power, may be fixed at each station: should anything cause one engine and pump to stop, the traffic would not be interrupted; the only delay would be the retardation of the train while passing over that section of pipe where only half the power was in action, and until the cause of the stoppage were removed the trains would be some five or six minutes more than usual performing the journey.

The next objection we have to meet is the interruption to the traffic from some derangement in the pipe. This comprehends, 1st, an accident to the pipe itself; and 2d, from the composition not being effectually sealed.

An accident to the pipe can only occur from breakage, and unless designedly perpetrated, could never happen at all. But for the sake of argument we will suppose a pipe has been broken—no matter how; the time of removing it and replacing it with another would be considerably less than the time now necessary to clear off the fragments of a broken engine and train after a collision; and supposing a length of valve to require replacing, it could be done in less time than replacing a rail when torn up by an engine running off the line.

If, instead of one, there were one hundred places along the pipe where the heater had imperfectly performed its functions, the admission of atmospheric air through the composition in these places would only reduce the column of mercury a few inches: no stoppage or interruption of the traffic could possibly occur from this cause, and by comparing the quantity of air pumped out each stroke of the pump, with the quantity that will leak in at each imperfectly sealed spot, any such erroneous idea will be removed. Perhaps on this head, an appeal to experience will be more satisfactory than any argument, however strong: in the whole of our workings, the column of mercury has never varied in height more than 2 inches on the same day; and as it requires eight times the number of minutes to destroy the vacuum in the pipe, when the engine is at rest, that it takes to raise it when in action, it follows that one-eighth only of the power (two horses) is all that is employed to overcome leakage. Perhaps the necessity of stopping the traffic of a line in the event of an accident until the damage is replaced or the obstacle cleared away, should be regarded upon all railways as a peculiar advantage: by this necessity all chance of "running into" is avoided, and where stationary power is employed the difficulties of commuication which a locomotive line has to contend with are overcome. By means of an electric telegraph, every engine station along 100 miles of road may be communicated with in half a minute, and thus the traffic may be suspended and resumed at pleasure.

On examining the facts we have collected, it will be seen that the atmospheric system is grounded on sound principles, and free from many objec-

* At Rock's Mine, Cornwall, an engine has worked day and night without intermission for 3 1-2 years. At the East London water works, a pair of engines, called "the twins," have worked 11 years, with scarcely one hour's rest day or night.

tions that the present railways have to contend with: and a very casual reference to these defects will prove the necessity of substituting an improved system to meet the wants of the public, when this means of travelling becomes fully developed and understood.

The general benefits that railway travelling has conferred, are admitted by all; their introduction has given a new stimulus to industry, and presented increased facilities for the merchant, manufacturer and agriculturist, by bringing the remotest parts of the kingdom within a days journey,—thus enabling goods and agricultural produce to be conveyed to distant towns, for which the previous mode of transport was unequal; indeed, the numerous advantages of railways have been fully appreciated by the public, who have not hesitated to embark immense sums of money to construct them between most of the principal towns.

In proportion as persons have acquired a knowledge of the commercial benefits that arise from this improved system of travelling, and have felt the advantages of it practically, their distaste for the old mode of conveyance has increased; and if railway communication were attainable at a cost at all approximating to that previously employed, it would very shortly become universal throughout the empire. But the general adoption of the railway system followed its introduction so speedily, that many roads were half finished before their expenses could be ascertained; each town capable of raising sufficient capital to connect itself with the metropolis did so immediately,—more eager to be on a par with its neighbor, than considerate of the expense it was about to incur. Fortunately these increased facilities in many cases created a traffic which compensated for the outlay that was found necessary to form and work these roads; and as there is now so large a portion of capital sunk in this description of property, and a moral certainty that a greater number of railways will be made in the next ten years than have been made and partially completed in the last,* any invention tending to facilitate their formation, or to reduce their cost, is a matter of the greatest national and commercial importance: and if by such an invention the speed of travelling can be further increased, the danger of accidents diminished, and the expense of transporting goods reduced to as low a rate as by canals, the traffic, and, as a natural consequence, the remuneration to the proprietors, will be proportionably augmented.

Our object is to point out, that these results will follow the adoption of the atmospheric system of working, and we think it will be admitted that we have fully borne out and justified this idea, when we have taken a review of the nature of the power and the experience already obtained on the one hand, and of the drawbacks under which the present systam labors on the other. We will first notice the principal defects in railways worked by locomotive power. These are the expenses consequent upon their formation and working, in addition to the impossibility of obtaining a speed beyond 25 miles an hour, without incurring a more than proportionate additional expense. For an engine that would draw 61·29 tons on a level at the rate of 25 miles an hour, would if required to travel 30 miles an hour, only be able to draw 29·66 tons, or, for the additional 5 miles in speed, a loss of more than one-half in power. These evils arise from the following causes.

First, from the necessity of making the roads comparatively level, owing to the nature of the power employed. The whole power of the locomotive engine is not available to impel the train because it has to drag itself and

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* In England alone, since 1831, upwards of 2000 miles of railway have been completed, or are in progress of completion.

tender. Thus a great portion of its power is consumed even on a level; but that loss of power is greatly augmented when contending with the slightest ascent.

The extent of this defect will be more clearly apparent by an example: Supposing a locomotive engine to possess a gross tractive force of 1700 lbs., and its weight including tender, to be 20 tons, (this is the actual weight and tractive force of the best locomotive engines in general use when travelling at a mean rate of 20 miles per hour,) and as 14 lbs. per ton is required to attain this velocity on a level road, 280 lbs. will be consumed to impel the engine and tender, leaving 1420 lbs. available for the train. This, at 14 lbs. per ton, will draw 101 tons on a level road. We will now place the same train on an inclined plane rising 1 in 50. The power required to draw a ton at the same speed is then increased from 14 lbs. to 59 lbs., or nearly 4½ times as much as on a level: therefore the engine and tender weighing 20 tons will consume 1180 lbs. instead of 280 lbs., and will leave but 520 lbs. available for the train, instead of 1420 lbs.; but as the train now needs 5959 lbs. to enable it to ascend, 11½ locomotives, each possessing a tractive force of 1700 lbs., together 19,550 lbs., will be required to produce that available force; we thus have an absolute waste of more than two-thirds of the power employed on an ascent of 1 in 50, while on a level it is less than one-sixth. By the same calculation it will be seen, that if the activity be slightly increased, the locomotive engine will not have sufficient power to draw itself and tender, even without the train.

Secondly, by the necessity of having great weight and strength of rails and foundation consequent on the employment of locomotive engines. These engines (exclusive of tender) weigh generally from 14 to 15 tons each; and, in addition to the rigidity of road required to sustain this weight passing over it on one carriage, the motion transferred to the wheels by the engines alternately on each side, causes a continual displacement or forcing out of the rails.

The third, and perhaps the greatest evil, is the heavy expense attendant on working a railway by the ordinary method; and this item is rendered more excessive by the necessity of having a large number of extra engines in store to keep an adequate supply in working order. By reference to the half-yearly accounts of the Liverpool and Manchester railway, the annual expense for locomotive power and coke is found to be from £57,000 to £60,000 a year, nearly £2000 a mile per annum, on a traffic of about 1700 tons a day. This amount is exclusive of first cost and interest on the original stock.

The fourth evil is the large consumption of fuel in proportion to the power obtained, which arises, in part, from the great velocity in the movement of the pistons, preventing the steam from acting on them with full force; which causes a back pressure on the pistons, reducing their force in proportion to the velocity at which they move: the power of the engine is thus constantly diminished as the velocity of the train is increased. To so great an extent is the combined action of these defects felt, that when travelling at 20 miles per hour, the effective power of the engine is reduced to half that which would be obtained from the same quantity of steam generated, and fuel consumed, with a stationary engine. When travelling at 30 miles per hour it is reduced to less than one-fourth; and at a speed but little exceeding 45 miles, the power is so far destroyed that the engine will scarcely draw more than itself and tender. An additional waste of fuel, to an immense extent, is also occasioned by the loss of power (as already shown) on inclined planes. And, lastly, the chances of accident from collision, running off the rail, bursting of boilers; effects, which have been too severely felt during the past six months.

From the foregoing remarks it will appear that the evils of the present system are entirely attributable to the use of locomotive power, and the remedy must be sought for in the employment of stationary power in its stead: the means by which this can be effected without diminishing the accommodation and advantages at present given to the public, are next to be considered; and it is confidently expected that in the following summary will be found, not only remedies for all existing evils, but also many important advantages, both in speed and safety, which cannot possibly be obtained by the above named system.

1st. The loss of power occasioned by the locomotive engines having to draw their own weight is entirely avoided, and steep hills may be ascended with no more additional power than that actually due to the acclivity, as there is no weight except the train.

There is no other known power which can be applied to locomotion without carrying considerable weight and friction with it. The ill effects of locomotive engines have been already pointed out, and the same disadvantages exist in the application of ropes, which must be drawn along with the train, and become an increased incumbrance on inclined planes. The defects of ropes in other respects are too generally known to need comment.

2d. The weight of the rails and chairs on the new system may be less by one-third than where locomotive engines are employed, as the carriages of the train will be too light to injure them. The annual charge of maintenance of way will, from the same cause, be reduced to a considerable extent.

3d. The wear and tear of locomotive, compared with stationary engines, is as 18 to 1.

4th. By the new system the full power of the engines is always obtained: and on an incline the additional quantity of fuel consumed in ascending will be saved in descending, as the trains run down by their own gravity. The expense of fuel will be further decreased, as the expense of using coal is only half that of coke.

On the new system the velocity depends entirely upon the velocity with which the air is withdrawn from the pipe; therefore, by simply increasing the air pump, any speed may be attained; and with a fixed quantity of traffic per diem, no considerable increase in the fuel consumed or any other expense is incurred for improved speed, further than the small additional power required to overcome the increased atmospheric resistance. An actual saving in the first cost of a railway constructed for high velocities may be effected, because, by performing the journey in less time, a greater number of trains may be despatched each day, and their weight diminished; therefore the piston, having less to draw, may be smaller in diameter. The cost of the pipe (which forms the largest item in the first cost of this railway) will thus be reduced in nearly the same proportion as the speed is increased.

Besides these advantages, this system possesses others of still more importance to the public. *No collision between trains can take place*, for as the power cannot be applied to more than one piston at a time in the same section of pipe, the trains must ever be the length of a section apart from each other; and if from any cause a train should be stopped in the middle of a section, the train which follows it will be obliged to stop also at the entrance of the pipe, as there will be no power to propel it until the first train is out. It is also impossible for two trains to run in opposite directions on the same line, as the power is only applied at one end of each section.

A train cannot get off the rail, as the leading carriage is firmly attached to the piston, which travels *in* the pipe *between* the rails, and the luggage and carriages cannot be burnt, as no engines travel with the trains.

We now come to the comparative cost of the two systems.

1st. The necessity of having the railway comparatively level causes the present enormous outlay for earth work, viaducts and tunnelling, and increases the cost of land, not only by lengthening the line to save cutting and embankment, but by the quantity wasted on each side of the road wherever such work is required. Thus, if an embankment or cutting has to be made of 30 feet, at least 60 feet of land must be covered on each side of the railway in order to obtain sufficient slope, making a width of 120 feet, besides the road, except where they occur in very favorable ground. The comparative expense of this item between the two systems can be ascertained by referring to the average cost of forming a turnpike road and that of the principal railways now in operation.

Since it is not necessary to make detours to avoid steep gradients, the direction of the road in a straight line may be more nearly preserved.

LOCOMOTIVE SYSTEM.	Per mile.
Taking five of the principal railroads as the basis of our calculation, their average expense of formation has exceeded*	£36,000
And the original stock of locomotives,	1,600
	37,600

ATMOSPHERIC SYSTEM.	Per mile.
The average expense of forming a turnpike road throughout England has been £3000 per mile, but for our road say	4,000
Allow extra for road bridges,	2,000
Rails, chairs, sleepers and laying down,	2,500
Main pipe and apparatus complete (on a scale for transporting 360 tons per hour, or 5000 tons per day of fourteen hours, on a road with gradients of 1 in 100,)	5,200
Fixed engines, air pumps and engine houses,	1,400
Travelling pistons,	20
	15,120
Saving per mile in forming and furnishing on the atmospheric system,	22,480
	37,600

Annual expenses of working per mile, when conveying two thousand tons per day. (This is beyond the average quantity conveyed on the Liverpool and Manchester railroad.)

LOCOMOTIVE SYSTEM.	Per mile.
5 per cent. interest on capital invested, £37,600,	1,880
Maintenance of way,	450
Locomotive department, including coke,	1,800
	4,130

ATMOSPHERIC SYSTEM.	Per mile.
5 per cent. interest on capital invested, viz., £15,120,	756
Maintenance of way, and attendance on mains,	300
Wear and tear of fixed engines, 5 per cent of cost,	70
Coal, 0·75 lb. per ton per mile, 214 tons, at 20s.	214
Wages to engine men and stokers,	60
Wages to train conductors,	26
Renewal of travelling apparatus and composition,	50
Sundries,	150
	1,626
Annual saving per mile on the atmospheric system,	2,504
	4,130

Total expenses per ton per mile on the locomotive system,	1·54d.
Total expenses per ton per mile on the atmospheric system,	0·06d.

Exclusive of carriages and management, which may be taken as the same on both systems.

* Our calculations are founded on the reports of different companies whose railways are complete or in a forward state.

In the comparison which we have instituted between the locomotive and the atmospheric systems, we have not dwelt particularly on many important defects of the locomotive system, but have only noticed them with a view to point out their existence, and to show that the very nature of the system we are advocating, prevents the possibility of their being found in it. We do not think, however, that we should do justice to ourselves if we were not to notice more fully some of the worst of these evils, with the view of ascertaining to what they are attributable, and what hope exists of remedying them. We have no wish, nor unfortunately have we any occasion, to exaggerate the dangers of steam travelling. Not a newspaper but teems with arguments the most cogent, the most appalling, in favor of a change of system. We may be told that these arguments have been listened to; that the attention of the legislature has been called to the subject, and that consequently steps will be taken so as to entirely prevent the recurrence of the deplorable sacrifices of human life. We answer, that it is impossible. The fault is in the system; and no legislative enactments, however stringent, can remedy it. We have no need of assertion to prove this position. The report of the Liverpool and Manchester railway directors, and adopted by the general meeting of railway proprietors, at Birmingham, on the best means of preventing accidents on the lines, has just been published, and we desire no other arguments to support our views than the opinions put forth by these directors, who must be admitted, from their great experience, to be competent judges of the question, and whose interest is too deeply concerned to allow them to exaggerate the evils they comment upon. the following is the substance of their report.

"In considering the subject of the various accidents which have recently taken place on different railways, and the different circumstances connected with each accident, it appears that they are attributable to one or more of the following causes:

"1st. The want or insufficiency of signal lights, giving warning of danger.

"2d. Neglect on the part of enginemen of such signals when given, comprehending a culpable want of care and vigilance in not keeping a good lood-out; and,

"3d. The difficulty of stopping a train when danger is perceived near at hand."

With respect to the first cause the committee are of opinion, "that the printed rules and regulations of this company, which have been brought under the consideration of many other companies, and, as your committee believe, constitute the basis and tenor of their respective regulations, are, on the whole, well calculated to answer the purposes intended. One modification seems desirable, viz: that the red light or the red flag should, in all cases, and under all circumstances, be viewed as a warning against danger."

As to the second point; "the committee can only recommend great care in the selection of active steady men in the first instance. Good wages, and a considerate regard to their comforts so long as they do their duty; accompanied by the strictest discipline, and by uniformly putting in force the provisions of Lord Seymour's act in cases of any neglect of duty or disobedience of orders, hazarding the safety of life or property, although no loss of either should take place."

"With respect to the third point under review, the difficulty of promptly stopping trains when danger is perceived, the most efficient means hitherto employed are immediately to reverse the engine, and put on the tender break. Great care should be taken by the engineers that the reversing gear is of the most improved construction, not liable to get out of order, and which cannot fail to act when the reversing lever is applied. * * With regard to the numerous proposals of improvements and schemes for the prevention of accidents by mechanical means, if that unceasing vigilance which cannot be too strongly insisted upon on the part of the engine driver should be at any time relaxed, those who have not been long conversant with the practical working of a railway can hardly be aware how many of them have been long since, and under various forms, already tried, and found to be attended with risks and inconveniences more than compensating for any supposed advantage."

The committee strongly deprecate the idea of relieving the engineman from "the responsible charge of his engine" by appointing a "conductor of a higher standing and superior acquirements, whose special business it should be to look out, and under whose orders the engineman should act.

"By introducing another man on the engine you have another pair of eyes to *look out;* but this advantage, if it be one, might be more than countervailed by the divided authority and responsibility which must inevitably take place.

"Jealousy and disunion, it is to be feared, would frequently arise. These would be destructive of confidence in their own resources to the men themselves, and fraught with danger to the whole train. As to the necessity for superior acquirements or professional skill, there is no evidence of a single accident having occurred owing to the want of these qualifications. The desiderata are *constant vigilance* and *presence of mind* in emergencies; and your committee are of opinion that no man, however professionally competent, ought to be trusted with the charge of an engine till he has served an apprenticeship to the business, and has thus become familiar with the rapidity of the locomotive engine and its consequent excitement, *with its severe exposure to the weather*, with the customs and practice of railway operations, and with all the contingencies of locomotive transit regarding police regulations, signals, etc."

Such are the only means recommended by the Liverpool and Manchester railway committee, with a view to get rid of the dangers attendant on this method of travelling; and we really believe that these gentlemen have suggested all that can be done; and if all railway accidents, or the greater number of them, were attributable to carelessness and neglect on the part of the engine drivers, their suggestion would go far to remedy the evil. But here we contend they are greatly mistaken; the fault is in the system, not in the men. It is quite true that the evidence produced at many of the inquests puts beyond doubt the fact, that the necessary signals have on those occasions been made and must have been seen; yet no attention appears to have been paid, and the most disastrous consequences have been the inevitable result. But does it follow that this inattention on the part of the conductor has been the result of *wilful* neglect? Can it be for a moment believed that any man would thus rush headlong into danger, to the almost certain destruction of his own life, and the imminent hazard of those committed to his care? Common sense repudiates the thought. Nothing short of madness could lead to such gross acts of crime and folly. Let us next consider the circumstances under which these accidents occur, and it will be readily seen that they may be accounted for much more satisfactorily. Many alternatives must be rejected before having recourse to the insanity of the engine drivers for an explanation. It will be seen that the question to be discussed is not, have the conductors the *will* to avert the calamities, but have they the POWER?—not whether we are to consider them as suicidal maniacs, but as the slaughtered victims of a murderous system. Let the impartial reader judge.

Suppose our engine director fully understands the construction and management of his engine; suppose we can answer for his discretion, that he never gets intoxicated, never gets fatigued, never falls asleep while on duty, never leaves his engine while on the line, never "sits down on the seat;"* suppose him uninfluenced by the "excitement of rapid travelling,"† or by the "severe exposure to the weather."‡ Let us suppose that he can readily attend to the working of his engine, and yet keep a good lookout ahead; that he retains his vision perfect under all circumstances; that it is unimpaired by moving rapidly through the air, and is not affected by the clouds of ashes from the chimney. Let us suppose, moreover, that the atmosphere is always clear, that fogs never occur, or that they never prevent him distinguishing the color of a flag or lamp; and, lastly, let us suppose that no curves exist on the line, and that he is consequently enabled to see the signal half a mile ahead of him. Now what is the time, under all these favorable circumstances, allowed to the conductor by the usual speed, to shut off the steam, give the signal for the breaks to be applied, or, if necessary, reverse his engine? *One minute!* But in addition to the above absurd suppositions, we have presumed that the accident by which a train has been stopped has taken place at a station, and that the danger is consequently known; we have presumed that, knowing this danger, the company's servants have hoisted the red flag or lamp. But trains much more frequently break down between stations, where they cannot be expected to be provided with signals: we frequently hear of trains getting on the wrong line and meeting each other. How are they in such cases to be apprised of their danger? If they are enabled to see each other at half a mile, and recognize their dangerous position, yet but *half a minute* must elapse before they come into collision if unchecked? Is it possible that this short space of time can be sufficient for the two engine drivers to think, act, and give their directions for others to act? And if so, can we be certain that the machinery by which the engines are stopped is in proper order to obey these actions of its director? It may be of "the most approved construction," and may have been perfect on commencing the journey; but does it follow that it is so at this particular moment? It is well known that the cost of repairing locomotive engines is about 50 per cent. of the first cost; is the reversing gear, are the valves, breaks, the machinery, in short, now required to act, never among these expensive repairs? Or are we to believe that the accidents by which they are deranged always occur at the stations? No answer is required to these questions. No one, we think, will presume to assert that these parts are excepted from the fatalities which occur to the rest, or that they take place while at rest. The precautions strongly insisted upon in the report relative to this machinery prove that they have been called for. And now we would ask, are we justified in attributing these melancholy occurrences to the folly of the engine driver? Is it not sufficient to see his mutilated corpse stretched before us, but we must accuse him of *felo de se*, and refuse his remains a christian burial, when an accident to the machinery (of the occurrence of which the report indirectly admits the possibility) would at once excuse him? Charity, pity, all the better feelings of humanity, answer in the affirmative.

It will be readily seen that the suppositions we have made in order to give every possible advantage to this system are absurd, for we have assumed

* One of the charges made against the unfortunate Simpson on the inquest.

† Vide report. ‡ Ibid.

humanity to be perfect, materials indestructible, the atmosphere invariable, curved lines straight; yet this is not sufficient: we must still presume that actions require no time for their performance, and that matter is deprived of its *vis inertiæ!* Had we drawn any inference from the facts that sad experience has afforded us to judge from, we should have concluded the danger to be entirely referable to the use of locomotives, huge masses moving at a great and *varying* velocity, and over which the conductor has comparatively no control. To render railway travelling safe, (a method of travelling now so essential to the commercial prosperity of this country,) we must begin by rejecting the locomotive, and substituting in its stead stationary power.

If we have shown, as we hope we have, dispassionately and fairly, that so large a balance of safety is due to the atmospheric system, the large saving of human life and suffering that would result from its adoption ought to be one of its best advocates for public patronage; and in the same proportion that it restored public confidence and appetite for railway travelling, would it benefit the directors and proprietors. Every fatal accident, on whichever railway it has occurred, has been followed by a sensible reduction in the traffic; and this can be a matter of no surprise, when it is recollected that the present traffic possessed by all railways was actually formed by the increased facilities and inducements they held out to travellers over turnpike roads; remove these facilities, and the increased traffic will vanish. No railroad in existence could pay its expenses carrying only such passengers as are actually obliged to travel, and therefore the best policy of railway directors is to induce the public to use their lines by affording them the fullest and best accommodation as regards safety, speed, cheap fares and agreeable travelling. That railway which provides best for the wants and wishes of the public will, and very properly so, become the most patronised; and it is scarcely too much to assert that a very large portion of business will spring up and locate itself along such lines, while others which may at present possess a large traffic will lose what they found to their hand, if, neglecting this course, they lull themselves into the mistaken notion that the monopoly they possess, not the convenience they afford, will guarantee them an equal amount of business.

The first grand object in railway undertakings is to render them a perfectly secure mode of transit—a conveyance by which the most timid may travel without hesitation, without a thought of fear, and of course without an example of ill, arising from the badness of their workings, to refer to: these great works, destined as they are to effect much good to all classes of society, will never be, nor indeed deserve to be, looked upon as a permanent benefit until they have arrived at this point. Precisely as a country flourishes under a well regulated system of police and justice, where the liberty and right of the subject are respected, so will railways flourish as human life in their keeping becomes secure. The high roads of England became more travelled over as the robbers that infested them fell into the hands of justice; and it is a matter of small importance to a person contemplating a journey whether he have to fear falling a prey to the assassin's knife, or losing his life from the collision of two railway trains. The possibility of either would equally prevent the timid from travelling, and the courageous from travelling more than necessity required.

To render the railway system perfectly secure is, then, the first object, and to this end should those who have its prosperity at heart look well. Humanity dictates it, and interest prompts it; and what greater inducements, we would ask, need be urged?

Perhaps the next point, after having arrived at that degree of security required to satisfy the public, is to obtain that system of working which is the most economical. A large portion of the British commercial public have, with that enterprize which characterizes all their actions, embarked large sums of money in establishing railway communications between most of the principal towns in the kingdom. They saw the advantages that were certain to result from such an improved communication, but they did not know, indeed it would have been too much to have expected from them the expense of making and maintaining this communication. They only knew what their engineers told them. Their engineers' estimates in most cases were considerably less than was found necessary for the work, and this, added to the increased annual expense of working (above that originially contemplated when most of the present lines were projected,) has placed these undertakings in a very questionable light as commercial speculations and permanent investments. If we show this to be the present position of most railways, which we intend doing by reference to their own accounts, we wish it to be understood that we do not from this circumstance draw a conclusion that they cannot be made a lucrative investment. On the contrary, we are of opinion that they can: we think it has been clearly shown that all their difficulties have arisen and are perpetuated by the use of an improper system of working. So long as the locomotive system is adhered to, a strict economy may in a small degree lessen the expenses, but no material improvement can be hoped or obtained. To strike at the root of the evil, the system must be abolished; anything short of this will not be productive of benefits on a sufficiently extensive scale to enable railways to maintain their present position, and yield a return for the millions they have cost. A better instance of this fact can scarcely be needed than an inspection of the receipts and expenditure of those railways already in operation. From the official weekly returns in the "Railway Times," we perceive *seventeen* railways are in operation the whole of their length, and out of the whole number only *three* are earning sufficient to pay their subscribers more than common interest for their money. Of the remaining fourteen, *six* are not taking as much for their *gross* receipts as the interest of their capital embarked, *independent* of working expenses; and the receipts on the remaining *eight*, after deducting the working expenses, do not leave £5 per cent. dividend for their subscribers.

Fifty millions sterling have been embarked in railway speculations, and seventeen lines have come into full working activity, of which number only *three* can show a return beyond common interest to the subscribers: it well behoves capitalists to ascertain the cause of their disappointments, and to seek to recover some of the golden harvests they were led to expect, and which have melted away before their eyes like ice in the rays of the sun. Anything short of perfect indifference to their own interest will force on them the conclusion that they must no longer shut out the idea of improving, and listen only to the counsel and advice of those at present in their confidence, whose interests are served by maintaining things as they now are, and by clinging to preconceptions and prejudices as part and parcel of their existence. When looking over the half yearly accounts of a railway, worked by locomotive power, common sense and observation cannot fail to lead to the conclusion, that a very large portion of what would be profits is absorbed by the nature of the power applied; but although a cursory notice of the accounts would prompt this conclusion, few would imagine, without giving the matter very close attention, how great this portion is. Some idea of it may be drawn from the following facts. Each train on railways is drawn by an engine, the average weight of which is 20 tons; therefore 20 tons carried with each train is perfectly useless. On the London and Birmingham railway the lowest charge for goods is £2 per ton for the whole 112 miles. Supposing, for the sake of argument, the expense of maintaining and working the locomotive department to remain unaltered, but the engines to weigh nothing; it is clear that the company would be able to transport 20 tons more with each train for the same cost, or 15 tons of profitable merchandize, after deducting one-fourth for the wagons, which at £2 per ton would add to their revenue £30 per journey, or, with their present number of trains, (12 each way daily)—£306,000 a year. No doubt this fact will take many railway proprietors by surprise, who by a natural course of reasoning will immediately seek to discover by what means so large an amount, at present wasted, can be made to find its way into their pockets. The means are obvious; the waste is occasioned by transporting useless weight; remove the useless weight, and the objection ceases of itself. Before the introduction of the atmospheric system, it was hopeless, by any known mechanical means, to effect this: every previous opplication of power carried considerable useless weight with it. The atmospheric is entirely free from this objection; and it was mainly from a knowledge of the benefits that must result from this source that we have labored so incessantly (and happily with such success) to mature and bring it before the public, for their consideration and approbation.

Such would be the effect of dismissing only the *useless weight;* but add to this the other advantage possessed by the atmospheric system, and the London and Birmingham railway (notwithstanding its present large capital sunk) would be enabled *to carry passengers at* 5*s. each, and goods at* 6*s.* 3*d. per ton, the whole* 112 *miles, and share the same dividend as now.*

The calculations from which this statement is adduced are shown as follows: viz.*

		Per day.	Per year.
2500 persons at 5*s*. each,		£ 625	
5930 tons merchandize at 6*s*. 3*d*. per ton,		1,853	
		£2,478—	£805,350
Expenses, viz:			
Coals, 38 stations × 500 lbs. per hour × 16 hours per day = 6867 tons per year at 10*s*. per ton,		£ 3,434	
76 engine drivers at £100 per year,	£7,600		
76 stokers at £50 per year,	3,800		
Repairs to engines, oil and tallow, at £70 each × 38,	2,660—	14,060	
Renewal of travelling apparatus, composition, charcoal, etc., £100 per mile × 112,		11,200	
Maintenance of way and attendance to main £300 per mile,		33,600	
Police, coaching, wagons, etc., (as on locomotive lines),		80,604	
General charges, (as on locomotive lines),		15,400	
Parish rates, (as on locomotive lines),		14,400	
Add 5 per cent. interest on £1,500,000, the total amount required to furnish the atmospheric apparatus on a scale for transporting 9600 tons per day,		75,000—	247,698
Balance,			£557,652

* This estimate of traffic is of course much greater than at present exists on the line, but considerably less than the reduced prices would produce; it is scarcely necessary to add, that at these rates any extent of traffic could be obtained in coals and iron alone, as it is less than a sea borne freight from the north.

	Per day.	Per year.
By reference to the last general meeting of the London and Birmingham railway company, (see "Railway Times," 13th February, 1841,) the present receipts average per year,	£810,000	
And the present expenses,	260,000	
Balance,		£550,000
The present charges are,		
For passengers, (average),		25*s.* each.
Lowest charge for merchandize,		40*s.* per ton.

We have already shown the expense of formation in railways to be greatly influenced by a portion of the power employed being unavailable, and that the road is levelled as a convenience for the propelling power, not the traffic conveyed. We have also shown that the destruction to the road is attributable to the weights and shocks of the engines, not of the trains; that the enormous expense of locomotive power and coke arises from the bad application of power and the artificial means employed to work engines at an unnatural speed. In other words, all the expenses have been traced home to the use of locomotive engines, which have, from the opening of railways for passenger traffic to the present day, been a source of continual annoyance and vexation; breakage after breakage has occurred, and been succeeded by increasing the weight and power of the machines; this in turn has led to the necessity of increasing the strength and stability of the rails and foundations on which they travel, and increasing the strength of the passenger carriages, to resist any shocks they may occasionally receive from their ponderous neighbor; until we have arrived at this conclusion, that on an iron railroad, where the surface is by comparison smooth and the track marked out, a carriage to convey eighteen passengers must weigh about 3 tons, while over a rough paved road an omnibus weighing only 1 ton will perform the same amount of duty. Here are facts which must at once convince every one that there are in the present system, radical defects to be weeded out: if no remedy were suggested, it might be difficult for railway companies to determine how to extricate themselves from their present position; but under existing circumstances their position is by no means a difficult one. The atmospheric railway has been tested by actual operation at the entire expense of the inventors and their friends. The public have not been asked to support it, or even encourage it, until it has been clearly proved beyond all doubt to merit confidence from its general usefulness. It has claims to notice both in a national and commercial point of view; for while it will afford the means of railway communication to second and third rate towns by the small outlay necessary for the formation and working, it will enable the proprietors of railway enterprizes already established or in course of formation, to realize that return for their capital which they so richly deserve, and which, under the present system, they so hopelessly look for.

The length of the foregoing treatise, prevents us from giving, as we promised and intended, in this number, the examination of Messrs. Gibbons, Cubit, Brunel and Stephenson, before the committee of the house of commons. We shall, however, continue the subject in our next, and at considerable length, that it may be properly understood in this country, at least as far as it can be from the experience of those who have examined, studied and tested it. In giving thus fully the views of the patentees, and those who have experimented upon it, we have but *one* object in view, and that is to bring the matter fairly before the railroad community that it may be understood, and if found to possess advantages over the present system, adopted; but if not, then let us stand by the "*iron horse*" which has already accomplished so much.

To succeed and come into general use, it has yet to overcome a powerful opposition, not greater however, than the locomotive has already overcome; we therefore have no anxiety in relation to it, as there is likely to be a thorough and probably fair trial of it on the Epsom road, after which. *opinion* or *theory* will give place to *fact*, and the system will be either sustained or exploded; although we do not agree with the "North American" that it has already "exploded" as there are quite as good opinions in its favor,—Mr. Cubit's, Mr. Brunel's and Mr. Gibbon's—as Mr. Stephenson's against it, as we will show in our next.

GEORGIA RAILROAD AND BANIKNG COMPANY.

We are indebted to J. E. Thompson, Esq., chief engineer, for a copy of their last report, giving a statement of their progress to April last, from which we learn that the work is progressing steadily, but surely, to completion. In 1837 forty miles of this road was brought into use; in 1838 it was extended to 75 miles; in 1839 to 88 miles; in 1840 to 105 miles, and in 1841 to 147½ miles. The total receipts for passengers and freight are given as $1,233,887 00, its total expenses $528,168 00 and its net profits $705,719 00. The rates were considerably reduced last year, and the business increased nearly 33 per cent., and the net profits are nearly $10,000 greater for 1843 than for the previous year, thus showing in an eminent degree, the correctness of the policy of putting the charges at rates which will *increase*, rather than prevent or divert in other channels the business of the region through which railroads pass. It is worthy of remark, that with an increase of business of over 30 per cent. in 1843, the expenses of the road were less by $9,246 than in 1842. The net profits exceed *six per cent.* on the cost of the road, including its branches and machinery, which is certainly encouraging to those interested, to push on the work as rapidly as possible; and it encourages us to look forward, with increasing confidence to its connection with other interests and other roads, until it rests one foot on the Mississippi and the other on the gulf of Mexico, with its outlet on the Atlantic.

ENGINEER'S REPORT.

To the Hon. John P King, president of the Georgia railroad and banking company.

SIR:—I have the pleasure to communicate to you the proceedings of this department for the year ending on the 31st of March.

Active operations upon the extension were commenced between Madison and Covington about fifteen months since. From the nature of the contracts entered into, the work has necessarily progressed but slowly. Yet we have every reason to believe, that the whole of the grading and masonry then contracted for—much of it quite heavy—will be finished by the first of July next, except probably a rock section which may not be completed until August. In consequence of the uncertainty which rested over the extension of our road, even to Covington, the wood work of the bridges, from its perishable character, was not contracted for until the general letting in November last, at which time it was thought that if immediately commenced, it could be finished as soon as the grading. The subsequent demand for labor, and consequent rise in its price, has however, materially interfered with the execution of the timber contracts, which together with the failure of the Nisbet iron works to supply the bridge irons required, has greatly retarded the progress of the work, and I fear, will prevent us from reaching Covington as early as we had desired.

As soon as practicable after the means necessary for the continuation of the road to the southeastern terminus of the State work had been obtained, the grading and bridging of the whole line was placed under contract. The work was let upon very favorable terms, but from causes already referred to, it has not progressed with that spirit which we had expected. Since the late decline in the staple of the country, labor has become more abundant, and the work is now advancing with renewed vigor. From our present prospects, it is believed that the whole line, with some immaterial exceptions will be ready by the first of February next for the reception of the superstructure. While we cannot calculate with certainty the precise time we shall reach Covington, yet we may safely place the completion of the entire road to the State terminus at not later than September, 1845.

The following is a revised estimate of the cost of the road from Madison to the southeast terminus of the Western and Atlantic railroad, a distance of 67$\frac{4}{10}$ miles.

Graduation, including culverts.			
From Madison to Rutledge's, 8·8 miles,		$26,500 00	
" Rutledge's to Social Circle, 7·3 miles,		27,800 00	
" Social Circle to Covington, 10·4 miles,		87,400 00	
" Covington to Holcomb's, 10·5 miles,		51,800 00	
" Holcomb's to Stone Mountain Depot, 15·0,		43,100 00	
" Stone Mountain to Marthaville, 15·4 miles,		71,600 00—	308,200 00
Bridging.			
Alcovy bridge and truss work,	1400 feet,	20,600 00	
Cornish creek bridge,	610 "	4,900 00	
Wood's mill bridge,	470 "	4.700 00	
Dried Indian creek bridge,	900 "	4,600 00	
Turkey creek bridge,	370 "	1,800 00	
Yellow river bridge and approaches,	490 "	12,800 00	
Sundry small railway and road bridges,		3,300 00—	52,700 00
Superstructure.			
Mud sills for main line and turnouts, 69 miles,		20,700 00	
Cross ties " " "		28,900 00	
Wooden rail or stringers, " "		29,800 00	
Iron (exclusive of duty) at $45 per ton, "		185,000 00	
Cast iron chairs and washers, "		11,000 00	
Screws, spikes and bolts, "		19,000 00	
Laying superstructure and contingencies, "		48,000 00—	342,400 00
Right of way, . - - -		18,000 00	
Real estate to be retained for use of road, -		12,000 00	
Engineering, etc., - - -		33,000 00	
Depots, wells, pumps, tanks and division houses,		18,000 00—	81,000 00
Total cost of road,			$784,300 00

Equal to $11,366 per mile for the length of single road, or $11,636 per mile for the distance between Madison and Marthaville; which, if the whole had been executed at the present low cash rates, could have been done for about $1000 per mile less. * * *

The receipts of the road for this year, have exceeded those of last year only $69 50, while the gross tonnage has been increased fully 33 per cent. On the down freight, the receipts have fallen off $6,173 80, and the passage money has increased $6,290 08—the up freight remaining nearly stationary. It will be recollected, however, that we received last year about $12,000 for the transportation of iron, spikes, etc., for the Western and Atlantic railroad, which should not be counted in the general business of the country. By deducting this amount from the receipts of that year, we have the increase of the receipts of this year, about equal to those of last year over the year previous.

The reduction in our rates was probably greater than succeeding circumstances have justified; especially as they have not been met by corresponding concessions on the part of our neighbors on the other side of the Savannah, except upon such articles as they are competitors with the steamboats for. But as there has been no diminution in our receipts, and notwithstanding the increased tonnage transported, the expenses of the road have fallen short of those of last year. We are not disposed, from these causes, as well as a disinclination to frequent changes, to make any material variation in our tariff.

Having failed in our efforts to form a satisfactory ticket at a reduced rate, for the travel going through from Baltimore to Montgomery, we have been content to confine ourselves to a ticket from Montgomery to Charleston—between which points passengers are now carried in less than two and a half days, for $26 50, by railroad and stages.

We have also, in conformity with a resolution of the board, carried out the suggestion referred to in my report of last year, in relation to planters accompanying their produce to market at a reduced rate. The system, as far as we can judge of its effects, seems to have operated alike beneficial to the company and planters, and is at least worthy of a longer trial.

The business of the road, and the expenses incurred in working it, during the year ending on the 31st ultimo, are shown in the following summary statement. The usual detailed statements of the several accounts, will be found among the accompanying papers.

CR.

By amount received for passengers up	$34,005 20	
" " " down	31,660 83	
" " extra trips, extra baggage, negroes, etc.	3,664 86	
" " freight up	69,661 19	
" " " down	78,400 26	
" " " between stations	388 52	
" " rents	809 66	
" " United States mail	29,246 97	$248,096 44

DR.

For expenses of conducting transportation	$26,902 61	
" " motive power	25,838 29	
" " maintenance of way,	38,156 97	
" " " cars	9,675 45	$100,573 32
Leaving net profit		$147,523 12

Over six per cent on the cost of the road, including the branches machinery, etc.

The expenses of the road have, for reasons given in my last annual report, fallen below those of last year. For the next year mainly from opposite causes, they will be somewhat higher.

The efficiency of our motive power has been so materially increased, that although we have had a larger tonnage than usual, and had disposed of one of our original stock of engines, we have still been able to do the business with regularity, without calling into service two of the remaining number. This improvement is mainly to be attributed to the alteration of the Tennessee, to Messrs. Baldwin and Whitney's improved freight engine, referred to in a former communication. This engine having been the first of the kind made, we had to encounter the risk of a failure in some of the details of its construction—the subsequent occurrence of which, as anticipated, prevented us from deriving any benefit from the services of the machine until last fall. We have since given it ample trial, and have become as fully satisfied with its practical performance, as we had previously been with the principles upon which it was built. As soon as we had fully tested this machine, we ordered in accordance with our original intention, a small engine of similar make, for the Athens branch, to be delivered this spring. We are informed however, by the manufacturers, that upon putting it together, its weight greatly exceeded our limits, and in consequence, we have been compelled to reject it, and wait until another can be completed.

The number of miles run by all our engines, during the year, is 153,125, of which 87,200 miles was by the regular passenger trains, on the main line and Athens branch, carrying also some freight. The net amount of freight hauled by all the trains one mile, is about 1,300,000 tons, exclusive of materials for the road. The expenses of the motive power department are $25,838 24, or 16 $\frac{8}{10}$ cents per mile run by the engines. The repairs of the engines and tenders, and the cost of fuel, are each 3 $\frac{7}{10}$ cents per mile run. The whole expense of the road is 65¼ cents per mile run by the trains. The cost of maintaining the road is, this year, $260 per mile or nearly 25 cents per mile run by the trains.

IRON REVENUE STEAMER ON LAKE ERIE.

We have been politely furnished with the following statement in relation to the iron revenue steamer on lake Erie, built by Messrs. Stillmam, Allen & Co., of this city, for the United States revenue service. Length of keel 144 feet, breadth of beam 23 feet, depth of hold 12 feet; keel 1 foot in depth of ½ inch iron; ribs or frame 4½ × ¾ inch; plating of bottom ⅜ inch.—Rigged with three masts, having a pair of Capt. Hunter's submerged wheels. Weight of iron about 125 tons. This ship was put up in the ship house of Stillman, Allen & Co., taken down in sections of convenient size for shipment, and sent to Buffalo, where she is now rapidly going on to completion. She is one of four of the same class now building under the direction of Capt. Wm. A. Howard. The engines for this vessel are being made at the "Buffalo steam engine works," according to the direction of Capt. Hunter, but of their capacity we are not informed.

☞ Will the chief engineer of the Baltimore and Ohio railroad please answer the following enquiry?

June 26.

Mr. Editor: To decide a discussion, will you be so kind as to furnish a reply to the following query, in the next number of your Journal, or whenever it is convenient to you: or call upon a correspondent well informed of the facts, for an answer?—What was the actual cost of the depot and car house at Baltimore? I am anxious to get a certain estimate, and your attention to this request will be considered a real favor. Respectfully your's,

A FRIEND TO INTERNAL IMPROVEMENTS.

DELAWARE BREAKWATER.

Major Bache, United States engineer, says, in his report to the secretary of war, dated October 15th, 1843,

"Since the session of 1837 and 1838, no appropriation has been made to continue the construction of the Delaware breakwater, and the last stone provided by that appropriation was deposited in 1839. * *

"The following table shows the number of days' shelter afforded to vessels by the Delaware breakwater, from the 1st of September, 1833, to the 30th of September, 1843, inclusive—omitting the periods embraced between the 1st of July and the 17th of October, 1834; and the 4th of June, 1840, and the 30th of April, 1841, (when no record was kept); and also omitting vessels carrying stone, or otherwise connected with the work.

Years.	Ships.	Brigs.	Schooners.	Sloops.	Pilot boats.	Total.	Remarks.
1833	22	178	372	167	127	866	From Sept. 1st, inclusive.
1834	48	315	667	303	411	1,744	July 1st to October 17th, inclusive, not recorded.
1835	133	569	1,719	461	644	3,526	
1836	301	1,027	2,719	620	767	5,433	
1837	227	478	2,777	629	732	4,843	
1838	165	732	3,191	765	685	5,538	
1839	165	504	3,561	734	697	5,661	
1840	172	279	1,909	308	371	3,039	To June 3d, inclusive.
1841	111	902	3,916	590	483	6,002	From May 1st, inclusive.
1842	107	1,060	5,335	802	794	8,098	
1843	84	644	3,865	962	572	6,127	To Sept. 30th, inclusive.
	1,535	6,688	30,031	6,341	6,283	50,878	

"Making a just allowance for the periods when no records were kept, it may be safely said, that from its commencement to the present time, the harbor has given sixty thousand days' shelter. According to the record for the last four years, twenty-two vessels on an average, had been lying in the harbor for each day. Sixty to seventy vessels are seen frequently lying in the harbor at the same time, and on one occasion the number of vessels reached as high as one hundred and eight. * * * *

"These works have not yet been completed to the extent of the design thus briefly described. The breakwater is in a course of construction for 862 yards, and the ice breaker for 467 yards. In other respects, the design of the harbor is necessarily incomplete. The entrances at the cape, and between the two works, are 780 yards, and 455 yards, respectively, instead of 500 yards and 350 yards, as at first contemplated. It would thus appear that on the one hand the breakwater proper is 338 yards, and the ice breaker 33 yards, less; and on the other, that the entrance towards the sea is 280 yards, and that between the works 105 yards, greater than the plan called for. In short, the lines of protection are less, and the entrances greater, by the quantities just given, than were originally designed. * *

"It is believed that no plan has been devised to correct the evils in the harbor caused by running ice. One is incidentally alluded to in the annual report of 1836, and the imperfection of it is clearly demonstrated. Any structure on the course of the current would not afford protection against running ice; and one of stone across the current would, by impeding it, create shoals that would injure if not destroy the harbor. The great desideratum is, to be able to obstruct the ice without obstructing the free course of the current. In order to accomplish this result, the application of the iron screw pile has been suggested in former reports These piles, it is conceived, may be so combined as to constitute a complete barrier against the passage of the floating ice, at the same time that the current is allowed to flow in its accustomed course, and with the same velocity. It is, in all respects, worthy of consideration, whether a fair experiment, conducted with liberal means, ought not to be made, in order to ascertain clearly whether the iron screw pile may not be successfully applied to this purpose. The result, if favorable, would constitute an epoch in the construction of ice harbors, and would lead to kindred applications of much importance. It is with a view to such an experiment, that an item for iron screw piles is included in the estimate of the operations for the next season. In using such piles in the formation of an ice harbor, they may either form a continuous work, composed of rows in quincunx order, or constitute piers at certain intervals, as may be deemed advisable, after proper investigations. Under any form of combination, the piles should be braced horizontally, by bars of iron, at low water and at the top, in order that the shock caused by the ice may be sustained, not by one pile, but by numerous contiguous piles. In adopting the work just described as a remedy for the defect in the harbor of the Delaware breakwater, arising from running ice, it should commence at the west end of the ice breaker, and extend towards the shore, on the shortest line, until the required protection is gained."

BEAR MOUNTAIN RAILROAD.

This road penetrates one of the richest and most extensive anthracite coal fields in the State. The Bear valley coal basin, which will be immediately opened by this road, comprises the southwestern termination of the great coal field surrounding the town of Pottsville. This basin is about thirteen miles in length, varying from two to three miles in breadth and the average breast of the coal veins above water level in the two mountains forming the sides of the basin, is over one thousand feet.

All the varieties of anthracite coal, red, white and grey ash, found in the Pottsville region, are found here, and the quality is in every respect of the most superior kind.

Prof. Walter R. Johnson, in his report on the Bear valley coal district, states that this coal bears a stronger analogy to that of Yniscedwyn in Wales, used in Crane's celebrated iron works, than any other anthracite coal in Pennsylvania.

Iron ore also in abundance and of excellent quality, has been found intervening the coal veins. The coal veins run lengthwise of the two mountains throughout their whole extent, and dip in each mountain under the enclosed valley, at an angle of about forty-five degrees. They are found alternating with coal slates and large strata of sand stone and conglomerate rock, interspersed with occasional layers of iron ore. The annexed diagram exhibits a cross section of these mountains and the position of the coal veins.

consisting of alternate strata of coal, coal slates, sandstones, fine conglomerate and kidney iron ore.

References.—A, entrance of tunnel; B and M, red shale; C and L, conglomerate; D, perpendicular height of Mountain, above grade line, 800 feet; E, grade line 17,424 feet per mile; F, Big Lick mountain; G, end of tunnel; H, Bear valley; I, Rausch gap; J, Rausch creek; K, Bear mountain.

The north, or Bear mountain is cut to its base by Rausch creek, forming a gap, on each side of which, all the veins can be opened; and the south or Big Lick mountain will be penetrated by the railroad tunnel directly opposite Rausch gap, thus opening all the veins in that mountain in the same manner.

By this means every coal vein in the entire region will be opened in the most advantageous manner for working. It is confidently believed that no other coal region in the world is possessed of equal advantages.

The height of the mountains above the tunnel, and above the grade line of the road in the gap, is about eight hundred feet, consequently the breast of coal in the veins outcropping at the summits of the mountains is over eleven hundred feet. The tunnel will cut across at least fifty veins of good coal varying in thickness from four to thirty feet, and besides these there are not less than thirty veins of similar thickness in Rausch gap.

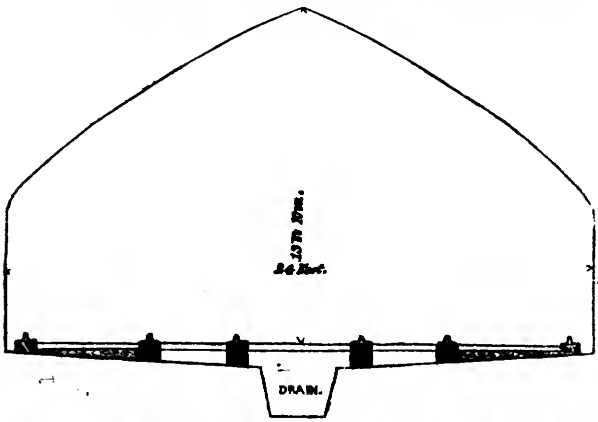
From this it will be perceived that even if the whole supply of coal for the United States, was to be obtained from this region for centuries to come, it would not be necessary to mine below water level and consequently the enormous outlays for machinery, and constant expense necessary to raise coal from below water level, will in this region be entirely avoided.

The railroad tunnel through the southern coal mountain will be about one and a half miles in length, and of sufficient width for three tracks, the centre track being intended for the use of locomotives and through trains, and the side tracks for coal cars only.

It will require about 750 lineal yards of this tunnel from the south end driven through solid rock to reach the outside coal vein, and the remaining distance will be through coal, coal slates, sandstones, conglomerate and iron ore. It is intended to drive about 800 lineal yards of this tunnel by the time the road is ready for business, leaving the remaining portion of the tunnel to be driven after the road goes into operation. The tunnel will be cut on a grade descending towards the canal at the same rate as the other portion of the road, viz. 17½ feet per mile, and when the tunnel is completed, the road will be extended on the same grade through Rausch gap.

The form and dimensions of this tunnel are shown in the following sectional drawing.

SECTION OF TUNNEL THROUGH BIG LICK MOUNTAIN.



From the termination of the road on the Pennsylvania canal at Dauphin to tide water at Havre-de-Grace is eighty miles. The canal from Dauphin to Columbia is of the same capacity as the Erie canal, capable of passing boats of from seventy-five to eighty tons burthen, and the Tide Water canal from Columbia to Havre-de-Grace is of still greater capacity. Havre-de-Grace being at the head of Chesapeake bay, the Atlantic coast can be reached from this place, more readily than from any other point where anthracite coal is shipped, unless it be Delaware city, and to this point the coal can be transported in the same boats used on the canal.

It is not the least recommendation of the Bear valley coal region, that it will have a very large home consumption, without coming into competition with the coal from any other region, and as the Bear mountain railroad will be the only means of transportation from these mines, it may perhaps escape the effects of "incendiary publications."

The coal from the Bear valley region will have the entire command of the trade south and west of the mines, including the cities of Lancaster, Baltimore, Washington, the Boroughs of Harrisburg, Columbia, York, Chambersburg, Carlisle, Hagerstown and the adjacent country, with its extensive iron and other manufacturing establishments and consequently must have a certain trade of nearly 300,000 tons per annum, before coming into competition with coal from other districts. When in addition to this we take into account its proximity to the seaboard, the favorable character of its avenues to market, and the low price at which it can be delivered in the Atlantic cities, there cannot be a doubt but that this coal basin and the railroad leading to it will yet eclipse all their cotemporaries in the magnitude of their operations.

IRA SPAULDING,

Dauphin, Pa., July 1844. *Chief Engineer, B. M. Railroad.*

We published in our June number a letter from Ira Spaulding, Esq., chief engineer of this road, showing that a new route had been discovered far more favorable than the one formerly contemplated through Lykins valley. It will be seen by reference to that letter, (page 171, June No.), that a saving of 14 miles in distance will be effected, and that instead of from a level to a maximum grade of 36 feet per mile, they will now have a *regular descending grade* of about 17 feet per mile from the *heart of the coal veins* to the canal at Dauphin, eight miles above Harrisburg.

We now give a further account of this remarkable work, with illustrations, showing the position of the coal bed, and the manner in which it is perforated by the railroad tunnel, of a mile and a half in length, which passes through at least fifty veins of coal, of from four to thirty feet in thickness, at a thousand feet below their outcropping. A position more favorable for working, it would seem to us, could not have been devised by the most ingenious and selfish man—as it may be led in shutes directly into the cars—and the road itself, having 17 feet fall, forms an ample drain to lead off the water—thus avoiding the immense expense at many other collieries of raising the coal and draining the mines by steam power.

We desire to make our acknowledgments to Messrs. Spaulding and Sickles for their remembrance of the Railroad Journal, in laying the merits of their work before the public. We hope to hear from them again soon in relation to their progress.

UTILITY OF WIRE ROPES.

The following statement, from the London Mining Journal, in relation to the use of wire ropes for coal mines, may be useful to those in this country requiring ropes for such purposes, or for inclined planes, as well as our worthy friend, Mr. John A. Roebling, of Saxonburg, Pa., who is engaged in the manufacture, as will be seen by reference to the Journal of November last—therefore we transfer it to our pages.

"The question of the comparative strength of hemp and wire ropes used in the 'winning' of coal, and, indeed, for every other purpose for which rope is applicable, having been frequently discussed in our columns, we have pleasure in complying with the request of a correspondent, by inserting the following communication, addressed to Mr. Newall, manufacturer of wire rope, by so distinguished a colliery reviewer as Mr. Matthew Liddell, dated from Benton Grange:

"'Dear Sir—I consider the following information may be interesting, and certainly goes far to establish confidence in the equal security of flat wire ropes with those made from hemp, when exposed to a sudden violent strain; which, it has been stated, would cause the former to snap, or break. On Monday, last, when employed in drawing coals, the breaksman of the engine, (46 horse power) on which a pair of your flat wire ropes were put in June last, neglected to check the engine on the approach of the cage and tubs to the surface; and, consequently, the engine continued at full speed, (the rope moving about 120 fathoms a minute), until suddenly stopped by the cage coming into violent contact with the pulley. The shock slightly displaced the pulley frame, when the rivets of the shackle which you attach to the end of the rope where the cage is hung on to it, were drawn through the strands of the rope, and the cage and coals fell on the 'keeps' at the top of the pit, which prevented their falling down the pit, so that the damage done was trifling. I have since then had the wire rope examined, and, although the strain on it must have been very great to stop the engine, yet it does not appear to have sustained any injury, and is, apparently, as good as when it was first put on. MATTHEW LIDDELL.'"

SAULT DE ST. MARIE CANAL, AND ST. JOSEPHS RAILROAD.

We have received, since our July number was put to press, a communication from the Hon. Mr. Woodbridge, of Michigan, in relation to the defeat of the bills before congress in aid of these important works, accompanied with various documents of interest, in relation to the Canadian canals and plank roads, together with the annual report of the board of internal improvement, of Michigan, for which we desire to tender him our thanks. We shall avail ourselves of their use, and then dispose of them in accordance with his directions.

HUNT'S MERCHANTS' MAGAZINE.

This popular and useful work was punctually on our table, and is, as usual, filled with useful information for the business man; and it should be on the desk of every merchant in the Union, and be read attentively by every clerk, as well as merchant.

PARSONS' LOCOMOTIVE EXPANSIVE APPARATUS.

The following communication from Horatio Allen, Esq., copied from the Franklin Journal, exposes one of the numerous *piracies* perpetrated by designing knaves upon ingenious inventors.

"SIRS—The March number of the Journal of the Franklin Institute contains a description of 'Parsons' locomotive expansive apparatus.' That part of the arrangement which provides an adjustable cut-off, by the use of two slide valves attached to the same rod, one by right handed, the other by left handed, screws, and the mode, adjustment, etc., are precisely those for which I obtained letters patent in August, 1841. The American Repertory for December, 1841, contained a part of my specification and claim.

"The patent of Mr. Parsons is dated December, 1842, and was enrolled in June, 1843.

"The 'adjustable cut-off,' as my invention is named, has been adopted on an engine lately put to work on the railroad from Jersey City to New Brunswick, to one on the Long Island road, and to engines building for the Patterson road, and for the Stonington road.

"I intend soon to send you accounts of the performance of these engines, which have been very satisfactory, and shall also furnish a full description of the combinations embraced in my patent. Yours respectfully,

"*New York, May* 14, 1844. HORATIO ALLEN."

Mode of Folating Large Stones for Building Sea Walls in Deep Water.—At the meeting of the institute of civil engineers of the 12th March, Mr. Bremner read a paper describing the casks used for floating the large stones for securing the foot of the sea wall of Banff harbor, which had failed. The casks were strongly built of fir staves, hooped externally with iron, and supported inside by radiating bars like the spokes of a wheel. Two of these casks, of 445 cubic feet capacity each, were use to convey stones of 30 tons weight, by passing two chain cables, which were wound round them, through the eyes of the lewises, which were fixed in the stone at low water, at which time the chains being hauled down tight, when the tide flowed, the buoyancy of the casks floated the stones, and they were towed by a boat over the place where the stone was intended to be deposited. The lashing being then cut away, the stone fell into its seat. This method was found to succeed in weather that would have destroyed any crane barges; and the works of Banff harbor were thus secured from further degradation, and were subsequently restored at a comparatively small cost.

Mode of making Looking-glasses, Mirrors, etc., without Mercury.—A correspondent (J. B. N.) sends us the following particulars of a process by which looking glasses, etc. may be silvered in the most effectual way without the use of mercury; he has done several; "the most splendid mirrors imaginable." The following is his account of the process:—"Take a little nitrate of silver; add carefully liquid ammonia till the precipitate formed is nearly all dissolved, but not fully; add a little of this to a mixture of alcohol and oil of cassia; the piece of glass to be silvered is laid flat, with a ledging tied round of pipe clay or the like, exactly as if a mould were to be taken; upon the glass pour the above named mixture till it has a depth of between a quarter and half an inch; then drop here and there upon this a mixture of oil of cloves and alcohol; a violent action takes place where the drops fall; this rapidly spreads, and the whole surface, in the course of from a quarter to half an hour, appears brown; the liquid is now poured off, and a layer of silver is found reduced upon the surface of the glass, forming a complete and beautiful mirror ready to be framed. The chemical action is no doubt the formation of aldehyde which reduces the silver. This process has recently been made the subject of a patent, for which, I am told, the firm of Rothschild has offered £100,000 for the purpose of suppressing the discovery, as it may affect the valuable monopoly in mercury possessed by that house. The offer has been refused. The name of the patentee, I am informed, is Durant, of Brighton." The process of silvering by means of aldehyde was exhibited two years ago at the Glasgow Philosophical Society, by Dr. Stenhouse.

Scaffolding.—Two papers on this subject were read at the same meeting of the Institution. The first paper was read by Mr. T. Grissell, in which the author described the scaffolding first used by Mr. Cubitt for the erection of the facade of the Birmingham railway station, and which had since been adopted for other works with complete success. It was stated to be composed of sills, uprights, cross-heads, longitudinal timbers, braces and struts, all of whole timber. The upright timbers were slightly turned into the horizontal timbers with junctions secured by iron dogs, driven into the timbers diagonally across the joints, which were preferable to bolts and spikes, inasmuch as they could be easily withdrawn, and the timber was not injured. The next paper on the subject was by M. Pierre Journet, whose scaffolding was stated to consist of a simple combination of a number of brackets, fixed at regular distances of about five feet apart vertically, upon girdles of chains and screws, braced tight round the column under repair: upon these brackets the platforms were laid, and as the workmen proceeded upwards, the lower brackets were alternately raised to the platforms above, where the workmen stood. The progress thus made in forming, and in taking down a scaffold, was stated to be very rapid, with corresponding economy of time and expense; no poles or cords were used and no waste of material occurred. By these means the obelisk of Luxor, at Paris, was repaired in a very short time and at a very small cost. The machine for raising building materials consisted of an endless chain of square open links, the lower end revolving around a driven wheel, and the upper end around a corresponding wheel, fixed upon a scaffold, at the height of the building. The hods, buckets and baskets were each furnished with a hook by which they were suspended on the rising side of the chain, and when they arrived at the necessary height, they were taken off by laborers, and carried to the spot where the materials were to be used; when empty they were hung upon the descending side of the chain and lowered to be again filled.

CONTENTS:

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5. | D. K. MINOR, Editor.

No. 9, Vol. 2 Third Series. | SEPTEMBER, 1844. | Whole No. 440. Vol. XVII.

THE ATMOSPHERIC RAILWAY.

Evidence given before a Committee of the House of Commons.

Mr. Barry Gibbons, engineer of the Dublin and Kingstown railway, examined: Trains propelled on the atmospheric principle started and stopped more easily, and with less loss of time, than those with locomotive power. The atmospheric principle on the Dalkey line, compared with the expense of other lines, as to haulage, was much cheaper than the locomotive. The maintenance of way was less favorable in a newly opened line than on an old one. Taking the cost of haulage on the locomotive line of the Dublin and Kingstown, according to the published accounts of the company, the cost of locomotive power on that line was 10 9-10*d.* per train per mile. The maintenance of way was 3 1-10*d.* making a total of 14*d.* The cost of moving power on the atmospheric principle was 7 1-10*d.* and the maintenance of way 1 3-10*d.* Could distinguish the wear and tear of rails on a locomotive line in the space of six weeks. In the estimate of 14*d.* there was an allowance made for wear and tear of rails. In the atmospheric there was no parallel allowance for the pipe. Believed, though there were great curves on the line, that there was no wear and tear of the pipe, and no centrifugal friction. The wear and tear of the pipe would not require an expenditure for fifty years. It became perfectly polished inside, owing to the tallow. In going round sharp curves on a locomotive line, the inside of the rail is worn away by the flange of the wheel. Did not make any allowance in the estimate for wear and tear of rails on an atmospheric line, because it was inappreciable. In the item for haulage, witness debitted wear and tear to the atmospheric railway, which would take place in the stationary engines, and included coals consumed, wear of machinery, and persons employed in the engine house. The cost of coals was 1*l.* 4*s.* 6*d.* per day; wages 12*s.*; wear and tear, oil. etc. 6*s.* If the Dalkey line were longer, the expense would be less. Had laid out an extension of it to Bray, six miles, and an engine would work at both places. There would be more consumption of coal, but at less per train per mile. Paid Messrs. Samuda for the construction of the line, and their estimate was not exceeded by 1*d.* Their promises as to load carried, and velocity attained, had been perfectly accomplished. They entered into a contract to carry trains of 26 tons at 30 miles an hour, and had performed it at double that rate. The Dublin and Kingstown was a very cheap line, and the low fares had increased the passengers enormously. The trains had been increased from time to time, and there had been a corresponding number of passengers. It induced a system of country residence. They estimated that every new house built in the neighborhood of a station was 20*l*. added to the annual receipts. There were four stations on the six miles. The fares were 1*s*., 8*d*., and 6*d*., but there was a reduction to families of 5, 10 and 20 per cent. The average fare was something under 1*d*. The fares on the Dalkey were 2*d*. and 3*d*. They would pay at that. The company received 45*l*. on last Sunday, which would represent 4500 persons. The increase in traffic on the Kingstown railway was not so much to be attributed to reduction of fares as to the frequency of the trains. The coals consumed by the engine on the atmospheric line were 35 cwt. per day, which would keep it working from 8 A. M. to 6 P. M. at intervals. Witness reckoned a daily mileage allowance for wear and tear of piston of 4*d*. per day. One set of piston leathers, costing 16*d*, worked a fortnight. The rails on the atmospheric line were 52lb. per yard weight. Had examined the pipe, and could find no lateral pressure made by the tube on the piston. The straightforward movement of the piston counteracted the centrifugal force of the curve; but witness did not think that the piston had ever been brought into operation to prevent the carriages going off the line. If it had ever exerted such a force there would have been some indication of it on the pipe. The atmospheric carriages were 15 cwt., or a ton lighter than the locomotive. Witness's estimate for maintenance on the locomotive line was for a double, the estimate for the atmospheric for only a single line. Had made the experiment of stopping the trains almost instantaneously, and had brought up a train to a dead rest, travelling at 40 miles an hour, within 220 yards. There were 7 carriages, and 78 persons in them. The weight of the rails on the Kingstown and those on the Dalkey was precisely the same. The calculation given by witness of 7*d*. for haulage on the atmospheric, was only for one way. If worked backwards and forwards as a locomotive, it would be 14*d*.; but the trains came back by their own gravity, and therefore cost nothing. Were the line on a level, the cost would have to be doubled.

Mr. I. K. Brunel, C. E., examined: Had been consulted on the expediency of working the proposed Croydon and Epsom on the atmospheric system, and had considered its application thereto very fully. Thought that the adoption of the atmospheric plan was well adapted for the working of the proposed line. Taking all things into consideration, the trains could be conveyed in a shorter time by it than by the ordinary locomotive engine, and with greater frequency. Where the trains were not very numerous, could understand that the working expenses would be less by locomotive power than by a fixed engine. In a great number of cases it would be the reverse; the working expenses would be reduced by the atmospheric principle, assuming that a great many trains would run. The prevailing gradients on the Epsom line were 1 in 100, which he thought applicable to a line with a view to economy in working. The diagrams of Mr. Samuda, as to the manner of working the trains might be worked with frequency and safety. There was a point where expensive locomotive power would become more economical than stationary power, if the number of trains were very much reduced. Thought that the atmospheric train could be propelled much faster than is done at present. Had no reason to doubt but that trains might go at a speed of 50 and 60 miles an hour. Had gone at 60 on a locomotive, and thought a train might go easier and at a higher rate by the atmospheric than by the locomotive engine. It had greater speed than the locomotive. It possessed the advantage over the latter of starting at once into a state of motion from a state of rest. This was a great advantage where there were many stations, as contemplated in the Epsom line. On the Great Western they found that it was six to eight miles from the station before they got into a good maximum rate of running; therefore it was only on a long distance from London to Slough that they did attain their full velocity. With respect to the atmospheric attaining a velocity of 50 miles an hour, it would depend entirely on the power, the size of the pipe, and the degree of vacuum. Did not see any difficulty in their getting it at the end of 2½ or 3 miles. Had no doubt but that if they chose to put on the power, they might obtain it at 1 mile or 1½. When witness saw the line at Dalkey, it was not laid in a manner which admitted of a very high velocity. Did not think it safe when he made the experiments to go higher than 40 miles. The derangement of the rails, and the difficulty of keeping the railway in perfect order, arose from the weight of the locomotive engines, and the mode of working them on the rails. Witness's object in making the experiments at Dalkey was to satisfy his own mind, with a view to govern him in advising others. The results of these experiments were, that he found they could attain a high velocity on the line in a short time, so as even to attain the rate of 50 miles an hour. Found that the mechanical part of the apparatus and valve was even then in a good working condition, and saw enough to satisfy his mind that it could be rendered still more perfect. Found that a weight was moved at a good velocity of 22 miles an hour—a weight fully as great as that due to the free effect of the vacuum in the piston. Satisfied himself that there was no amount of friction or leakage round the piston, nor other mechanical defects, which would prevent getting the full effect of the vacuum. Was confirmed in the opinion that a mechanical contrivance of that sort could be worked, so as to produce that effect at a less cost than the ordinary mode of applying power by a locomotive. Had in consequence of these experiments advised the promoters of the Croydon and Epsom to adopt the atmospheric. Had no doubt that an atmospheric railway might be made more comfortable to passengers than a locomotive, which was one of the great advantages to be derived from it. Thought that the rails might be kept in much more perfect order than with locomotive carriages; and that carriages might be constructed in a totally different manner from those now in use. The motion would be smooth and noiseless. There was also the absence of coke dust from the chimney. With respect to the experiments of stopping trains, thought that on a railway worked by stationary power, whether atmospheric or other, the power of stopping was greater than it was on a locomotive line. The power to be overcome in stopping a train arose, not from the power of friction, but from the momentum of the train, which, at 40 miles an hour, would be 10 or 15 times as great as the power of traction that could be produced for a distance of 250 yards; and therefore in stopping a train at a short distance of 250 yards, what they had to think of was the momentum of the train. Did not think that the reversing of the engine at all equalled the advantage that might be derived from breaks or slides, such as those Mr. Cubitt spoke of on carriages on the atmospheric line. The reversal of an engine for stopping a train did not produce so much effect as might be supposed. On the Great Western they never reversed; but the break in the tender stopped the train at high velocities. Had calculated the power of the engine at Dalkey. In a commercial point of view, Mr. Samuda's mode of calculating was correct. The power on the atmospheric railway had a facility for adapting itself to the load. That was a great advantage. Where the gradients were steep they could apply more power.

Assuming even that the pipe was not of the same size everywhere, at one small steep part of the line they might work a vacuum up to 18 or 20 inches of mercury, which would not be so economical as working it at 14 or 16 inches. Still, for a short part of the line, they could do so; whereas on the rest of the line they might work at the more economical pressure of 14 to 16 inches of mercury. With respect to the variation of the work, according to the variation in the weight of the train, of course any engine working expansively, and well constructed, would adapt itself to the weight of the train; and the cost of working the engine would be somewhat proportional to the weight. Was so satisfied of the advantage of the atmospheric, that he had proposed to adopt it on the line (26 miles) he was now surveying from Croydon to Chatham. An advantage of the atmospheric was, that when a train stopped at the station, the power for propelling was accumulating in the pipe, so as to bring the train more rapidly into motion from the state of rest. Witness's preference of the atmospheric was limited to cases where the passage of trains was required to be frequent. Had no hesitation in saying, that if the two lines now before the committee were to be worked by locomotive power, the Southwestern would be the cheapest and safest; but if the atmospheric were applied, it could be done cheaper by the Croydon and Epsom. Had no doubt but that the atmospheric upon a single line, where everything was adapted to it, was much safer than a locomotive on a single line with double power. The atmospheric might be so managed that no carelessness could produce a collision; but it was impossible on a locomotive line to prevent one train catching or meeting another. Thought that the leakage could safely be neglected. Did not think that any experiments which had yet been made would enable a correct calculation to be made of the amount of power required to overcome the leakage. He spoke guardedly and carefully, inasmuch as he was expressing an opinion adverse to that of his friend, Mr. R. Stephenson, whose report he had seen. Thought there was no difficulty in constructing carriages in the manner stated by Mr. Cubitt, by bringing them at once on slides or sledges, or by locking all the wheels of one entire train, which, now that they used steel tires, he should not be afraid of doing. Thought there would be no difficulty at all in keeping the atmospheric railway in such good order that the carriages might be better constructed and connected one with another, so that the break might be made to act in the whole at once. There had lately been introduced a new mode of valve-gearing, which facilitated the adaptation of engines to the load. The practical effect of the expansive gear was rather to put larger cylinders on the engine, and to work economically, than to vary the power much, because the variation of power between shutting off the steam was not very great. The sole object of this improvement was, by the use of a rather larger cylinder than was necessary to enable the steam to be used expansively, and thereby obtain economy of fuel. Was among the first to use the expansive gear on the Great Western, but had no such object as the saving of steam in going down an incline, in order to reserve it for use in going up an incline. Had advised a line between Chatham and Croydon to be laid down on that principle, and also between Genoa and Turin, which was over a steep part of the Apennines. Witness wished to be allowed to explain himself more particularly on one point, as he was now giving an opinion professionally, and more particularly as a report had just been published by an eminent—probably the most eminent—man in his own profession, in which a strong opinion was expressed on all these points diametrically opposite to those which he entertained. He should wish it to be understood that he was not carelessly giving any opinion now without recollecting that circumstance, and he should, in his own vindication, repeat the object of his making the experiments at Dalkey, and also say, with sentiments of much respect for Mr. Robert Stephenson, that he still thought it possible to form a more correct opinion on this particular case by a general practical view of the working of the Dalkey line, and of the modifications of which it was susceptible when applied to longer lines, than by the very minute calculations and minute experiments recited in Mr. Stephenson's report. In the first place, the Dalkey line was too short, and, he must say, too badly constructed, owing to local difficulties, to allow either velocity to be attained or the train to be worked, with ordinary average resistance. Believed that resistance upon that line was much greater than it was on a good railway, and that there were sources of great loss of power in the connecting pipe and other parts which, according to his opinion as a mechanical man, might be easily remedied and overcome.

Mr. R. Stephenson's objections will be found substantially in the following extracts from his report, for which, as well as for the preceding abstract we are indebted to the Railway Chronicle.

"My first impression was that much higher velocities were attainable by the atmospheric system than had yet been accomplished by locomotive engines; but a very careful reflection upon all the circumstances which the last series of experiments developed and, the detailed calculations which have been made upon them, has led me to alter that impression. I am fully aware that the calculations which have been given do not absolutely put a limit to the speed, and that the investigation may resolve itself merely into a question of power, and consequently into one of expense; to a certain extent, this is the case, but an inquiry of this kind, which is as essentially commercial as scientific, is one in which pecuniary limits must continually present themselves, and not unfrequently prove more formidable than those of a mechanical nature. In pursuing my calculations, therefore I have felt that it was imperative to determine with some accuracy the probable additional power which it would be necessary to reckon upon, beyond that which has been employed at Kingstown; and I am convinced the increase which has been stated as requisite to attain the assumed velocity of 50 miles per hour is rather under than over estimated; and this single example, based as it is entirely upon experimental data, is sufficient, in my opinion, to demonstrate conclusively, that any velocity beyond that which is now frequently attained upon railways, must be attended with a most inordinate waste of power. I have already contrasted the actual velocities of the trains with those which would be indicated by theory, and have shown that the loss of velocity arises solely from the leakage of the apparatus, and that as the rarefaction is increased this content of leakage becomes augmented, while the pump is only capable of exhausting a constant content of air without reference to the density. This leads us to the conclusion that when the barometer rises to within a few inches of its utmost height, the expansion of the air leaking into the apparatus must become fully equal to the total capacity of the pump, and no advance of the tube piston can be effected. The case occurs on the Kingstown and Dalkey railway, with a height of barometer of 25½ inches, which is the maximum height that can be attained in the entire length of the vacuum tube; and therefore a train requiring this height of barometer could not be started if the air pump did not exceed its uniform rate, although the engine would be working at almost its greatest power. This conclusion, which is unquestionably correct, points out the improvident expenditure of power when a high degree of rarefaction is required."

Having thus removed the great claim made by the inventors to the exclusive enjoyment of high velocities, Mr. Stephenson next proceeds to compare the work actually done by the atmospheric system on the Dalkey line with the work actually done by *stationary power and rope system*, as now in use at Camden-town. The comparison is fair, in this respect, that the Camden-town incline is 1 in 106, and the Dalkey incline is 1 in 115 being in favor of the atmospheric; only there are sharp curves on the latter, which do not exist on the former. The results of the comparison may be arranged under several heads, as follows:—

1. *Loss of power* by rope and atmospheric tube:—

"In proceeding to compare with these the results of the experiments on the atmospheric railway, it is my object to select a case in each, which shall present the closest analogy in the amount of their resistances and velocity. The 4th train in table No. VII, and the 18th in table No. V, correspond very closely in these particulars, the total resistance of the former, including the friction, gravity, and resistance of atmosphere, being equal to 102 horses' power, and of the latter, 100 horses' power, and the respective velocities being 20 and 18 miles per hour. The loss of power from the working of the rope in the former case is equal to 30 per cent. of the total, while the loss in the latter, arising from raising the vacuum, leakage, and imperfections of the apparatus, amounts to 74 per cent. of the total power. In order however, to institute a correct comparison between these two cases, the total power in the former must be increased in the proportion of the mean to the maximum velocity, which in this instance is ascertained, from experiments made, to add 37 horses' power to the total, and the comparison stands thus: the loss of power on the Euston incline amounts to 45 per cent., while that on the Kingstown and Dalkey railway is 74 per cent. The result is obtained with a train which represents the average working of the Euston incline; it is therefore evident that in this particular instance the rope is very considerably more economical than the atmospheric system. If we assume other weights of train, we shall perceive, that as they become lighter the proportion of loss by the atmospheric apparatus will be diminished on account of the reduction in the effect of leakage accompanying the reduction in pressure, but the proportion of loss by the rope will be increased, as the power required to work the rope itself is the same with a light as with a heavy train; while on the other hand, with heavier trains the proportion of loss by the rope will be diminished, and that by the atmospheric system greatly augmented, from the increased effect of the leakage, and the additional power required to raise the vacuum to a greater height."

2. *Consumption of fuel* by the rope system and the tube system compared:—

"This I am enabled to accomplish from the observation of a fortnight's working of the Euston incline, and from an experiment on the Kingstown and Dalkey railway, in which the number of trains, the exact weight of each, and the consumption of fuel, was ascertained during an entire day. The result of the former was, that 13 trains averaging 41 tons each, the mean resistance of which amounted to 1590 lb., were drawn up the incline of 0·91 mile length, at a mean velocity of about 17 miles per hour, in one day of 15 hours, with a consumption of 30 cwt. of coal; and the result of the latter was that 10 trains averaging 44 tons each, the mean resistance of which amounted to 1205 lb., were drawn up the incline of 1·22 miles length, at a mean velocity of about 14 miles per hour, in one day of eight hours, with a consumption of 29 cwt. of coal. The consumption of coal per mile of the trains in these two cases amounts to 284 lb. on the Euston incline, and 266 lb. at Kingstown; and dividing these by their respective amounts of friction and gravity, we obtain the comparative consumption per lb. of tractive force as ·18 lb. in the former case, and ·21 lb. in the latter."

3. Power of *overcoming bad gradients*:—

"If we take some of the trains which are drawn up the Euston incline, amounting to fully 100 tons weight, we shall find that the total resistance exceeds the capacity of the tube which is employed at Kingstown, namely, 15 inches diameter; for supposing the pressure to be equal to 22 inches height of the barometer, or 11 lb. per square inch, the train just named upon the gradient of 1 in 75, which is near the upper end of the Euston incline, and continues for about one-third of its length, would offer a resistance, at a velocity of 17 miles per hour, of about 4,500 lb., and would therefore require a tube of 23 inches diameter. Such an increase of tube. it must be observed, immediately implied a great reduction of velocity with the atmospheric system, or an increased size of air pump, involving a corresponding increase of power, because the ratio between the areas of the air pump and vacuum tube is affected; and it has been clearly shown that, working at a high vacuum in a small tube, or increasing the size of the tube and lowering the vacuum, if the same amount of power be employed, involves equally the sacrifice of velocity. Here we perceive a decided proof, that what is termed good gradients is not a matter of indifference to the atmospheric system, and that we shall not be justified in attributing to it the power of economising the construction of railways to any considerable extent, by avoiding the necessity of levelling the face of the country."

The comparison with the locomotive, even in duty alone, is also of a kind unfavorable to it, keeping out of view altogether the peculiar disadvantages of stationary as compared with locomotive power. The result is as follows:

"If we convert the loads moved in the experiments into equivalent loads on a level, we shall then find that in no case they exceed the duty which is being daily performed by locomotive engines. Thus, taking experiment No. 4, the load being 26·5 tons, the resistance per ton upon an incline of 1 in 115, at a velocity of 34·7 miles per hour, estimating the resistance of the atmosphere according to Lardner's experiments previously referred to, will stand thus—gravity, 20 lb. per ton; friction, 10 lb.; atmosphere, 20 lb.: total resistance, 50 lb. per ton. And the resistance upon a level will be—friction, 10 lb. per ton; atmosphere, 20 lb.: total resistance, 30 lb. per ton. Therefore this train of 26·5 tons, on the incline of 1 in 115, will be equivalent to 44 tons upon a level, at the same speed of 34·7 miles per hour. This duty, which is indisputably the utmost given by the experiments at Kingstown, is much exceeded daily on many lines of railway in this country, and especially by the Great Western, and Northern and Eastern. Throughout the experiments, it will be seen that the duty performed by the Kingstown and Dalkey engine, when reduced to an equivalent level, falls short of the daily performance of locomotive engines on our principal lines of railway, both as regards speed and load."

The conclusion of the whole matter, considered as a purely mechanical question, is given in the following sentences:—

"On a long series of bad gradients, extending over several miles, where the kind of traffic is such that it is essential to avoid intermediate stoppages, the atmospheric system would be the most expedient. If, however, intermediate stoppages are not objectionable, as is the case in the conveyance of heavy goods and mineral trains on the railways in the neighborhood of Newcastle-upon-Tyne, the application of the rope is preferable to the atmospheric system. This conclusion I conceive to be fully established by the comparison which has been made between the Kingstown and Euston inclines. Again, on lines of railway where moderate gradients are attainable at a reasonable expense, the locomotive engine is decidedly superior, both as regards power and speed, to any results developed or likely to be developed by the atmospheric system. In considering these last, as well as all the preceding calculations and remarks, it must be borne in mind that they have reference solely to the question of power, and are entirely independent of the question of expense or convenience: the next step in the inquiry will therefore be, the expense of constructing the lines on each system and the probable cost of working."

Hitherto the question has been treated wholly as one respecting the value of a given mechanical means of transmitting power.

There remain to be considered the questions of *cost and convenience;* and here, as well as throughout the whole line of argument, there will be observed a close analogy between the results and reasonings of Mr. Stephenson's report and those in pp. 102, 103 of our last, already referred to.

The inventors of this system, in vaunting its excellence, rely much on the supposed advantage of being able to work with single lines. This Mr. S. completely refutes: he proves the necessity, not only of two lines, but of duplicate engines. This raises the cost of the atmospheric to £11,000 per mile; so that on such a line as the London and Birmingham, the total cost, in all items, for locomotive power, is - - - - £321,974
and for the atmospheric, - - - - - 1,221,000

But even the expense of working, after all this greater expenditure of capital, is against the atmospheric.

The cost of locomotive power upon the London and Birmingham railway, for 1843, was as follows:—

" Wages of engine drivers and firemen, - - - -	£9,673	
Coke, - - - - - - - -	25,541	
Oil, horse pipes and fire tools, pumping engines and water, -	4,099	
Laborers and cleaners, waste and oil, - - - -	4,194	
Repairs of engines and tenders, - - - - -	12,521	
Coals and fire wood, expenses of stationary engine at Wolverton, repairs of buildings, gas and incidental charges, - - -	3,172	
Superintendent, clerks' and foremen's salaries, and office charges,	4,634	—£63,834

The expense of working the atmospheric system for one year, I estimate approximately as follows:—

" Wages of engine men, 64 at 6s.; stokers, 64 at 3s., -	£10,512	
The same during the night, - - - - -	10,512	
Coal, 172 tons per day, at 9s., - - - - - -	28,332	
Oil, hemp, tallow and repairs at 5 per cent. on cost of engines, -	20,000	
Superintendence same as locomotive, - - - -	4,634	—£73,990

I have already stated that the above sum has no pretension to precise accuracy, but since I have intentionally omitted numerous items of expense, which must arise (the exact amount of which no one can venture to predict or to introduce into such a calculation with much confidence,) I prefer making the comparison under that aspect which is the most favorable to the new invention under discussion; because I conceive the question between the atmospheric and locomotive systems does not by any means, after what has been advanced, depend on the mere annual cost of working. I shall content myself with the above statement, which in my opinion sufficiently establishes the fact, that the cost of working the London and Birmingham railway, or any other line with a similar traffic, by the atmospheric system would greatly exceed that by locomotive engines."

But, to do the system full justice, a single line, the favorite instance, may be taken at their own estimates; and the result entirely coincides with that given by our correspondent S., in our last.

"Let us now conceive it applied to a case of an opposite character; for example, the Norwich and Yarmouth railway, which has cost about £10,000 per mile, including carrying stock and every appurtenance. This line passes over a country in which the application of the atmospheric system could have effected no economy in the formation of the line, which has not exceeded a cost of £8,000 per mile. The application of a single line of the atmospheric apparatus would, in this instance, have added at least £5,000 per mile, which upon 20 miles, the length of the railway, would amount to £100,000. The mere interest of this sum, at 5 per cent. is £5,000 per annum, whereas the actual working of this line, including maintenance of way, booking offices, porterage and all other constant traffic charges, has been let for £7,000 per annum, being only £2,000 above the bare interest of the extra capital which would be required to lay down the atmospheric apparatus; an amount which would be quite inadequate to meet the wear and tear of the machinery alone, leaving nothing to meet the current cost of working. Here, therefore, we have a case, where the country is favorable, the original capital small, and the traffic moderate, where the cost of the atmospheric system would be so burdensome as to render it totally inapplicable."

In the appendix, the comparison of the atmospheric system with that on the Blackwall railway is given with great clearness by Mr. Bidder, and leads to this conclusion, that—

"Unless some expedient with which I at present am unacquainted can be devised for obviating the necessity of stopping at each intermediate station, it would appear that the trains could not be run more frequently than at half hour intervals with the engines now at work, thus reducing the trains to one half their present number, and this, too, without effecting any saving in the working expenses, inasmuch as there would be no reduction in the staff of conductors while the constant and severe breaking would increase the cost of maintenance of way and carriages; the wages of the rope men also would not compensate, for the extra cost arising from the engines being kept continually at work, instead of for ten minutes only out of every quarter of an hour, as is now the case; and lastly, the interest of the outlay requisite to introduce this system would exceed the annual cost of reparing and replacing the rope."

Mr. Stephenson sums up the whole case thus:—

"1st. That the atmospheric system is not an economical mode of transmitting power, and inferior in this respect both to locomotive engines and stationary engines with ropes. 2nd. That it is not calculated practically to acquire and maintain higher velocities than are comprised in the present working of locomotive engines. 3d. That it would not in the majority of instances produce economy in the original construction of railways, and in many would most materially augment their cost. 4th. That on some short railways, where the traffic is large, admitting of trains of moderate weight but requiring high velocities and frequent departures, and where the face of the country is such as to preclude the use of gradients suitable for locomotive engines, the atmospheric system would prove the most eligible. 5th. That on short lines of railway, say four or five miles in length, in the vicinity of large towns, where frequent and rapid communication is required between the termini alone, the atmospheric system might be advantageously applied. 6th. That on short lines, such as the Blackwall railway, where the traffic is chiefly derived from intermediate points, requiring frequent stoppages between the termini, the atmospheric system is inapplicable; being much inferior to the plan of disconnecting the carriages from a rope, for the accommodation of the intermediate traffic. 7. That on long lines of railway, the requisites of a large traffic cannot be attained by so inflexible a system as the atmospheric, in which the efficient operation of the whole depends so completely upon the perfect performance of each individual section of the machinery."

Mr. Herapath takes strong ground against the atmospheric railway, and speaking of the great loss of power from the friction of the air in the pipes, says:—

"That I am not unsupported in the views of the inefficiency of these atmospheric machines, I shall show by a quotation, furnished me a few days ago by a friend, from Dr. Robison's Mechanical Philosophy. The first experiment was made by Papin, an able man of science and a very eminent engineer. The second seems also to have been made by a good engineer and it is therefore presumed that both of these facts ought to be well known to our engineers of the present day. It is to be lamented that the size of the tubes is not mentioned, but doubtless they were small, perhaps only a few inches in diameter. As bearing, however, on the general question of the great amount of friction of air in tubes, it is not material to know the exact size.

"Dr. Papin, a most ingenious man, proposed this (the motion of air in pipes) as the most effectual method of transferring the action of a moving power to a great distance. Suppose for instance, that it was required to raise water out of a mine by a water machine, and that there was no fall of water nearer than a mile's distance. He employed this water to drive a piston, which should compress the air in a cylinder communicating by a long pipe, with another cylinder at the mouth of the mine. He expected that as soon as the piston at the water machine had compressed the air sufficiently, it would cause the air in the cylinder at the mine, to force up its piston, and thus work the pump. Dr. Hooke made many objections to the method when laid before the Royal Society, and it was much debated there. But dynamics was at this time an infant science, and very little understood. Newton had not then taken any part in the business of the society, otherwise the true objections would not have escaped his sagacious mind. Notwithstanding Papin's great reputation as an engineer and mechanic, he could not bring his machine into use in England: but afterwards in France and Germany, where he settled, he got some persons of great fortune to employ him in this project; and he erected great machines at Auvergne and Westphalia, for draining mines. But so far from being effective machines, they would not even begin to move. He attributed the failure to the quantity of air in the pipe of communication, which must be condensed before it can condense the air in the remote cylinder. This indeed is true, and he should have thought of this earlier. He therefore diminished the size of this pipe, and made his water machine exhaust instead of condensing, and had no doubt but that the immense velocity with which air rushes into a void, would make a rapid and effectual communication of power. But he was equally disappointed here, and *the machine at the mine stood still as before.*

"Near a century after this a very intelligent engineer attempted a much more feasible thing of this kind at an iron foundry in Wales. He erected a machine at a powerful fall of water, which worked a set of cylinder bellows, the blowpipe of which was conducted to the distance of a mile and a half, where it was applied to a blast furnace. But notwithstanding every care to make the conducting pipe *very air-tight, of great size, and as smooth as possible*, it would hardly blow out a candle. The failure was ascribed to the impossibility of making the pipe air-tight. But what was surprising, above ten minutes elapsed after the action of the piston in the bellows, before the least wind could be perceived at the end of the pipe; whereas the engineer expected an interval of six seconds only."

It was our intention to have offered some remarks of our own on this novel and extraordinary project; but when we find such men as R. Stephenson and Brunel entertaining diametrically opposite opinions after actual examination, we think it will better become us to merely submit their views to our readers. The cost alone will prevent the possibility of its adoption on the vast majority of roads in this country, though we think that the coal region of Pennsylvania affords some suitable openings.

It will be seen that Mr. Stephenson deduces all his conclusions from his own experiments, considering them as infallible, while Mr. Brunel founds his opinion on what—judging from the present state of things—may reasonably be expected from experience skill and observation, and we think this is with *practical* men the safer mode.

CENTRAL RAILROAD, GEORGIA.

This important work, the longest railway in existence, is now completed and the following extracts from the report of the engineer, Mr. L. O. Reynolds, will give our readers a good idea of the railway generally.

" The quantity of excavation and embankment throughout the whole line is about five million six hundred thousand cubic yards. There are, including the long bridge over the Oconee swamp, about six miles in extent of trestle bridging; about one-third of this may be, at a future day, filled up with earth.

" The road-bed is graded to a width of 15 feet on the embankments, with slopes of one and a half base to one vertical. The excavations below station No. 10, are generally graded 25 feet wide; beyond that station, 20 feet; side slopes generally, 45 degrees—except in loose soils, when they are similar to the embankments, and in some instances two to one.

" There has been no rock excavation of consequence, but many of the cuts have been through a compact mixture of clay and sand, which required the aid of the pick in excavating.

" Considerable work will be necessary during the present and next years, in extending and perfecting the drainage of the road. Nothing is more important than good drainage to insure a firm and even track.

" The maximum inclination of grade of the road is 30 feet per mile. Although I have inserted a table of the gradients and curves of the road in a former report, I will repeat that they may be classed as follows:

	Miles.	Feet.
Level, - - - - - -	26	4,378
Inclinations not over 5 feet per mile,	44	4,880
" from 5 to 10 " "	30	4,600
" " 10 to 15 " "	17	4,240
" " 15 to 20 " "	13	3,160
" " 20 to 25 " "	9	3,880
" " 25 to 30 " "	47—190	210—1,600

"The following table exhibits the proportion of straight and curved line, with the various radii of the curves. Number of curves, 109; number of straight lines, 110.

Length of Radius.	Number of Curves.	Aggregate Distance.
2,000 feet.	25	42,835 feet.
2,100 "	4	9,802 "
2,300 "	2	3,943 "
2,500 "	5	8,138 "
3,000 "	13	20,788 "
3,500 "	6	13,781 "
4,000 "	12	25,683 "
4,500 "	2	4,980 "
5,000 "	15	45,729 "
7,000 "	2	3,656 "
8,000 "	5	15,312 "
10,000 "	8	28,100 "
15,000 "	5	21,916 "
16,000 "	1	7,139 "
20,000 "	1	8,374 "
30,000 "	2	6,920 "
150,000 "	1	26,500 "
Total,	109	293,596 "
Total length of curved line,	55 miles, and	3,156 "
" " straight line,	134 " "	3,724 "
Whole length of road,	190 " "	1,600 "

The summit is 464 feet above tide, and the level of the Ocmulgee bridge (floor) is 297 feet above tide. This bridge we take to be the western terminus of the road.

"The plan of superstructure for one hundred miles from Savannah, is as follows:

"Cross sleepers are first bedded in the ground and rammed solid, their upper surfaces being level with the grade of the road; string pieces, 6 in. deep and 12 in. wide, are then trenailed flatwise on the sleepers, and the ground rammed under them, affording a continuous bearing. On the top, and in the centre of these string pieces, is placed a small lath or ribbon, 3 by 2 in. of hard pine; and this is surmounted by the plate, or strap rail of iron, 3 in. wide by ¾ in. thick. The iron is confined by spikes 7 in. long, passing through the ribbon into the string piece. Wrought iron splicing plates, ¼ in. thick, are placed under the joinings of the bars, the spikes passing through them. The balance of the road above the 100 mile station is similar, excepting that a light T rail is laid on the string piece, instead of the ribbon and plate rail.

"Total cost of the road, $2,581,723. This amount is made up of various items, which may be set down as follows:

"Grading, including grubbing, clearing, excavation, embankment and wooden culverts,	975,898
Culverts of masonry,	49,000
Depot at Savannah,	33,078
Depot at Macon,	24,767
Bridges, including Oconee, which cost $70,000,	126,000
Laying superstructure, and materials, except iron,	424,400
Wells, pumps and cisterns,	4,600

Iron rails, spikes and plates, - - - - - -	476,081
Damage by freshet of 1841, - - - - -	68,000
Right of way, - - - - - - - -	36,153
Engineering, including preliminary surveys, - -	154,530
Motive power and cars, - - - - - -	168,343
Tools, machinery, etc., in shops, - - - - -	15,000
Incidental expenses, - - - - - - -	25,873
	$2,581,723
"Average cost of road per mile, exclusive of motive power,	$12,702

"Since the date of my last report, we have increased our motive power by the addition of six freight engines of the second class, making our number now 14, viz: 8 third class 6 wheel engines, 5 second class 8 wheel freight engines, 1 second class 6 wheel connected freight engine; all of which are in running order, except one. These engines have performed from the 1st November, 1842, to 1st December, 1843, a total distance of 181,954 miles.

"The whole amount of fuel consumed in performance of the above distance, was 2,739 cords of wood, being an average of 66·43 miles run for every cord of wood consumed.

"Two additional freight engines, and the wheels, etc., for fifty burthen cars, have been ordered, and will be received in time to meet the business of the next fall.

"This will swell the number of eight wheel burthen cars to upwards of one hundred and fifty."

The receipts for 13 months ending Nov., 1843, were $227,531 94, of which $37,329 37 were from passengers, $17,517 76 from the U. S. mail and the remainder from freight. Number of passengers, 10,461, of bales of cotton 47,133.

The expenses for that period have been as follows:

"Repairs of the road, - - - -	61,886 89	
Tools and materials for repairs of engines and cars,	3,175 08	
Salaries, - - - - - - -	9,885 32	
" way stations, - - - - -	8,276 53	
Oil and tallow, - - - - - -	1,237 75	
Fuel and water, - - - - -	11,477 39	
Labor, provisions and forage, - - -	2,578 14	
Damage, - - - - - - -	1,338 82	
Insurance on cotton, - - - - -	1,352 19	
Machinists, runners and firemen, - - -	15,194 12	
Carpenters, - - - - - -	2,266 67	
Blacksmiths, - - - - - - -	1,773 78	
Conductors and train hands, - - -	11,935 77	
Incidental expenses, - - - - - -	2,042 99—	134,341 43
Leaving a nett profit, of - - - - -		$93,190 51

"The comptuation of profits, receipts, etc., is made up to Dec. 1st, being one month over a year, that the accounts may correspond in date with those of the bank for the future."

The receipts for the three following months, were $86,716 73.

"It will, no doubt, be observed that, in the account of expenses, the items of repairs of road is much increased over last year. We have most sensibly felt the benefit of increasing the outlay for this purpose in the improved condition of the road, and the regularity with which our trains perform their trips.

"In order however, to show that the expense of this particular branch of the service is still within moderate limits, I may here mention that the annual cost of repairs of our road average - - $317 per mile.

South Carolina railroad,	372	"
Georgia railroad,	303	"
Average of eight principal railroads in Massachusetts,	477	"
" Western railroad,	310	"

"The expense of working our road per mile run, during the above period, has been - - - - - - - 73·8 cents."

HOUSATONIC RAILROAD REPORT.

We have the report of this company, dated 24th June, 1844, and make such extracts as will interest our readers. It is mainly occupied by the financial affairs of the company.

"The entire length of the Housatonic railroad, from the tide water at Bridgeport to the north line of the State of Connecticut, is $73\frac{20}{100}$ miles. In this distance there are twelve regular stations, for the receipt and discharge of passengers and freight, namely, at Stepney, Botsford's, Newtown, Hawleyville, Brookfield, New Milford, Gaylord's Bridge, Kent, Cornwall Bridge, West Cornwall, Falls Village and North Canaan. The maximum grade is 40 feet to the mile, but more than half the length of the road is passed on grades of under 26 feet to the mile.

"The following expenditures have been made in the construction of the road and appendages.

"Obtaining charter, preliminary surveys, etc.,	6,150 32
Right of way and land damages,	60,051 43
Grading and superstructure,	967,005 60
Engineering,	24,407 23
Turntables,	1,493 64
Engine houses,	4,383 68
Construction of Depots, etc.,	11,733 70
Profit and loss,	46,770 53
Contingent expenses,	23,097 32
Real estate,	1,669 80
Engines and cars,	97,359 66
	$1,244,122 91

"This expenditure of $1,244,122 91, for a road of 74 miles in length, with an ample outfit of engines and cars, will bear favorable comparison with any other railroad in the United States, of similar construction."

"The Berkshire railroad company, chartered by the State of Massachusetts, with a capital of $250,000, all paid in, constructed their road from the northern termination of the Housatonic road to the village of West Stockbridge. There are four regular stations on this road—at Sheffield, Great Barrington, Van Deusenville and West Stockbridge. Its entire length is $21\frac{14}{100}$ miles. The grades are similar to those on the Housatonic road. The use of the road is granted to the Housatonic railroad company during the term of the charter, at an annual rent of $17,500, payable monthly. The road is to be kept in repair by the lessees, and in effect the Housatonic railroad company possess as complete control over it, as if it had been constructed under their own charter. The rent is paid in full, and is considered as one of the charges of monthly expense and settled accordingly. The

Berkshire company have the right to increase capital to $600,000, and an arrangement may be made for the issue of stock to an amount which may be necessary for substituting heavier rail, upon adding to the rent paid by this company a sum equal to seven per cent. upon the expenditure. This insures a superstructure equal to any which may be adopted on the Housatonic road, whenever a new and stronger rail may be laid on that road. From West Stockbridge, the line is continued to the Western road, by the West Stockbridge company, a distance of about 2¾ miles. That road is leased to the Housatonic railroad company, for the term of the charter, at an annual rent of about $1000. One half of the expense of the maintenance of the road is to be paid by the lessees. Provision is made in the lease, by which an edge rail may be laid by the Housatonic railroad company; in which case an allowance equal to one half of the average repairs of the present road, is to be made to the Housatonic railroad company."

" Receipts of	1842.	1843.	1844.
January,	$8,072 85	$11,826 87	$15,305 07
February,	6,011 75	10,212 36	15,534 03
March,	6,083 41	13,563 93	14,065 47
April	5,779 23	9,738 24	10,101 06
May,	6,363 03	10,310 64	13,142 67
Total 5 months,	$32,310 27	$55,652 04	$68,148 30

RAILWAYS IN MICHIGAN.

The rapid increase of income on these works, is truly gratifying. The Central railroad is to be opened very soon to Kalamazoo and this, the commissioners say, will itself pay the interest on the State debt.

They complain much of the heavy duty lately imposed on railroad iron.

"The tariff of 1842 placed a cash duty of $25 per ton on railroad iron, which prevented the commissioners from importing it, as they were unable to make payment of so large a proportion of the cost of the iron on its arrival in this country. The low price of iron in England would have enabled them to have imported it to great advantage had it not been for the heavy duty placed upon it, for the first time, by the act of 1842. This duty is a serious obstacle to the extension of our railroads, and the commissioners would respectfully suggest to the legislature the propriety of endeavoring to have the tariff act so modified, as to allow its importation free of duty, as heretofore, particularly for roads which had been commenced while such permission was allowed."

Of the Southern railroad they say:

"This road was ironed and put in operation to Hillsdale, 68 miles from Monroe, early in October, since which time all the locomotive power on the road has been fully employed, and a large amount of produce remained on hand at the different points on the road which it was impossible to transport in time for shipment to the east, for a want of machinery and cars. The limited means the board then had control of, not enabling them to provide in season the necessary facilities for doing all the business that was offered. Two new locomotives have been placed upon the road and a sufficient number of cars will be prepared in season, to do all the business that offers during the coming year. The difficulties which have heretofore prevented this road from producing any revenue, have now been principally overcome. The facilities for shipment of produce at its eastern termination, have much increased, and by its extension west of Adrian, the competition with the Toledo road is obviated."

The following extract from the report of Mr. Berrien, the chief engineer, is interesting. Speaking of the "warrants" in which the contractors are paid, he says:

"For all purposes except the purchase of a few things considered as cash articles, they are used to much better advantage, and being the same as cash to those who use them for the purchase of public land, a great many are induced to seek employment upon the road for the purpose of applying the proceeds of their labor, and obtaining land, which probably they could not obtain in any other way. In addition to the above is the fact that but little money is used at present in payment for labor of any kind, also helping to increase the demand for work upon the railroad, and the effect of competition has been a very great reduction in prices.

"Were money to be used we should undoubtedly be able to make more rapid progress; yet, with the exception of the time required, it is matter of doubt whether the road could be carried on to much greater advantage with money than is now being done with warrants. At any rate, there is no doubt of the fact, that the greater part of the work, and grading especially, is done at present at much lower rates in warrants than were paid for similar work, a few years ago, in cash."

ON PLANK ROADS IN CANADA.

Lord Sydenham, during his long sojourn in Russia, travelled on several of them, and found them well adapted to the circumstances and the climate; and, as both were very similar to those in Canada, he was strongly of the opinion that their introduction there would greatly conduce to the public interest. A few miles of road in the neighborhood of Toronto was first laid with plank by the local commissions who had the management of it. The cost of stone and the great, expense they had been at in macadamizing a portion of the same road, as well as the heavy annual repairs, had induced them to try the experiment in that province of laying a planked surface on the road. A gentleman describing it, says: "The few miles nearest the city, and over which very considerable traffic existed, were planked; and, upon inspection, it was found the top surface of the timber was worn in the centre for the breadth of 7 feet, and to the depth of $\frac{5}{8}$ of an inch; the ends being to the full dimensions as the plank came from the saw. The bottom or under side of the planks, was found throughout perfectly sound. In two or three places, where a small cavity was left by the foot of a horse or other animal, there was found a slight pinkish tinge corresponding with the cavity, and indicating the commencement of fungus. The sleepers appeared perfectly sound." The facts elicited by examination of the portion of the road laid down but one season, were the same as the foregoing, except that but $\frac{3}{8}$ of abrasion had taken place. From the foregoing, it will be seen—

1st. That the wear and tear of the plank road, even near a populous town, is confined to the 7 feet in width of the centre.

2d. That, for the preservation of the planks from decay underneath, it is indispensable that every portion of it be solidly imbedded in the formation.

3d. That considerably more than half the wear and tear which occurs in seven years' use of the road, takes place the first year; which is easily accounted for, by the natural stripping off while the plank is fresh, of those fibres which were cross-cut by the saw; and from the fact of the dung of the cattle getting bound with the raised fibre of the wood and thus forming a tough elastic covering, which saves the plank in a great measure, from the effects of the horse's shoes, and the tire of the wheels. On this road the plank is 16 feet long, 3 inches thick, laid crossways at cross angles to the road, on 5 sleepers of pine 5×3 laid on edge, and in the line of the road; and this was considered the best mode of laying a plank road, except that on a country road plank 8 or 10 feet long will be found quite sufficient. On the Chambly road (plank) the planks are 12 feet long, but laid diagonally, so as to make the road but 8 feet wide. This was opposed by some, and very justly; for, as apprehended, the weight of half the vehicle and load coming suddenly on one end of the plank, and the other end not being kept down at the same time, the traffic constantly tends to disrupt the road, and the planks are loose, and spring from end to end. Another principle connected with the laying of this road, (which was opposed) is that of having the sleepers of much larger scantling than on the Toronto road. It was remarked that, as all earth formation under a road of this nature will more or less subside and shrink, the giving to the sleepers too much area would enable them to bear up the plank, leaving the earth to settle from them, thereby causing springing in the plank, which tends greatly to their being cut away; (in fact, they quickly become rounded from the edges;) and, also, that fungus and decay of the plank would be brought on, in consequence of the confined air below. These apprehensions are realized. At Quebec, part of the road has been planked, the plank being laid lengthwise of the road. It was considered that the planks would stand better the friction, and, when necessary, could be more easily taken up, and the road repaired. One strong objection to this mode of laying the plank is found to be, that the horses cannot keep their feet when much weighted, and are much exposed to falling, in consequence. Under all the circumstances, most have approved the manner in which the planks are laid on the Toronto road. Those now being planked under the department in the western section of the province are so laid, except that the planks are spiked with a 5½ inch spike—one in each end. With respect to plank roads generally, I wish none to suppose that I am an advocate for their adoption, except in those sections of the country where nature has afforded no better material, and where funds can be obtained for a better structure. There are stretches of 30 and 40 miles, in parts of the west, where the soil is a deep rich vegetable mould, and without stone or gravel of any description; in such cases you must be content to wade through the mud, or adopt the plank roads. When the traffic or intercourse of a section of country requires that good roads should be afforded for it, the adoption of plank or stone roads should be governed simply by a comparison of the first cost of each, in conjunction with the probable annual expense of repairs; and if this comparison is based on the plank lasting 12 years, (or some say 10 years,) a safe conclusion will be arrived at. In some cases in Canada, the adoption of plank instead of stone would have made such a saving as would have replanked the road every five years, if necessary. There are many sections in the west, where timber abounds, especially in Ohio, Indiana and Kentucky, where such roads might be introduced with great advantage.

GEORGIA RAILROAD.

In our last we gave extracts from the report of Mr. Thompson containing numerous details of interest to the profession, but to render the account of this specimen of civil (not political or State) engineering complete, we copy the following tables of receipts and expenditures for upwards of 6 years.

STATEMENT of the YEARLY EXPENSES incurred for WORKING the GEORGIA RAILROAD, from April 1, 1839, to April 1, 1844.

	Year ending April 1, 1840.		Year ending April 1, 1841.		Year ending April 1, 1842.		Year ending April 1, 1843.		Year ending April 1, 1844.	
	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.
CONDUCTING TRANSPORTATION.										
Stationery and printing,	589 55		475 04		777 59		586 69		1,194 01	
Loss and damage,	1,666 93		738 67		1,909 18		382 34		2,248 48	
Incidentals,	1,101 31		883 45		1,624 68		1,866 08		1,755 26	
Oil and tallow for cars,	288 61		182 78		402 72		410 97		342 63	
Provision, clothing, etc., for negroes,	4,041 57		2,593 98		2,849 42		2,862 07		2,726 00	
Expenses of Warrenton branch,	360 25		799 43		1,062 62		591 10		772 42	
Expenses of horse car—Athens branch,					583 34		2,336 33		1,352 49	
Wages laborers,	4,522 59		2,355 11		2,022 24		3,958 23		4,111 31	
Agents and clerks,	7,467 89		7,356 39		8,742 88		9,329 42		9,289 19	
Conductors,	3,927 81		2,484 75		2,024 83		2,663 79		2,796 79	
Work done by car factory,					220 50		152 50		223 00	
Work done by machine shop.					480 00		31 50		91 00	
MOTIVE POWER.		23,966 51		17,896 60		22,699 97		25,170 02		26,902 61
Stationery and printing,	59 17		16 25		13 08					
Expenses of water stations,	3,009 40		2,480 98		2,518 11		2,061 12		1,963 14	
Incidentals,	70 82		27 95		329 49		184 62		255 19	
Fuel,	6,839 24		5,402 87		7,186 61		6,405 12		2,652 17	
Oil and tallow for engines,	3,108 84		1,177 54		1,538 73		1,411 34		1,459 46	
Ordinary and extraordinary repairs to engines,	6,403 38		6,792 19		9,610 28		7,866 90		5,658 40	
Improvements to engines,							2,288 00		1,632 50	
Engine drivers and firemen,	7,523 73		4,715 13		7,079 33		7,151 14		6,442 43	
Provisions, clothing, etc., for negroes.	1,303 59		[illegible] 97		1,735 42		2,852 10		2,775 00	
MAINTENANCE OF WAY.		28,518 17		22,652 89		[illegible] 05		30,220 34		25,838 29
Men's wages,	12,514 12		[illegible],103 [illegible]		1[illegible],549 58		18,322 73		14,862 76	
Supervisors,	1,999 94		1,[illegible] 36		[illegible],733 29		2,724 23		1,694 77	
Provisions, clothing, etc., for negroes,	2,174 69		[illegible] 35		2,703 06		1,764 62		2,938 23	
Incidentals,	229 26		[illegible] 49		524 99		809 49		1,127 66	
Tools,	414 07		[illegible]		826 99		399 78		715 84	
Iron and spikes,					550 47		1,969 66		1,949 43	
Wooden rails and cross ties,	1,401 17		5,446 38		11,382 80		16,046 74		14,353 07	
Repairs of culverts,							376 88			
Work done by car factory,			436 20		511 16		795 70		184 95	
Work done by machine shop,					910 17		1,474 51		366 26	
		18,733 25		21,836 61		38,602 51		41,684 34		38,156 97

MAINTENANCE OF CARS.

Ordinary repairs,	4,936 30		4,735 20		3,660 00		2,144 37		6,015 45	
New baggage car,							1,050 00		1,050 00	
Renewal of wheels,					1,167 50		3,098 63		864 00	
Renewal of axles,							351 37		151 00	
New platform car,							2,500 00		1,565 00	
Extraordinary repairs.	480 00		189 15		1,287 00		600 00			
		5,416 30		4,924 35		6,114 50		9,744 37		9,675 45
		76,634 23		67,283 44		97,518 03		109,819 07		100,573 32

STATEMENT of the YEARLY RECEIPTS, EXPENSES and NET PROFITS of the GEORGIA RAILROAD COMPANY, from the opening of the road to the 1st of April, 1844, exclusive of charges made for transporting materials used in building the road.

DATES.	Miles road in use.	PASSENGERS.		FREIGHT.				Mail, rents and storage, etc.	Total receipts.	Total expenses.	Net profits.
				Up.	Down.		Up and down.				
		Numb.	Amount.	Amount.	Amount.	Bales cotton.	Amount.	Amount.	Amount.	Amount.	Amount.
From Nov. 1, 1837, to May 1, 1838	40	12,986	23,164 00	4,390 00	8,199 00	8,267	12,589 00		35,753 00	19,367 00	16,386 00
" May 1, 1838, to May 1, 1839	75	28,091	66,140 00	27,543 00	33,429 00	25,613	60,982 00	7,807 00	134,929 00	63,362 00	71,567 00
" May 1, 1839, to April 1, 1840	88	22,632	63,506 00	35,245 00	66,174 00	47,235	101,419 00	19,679 00	184,603 00	70,246 00	114,357 00
" April 1, 1840, to April 1, 1841	105	22,910	66,262 00	37,463 00	28,963 00	20,878	66,426 00	25,537 00	158,225 00	67,283 00	90,942 00
" April 1, 1841, to April 1, 1842	147 1-2	22,784	71,460 00	59,610 00	59,358 00	40,611	118,968 00	33,827 00	224,255 00	97,518 00	126,737 00
" April 1, 1842, to April 1, 1843	147 1-2	19,075	61,935 00	69,591 00	84,574 00	63,276	154,165 00	31,926 00	248,026 00	109,819 00	138,207 00
" April 1, 1843, to April 1, 1844	147 1-2	19,003	65,667 00	69,661 00	78,400 00	70,754	148,061 00	34,367 00	248,096 00	100,573 00	147,523 00
		147,481	418,183 00	303,503 00	359,107 00	276,634	662,610 00	153,143 00	1,233,887 00	528,168 00	705,719 00

SUSPENSION AQUEDUCT.

We are glad to learn that an aqueduct suspended by wire cables is to be erected at Pittsburgh by Mr. John A. Roebling, C. E., a name familiar to the readers of the *Journal*. The span is 160 feet, the deflection 17 feet and the total weight of trunk, cables and water, 353 tons of 2000 lbs. The strain at the points of suspension is estimated at 451 21 tons, the area of each chain is to be 27 sq. in. and the wire of which they are formed is calculated to bear a maximum load of 90,000 lbs. per sq. in.; but the greatest strain to which the cables will be actually subjected will not exceed 18,000 lbs., or $\frac{1}{5}$ of the maximum load.

The trunk will be of wood, 13·5 ft. at bottom, 15 ft. at water-line, sides 8 ft. high, all of 3 in. plank, in two courses laid diagonally, and well spiked together. The stiffness of the trunk will be sufficient to prevent vibration, even in the most violent storms and will be sufficient to support itself when empty.

A wooden aqueduct is estimated at $50,000, and Mr. R. says in a communication published in a Pittsburg paper.

"I have estimated, and I am willing, to undertake a thorough repair of the piers and abutments for $7,000
"Adding to this the expense of the new structure, of 56,000
"And we have a sum of, 62,000
as the total expense of a suspension aqueduct, including everything."

He also very justly observes,

'There is another and a strong argument in favor of the suspension plan, which is entitled to attention. The true interest of the city, as has been observed before demands a permanent work. But the principal parts of a suspension auqeduct will be formed of iron and stone, which will last for centuries. And the wooden parts, the trunk and the beams can at any time be substituted by iron ones, so as to render the whole structure imperishable, and insure the services of the aqueduct for the future. The difference of weight by the substitution of iron for the beams and trunk in place of wood, would be in favor of iron.'

The idea of carrying the Croton water across the Harlem river suggested itself to numerous persons, and we are by no means certain that it would not have been quite as safe as the present structure, at one-fourth the cost. Mr. Roebling quotes the opinions of some eminent French engineers in favor of the application of the principle of suspension to aqueducts, and appears to have thoroughly investigated everything likely to have any bearing on the success of this new and—as we think—great improvement on the ordinary wooden aqueducts of this country.

NORTHERN RAILROADS.

The railway is creeping up to the Canada lines, and we understand that a survey of a route or routes thence to Montreal is going on at this time. The line from New Haven up the Connecticut river and that from Boston across the country will ere long meet, and the question then is, shall we cross Vermont to Burlington on lake Champlain, or continue the route north by lake Memphremagog to Montreal. The distance will of course be less to Burlington, and, as this line will traverse the best part of Vermont, its receipts will be much greater than the direct line to Montreal which runs for many miles through a wilderness. The travel from Montreal to Boston will be well accommodated by either route and as the line to Burlington will receive the trade of Vermont, of lake Champlain and of the iron region of New York *in addition*, it appears to us that, in the vital consideration of income, it has very decidedly the advantage over its northern rival. Both routes have been examined, though not instrumentally. The survey now going on will give all the requisite information as to the ground on the direct line to Montreal, and though we have no hope of ever seeing a railway there we still believe that the survey now making may not be without benefit. For, if skilfully conducted, it will show whether a railway can succeed there, and, if that be impracticable, what other communication can be recommended.

But the present break in the line from Montreal to Boston and New York —we mean the distance from Saratoga to Whitehall—which has been a cause of complaint to the travelling community for the last ten years and which is likely to remain so for some years longer, prevents us from indulging in any anticipations of a good route to the north. This link is alone required to complete the communication by steam from the St. Lawrence to the Hudson, that is, from Quebec almost to Charleston, yet it is scarcely spoken of.

ENGLISH RAILWAY BILL.

Our readers will perhaps recollect that some of the arguments used against the *probable* effect of the "Railway Bill," are precisely those used by some of our contributors as well as ourselves against the *actual* effect of our New York system of "State works," in crippling private enterprize and degrading the profession. The following is from Herapath's Railway Magazine, Feb. 6, 1844.

"Shortly and quietly thus stands the case between the two parties. The government sees in the large and growing capitals of the railways and the endless offices that arise out of them, a new and vast source, from which it could derive fresh, and an almost unlimited extension of patronage, and of course of power. Garnish it how parties please, this is the simple and naked fact. No man can deny it, no one can give any other reason for the present bill. What is the case with the other or companies' side. Briefly this; they have laid out a great deal of money, have had a great deal to contend with, have hitherto received but little return, and of course now when railways are beginning to show symptoms of repaying them for their trouble, loss and anxiety, they are very anxious to enjoy the fruits of their enterprize, and the management of their property. If left undisturbed, they find they can do both with advantage to themselves and the public. They say, and very truly, "if it had not been for us, these lines would not have been made, and why, therefore, when we have risked and done so much, are we to be dispossessed of them?" That the government would not have made them is certain, for when the companies were in difficulties, and many of them in danger of being obliged to abandon their works, it would not help them with the smallest donation or even loan. Is it just then, that it should enjoy that which it neither created or assisted? That it should wrench from enterprizing individuals, the work of their hands, the moment it bids fair to repay them for their labor and risk? Where do we find a parallel to this? Men have hitherto been allowed to reap that which they have sown, and the success of their labors has always been considered exclusively and sacredly their own. Government has never interfered with mercantile speculations, but has been satisfied with that, which it must have one way or the other, from direct or indirect taxation of successful enterprize. Private enterprize has justly been regarded as the body and soul of the prosperity of the country, and for that reason has always been encouraged, and its results respected. The present is the first instance within the compass of our knowledge, of the executive thinking to intermeddle with it. A new light has, however, now broken in upon the ministry. It is considered advisable, that her majesty should become coach-mistress-general and carrier-in-chief of the country. All the engine drivers and stokers and guards and ticket takers and clerks and porters, are to hold their appointments direct from the royal hand, and the minister of the day to have the patronage of the appointments. To accomplish so desirable an object, good old customs are to be broken through, private rights are to be trampled on and the sanctity of property violated.

"The advocates of this measure may contend that the sole object is to interfere with the future lines only. We admit that is the professed and ostensible object, but like their profession of non-interference it is all a hollow sound. The real object is the possession of all the railways, and the present are to be reached through the future. No man doubts this now, it is too clear and transparent. We have long seen and long taught it, but were not believed. Our hints and warnings were looked upon as idle croakings and therefore disregarded, but now there is but one view, one sentiment, one opinion among all men. They all see and all acknowledge that the government object is to seize the railways, not for the sake of doing good, but for the sake of the patronage, and to have the key and control of all our movements. How far this is desirable, and the use that may be made of it, may be judged of from the late creditable transactions in the post office.

"Here is one point of view in which we wish the public to consider the consequences of the State getting possession of the railways. The public has lately seen how much the sanctity of the seal is respected and if the railways get into the hands of the government, it may soon find that the boasted liberty of locomotion will be just about as much valued. It is impossible to enumerate the uses to which the possession of the railways in the hands of a jealous or arbitrary government may be turned. In times of election they would be powerful instruments in obstructing this return or forwarding that, and consequently in controlling the elections and filling the house of commons with just such members as may be wanted. We recommend the public well to look to this side of the subject before it urges on an event it may have so much occasion hereafter to repent.

"Again, with regard to the fares, the public is tickled with the notion that if the government had the railways, travelling would be much cheaper. A greater mistake never was made. It is true all the government might care about would be the covering of the expenses, and the return of the low rate of interest at which, on the State security, the money may be raised. But then the government management of everything it takes in hand is so notoriously costly, that there would be at least double the persons to do the work of the present. Men who get into government situations do not expect to work, but simply to receive their salary. What said a well paid government official to a friend of ours sometime since, who was complementing him on the goodness of his post? "There is more trouble in it, sir, than you are aware of. Besides paying a deputy I am obliged to sign my name four times a year to receipts for my salary." Thus it is with government officials, and thus it is the expenses of everything it takes in hand are increased. It is not too much to say, that if the present railways were in the hands of the government, that the expenses of working them would be doubled or tripled. The saving, therefore, in interest would be much more than swallowed up in the expenses, and the executive, supposing it had the most cordial desire to benefit the public by cheaper travelling would be unable to do it, or if it did the chance is that the public would have to make up deficiencies by other taxes. If ministers are wise they will have nothing to do with commercial matters, and if they are inclined to, the public will act wisely to check and prevent them.

"We have an example of the expense of State management in the Belgian railways. There, though the management is under the most economical arrangement, the expenses much exceed ours, which are yet far from reduced to their minimum. What, then, would the working expenses be under our notoriously costly executive? We repeat, if the State take railways into its keeping, the public will have cause to repent it, not only as furnishing the government with a new and dangerous instrument of control but as putting into its hands matters which it would be unable to manage economically, and which would therefore, in all probability, entail upon the country a loss in proportion to its magnitude.

"But the principle of the bill is not more unjust, than are its clauses monstrous and unheard of. If, after 15 years from passing the act of any railway, its profits should exceed 10 per cent., the board of trade may lower the tolls. And if it finds it has gone too far, and reduced the profits below 10 per cent., it may elect between raising them and paying the deficiency below 10 per cent. out of the public purse. To the latter part the railways could not object; it is for the public to consider how far it is palateable to itself to pay for the board of trade errors. But here also comes in another most iniquitous clause, namely, that the board of trade is to have the sole power of deciding whether the management of the railway is economical, and to make deductions accordingly from the expenses. So that the board of trade is first to curtail the profits, and then to be sole judges of the economy of management!"

A deputation consisting of the representatives of 29 railway companies, the united capitals of which exceed £50,000,000 presented the following:

"*Statement of a few prominent reasons against the measure.*"

"This bill is objected to,—

"1. Because its provisions are not called for by any complaint on the part of the public, expressed by petition or otherwise, with reference to the matters to which it relates.

"2. Because it is introduced at so late a period of the session, and so closely following the voluminous reports and evidence on which it is alleged to be founded, as to render it quite impossible that its provisions should have sufficient considerations either by the legislature or by the parties affected by it.

"3. Because the bill (taken in connection with the reports and the resolutions therein proposed to be adopted as standing orders) is obviously intended to vest in a department of the government a power of interference with, and undue control over, all existing as well as future railways, by enabling them to foster and encourage competition in all cases where existing companies will not submit to any terms and conditions, however stringent or ruinous, which may be sought to be imposed on them; and by enabling them also, if they think fit, to become themselves the proprietors of all new and competing lines of railway.

"4. Because such a proposal is at variance with the principles which have hitherto governed the legislature of the country in its conduct, not only towards railways but towards all similar undertakings, and would have the effect of shaking the public confidence and security for the future in all such undertakings, and in all privileges granted by the legislature.

"5. Because the exclusive application of such a bill to railways only is obviously most unjust.

"6. Because an unheard-of power would be vested by the bill in the government, giving rise to a system of private solicitation and influence, and possibly to the exercise of undue partiality, in matters which have hitherto come openly and exclusively under the cognisance of the legislature.

"7. Because there is no experience in this country to justify so great a change in the system of legislation with reference to railways, as that proposed and the experience afforded by foreign countries only demonstrates the superiority of the system which has hitherto prevailed in England, where public works, promoted by private enterprize and unfettered by government interference, have flourished to an extent unknown elsewhere.

"8. Because there is no pretence for such government interference arising out of misconduct by railway companies, or undue profits realized by them; but, on the contrary, it is admitted on all hands, that the undertakings under their charge have been admirably managed, at liberal rates to the public, and, on the aggregate, with insufficiently remunerative profit to themselves.

"9. Because, if such undertakings were vested in the hands of the government, and should prove unsuccessful, the loss which is now borne by private companies, would have to be made up by general taxation; and it is most unfair that the government, as proposed by the bill, should have an option of purchasing only those undertakings which are profitable, and rejecting those which are unprofitable.

"10. Because the power to reduce the charges of companies paying a dividend of 10 per cent. under the guarantee of maintaining that dividend, would leave the company to whom such guarantee should be granted, without further inducement to meet the public convenience, and thus, while the guarantee in case of deficient revenue would have to be made good by the public, they would be worse served than at present.

"11. Because the provisions of the bill which give immediate power to the board of trade to regulate third class trains, are inconsistent with the existing rights of railway companies, and the provisions which declare that their stations shall be open to all public conveyances, are calculated to benefit only a small section of the community, viz., the hackney cab and omnibus proprietors, to the manifest inconvenience and annoyance of all the rest of the community, and would tend to the utmost confusion, extortion and general inconvenience.

"12. Because the attempt by the government to tamper and meddle with undertakings in which property has been embarked, on the security of privileges granted by the legislature, tends to weaken the faith and security of the capitalist in those undertakings, and to induce him to embark his property in foreign speculations, to the infinite detriment of this country: and if the present attempt should prove successful, it would afford a precedent for others, directed not only against railways but against all similar undertakings."

WELLAND CANAL.

It appears that two-fifths of all the wheat coming this year from the west pass through the Welland canal, but only one-fourth of this quantity goes to Canada. Wheat for Oswego and Ogdensburg finds a shorter route by the Welland than by the Erie, besides avoiding transhipment. Our correspondent on the "Canals of Canada" has uniformly considered this as a work of more importance to New York than to Canada and the trade this year will bear out that view. Some years since, in an article on the "Spring Trade," he went so far as to place the Welland canal at the head of all routes for early freight to the west, by way of Albany, *if* the New York railways could only carry freight; and, as they now have this privilege, though to a very limited extent and with exceedingly heavy pecuniary impositions, we shall soon see whether the merchants of Boston and New York will avail themselves of the new route for early freight, via Oswego and the Welland canal, the western terminus of which is to the westward of Dunkirk, besides being on the windward side of the lake, thus offering in *late* seasons an earlier route by canal than can be furnished by any railway in the State of New York. Such at least are the views of the correspondent alluded to.

The Welland canal will however become doubly important to New York, should a drawback be allowed by our government. Then will Upper Canada receive nearly all her supplies via New York and Oswego, and the people on the borders of lake Huron will receive their spring goods some weeks before the arrival of the first ship at Montreal. Indeed that city itself may be reached via Oswego and the St. Lawrence about two weeks before that period: and, it is very certain, that the entire Upper province will be tributary to New York as soon as a little common sense can be infused into congress. Fearful odds, it will be said, but we are not without hope. Now our correspondent who is well acquainted with the trade of the Erie canal and of the St. Lawrence says that *all* the *down* freight must go by the river to Montreal and if all or nearly all the *up* freight should go by way of Oswego, what are the canals on the St Lawrence to do?

Had our Canadian neighbors built the Great Western railway from Hamilton to Detroit they would have had a work which would have yielded a surplus the first year, and which would have made us tributary to them; but there is no accounting for tastes. The following extract does not state the tolls received in 1842 and 1843. We believe they have little if at all exceeded $100,000, the interest on two millions or half the estimated cost of the canal. It was not till the year 1839 that the Erie canal had paid expenses and interest, that is thirteen years after its opening. On the other hand the four railways from Schenectady to Rochester paid from the beginning, though not allowed to compete with the canal in the transportation of freight.

"*The Welland Canal and its Business.*—The Buffalo Commercial of Saturday gives this description of the Welland canal and of its business in the transportation of American produce.

"The work is 38 miles long 10 feet deep, and has a large number, some forty locks to overcome a rise of 360 feet existing between Port Dalhousie on lake Ontario, and Port Colborn, on lake Erie.

"The total business of the Welland canal for 1840 and 1841, was

		1840.	1841.
Flour,	Bbls.	186,864	193,137
Beef and pork,	"	14,889	24,195
Wheat,	bush.	1,720,660	1,212,400
Corn,	"	27,088	90,160
Staves,		1,623,000	2,725,000

"Among the items going towards the west, were—

Salt,	bbls.	153,030	149,337
Merchandize,	tons	2,770	3,718
Tolls received,		£18,037	£18,583

"The quantity of a few leading articles exported from the port of Cleveland alone, throguh that channel, was—

		1842.	1843.
Wheat,	bush.	380,684	90,689
Corn,	"	59,670	78,481
Flour,	bbls.	94,248	49,360
Pork and beef,	"	40,098	5,000
Total value of all exports,		$1,017,000	$357,400

"This season the shipments from Cleveland have been very heavy, and will doubtless exceed those of 1842.

"A partial and satisfactory view so far as it goes, may be had of the extent of the shipment by the Welland canal this season, obtained from the St. Catharines, W. C., Journal:

"The amount of wheat entering this season at Port Colburn up to the 22d July was 865,024 bushels, of which 657,429 bushels were for Oswego and Ogdensburgh, and the remainder as follows—

	St. Catharines.	Kingston.	Grananoque.	Total.
Wheat bushels,	09,329	57,507	50,799	207,655

the duty on which at 9 cts. a bushel, amounts to £4,672, which, added to the sum collected on flour, pork, and other products, cannot fail to give an increase of revenue far beyond any former period. This exhibit must be of considerable interest to the trade, and we shall look with much anxiety for further movements."

Since the above was in type, we have seen in the papers an article from the St. Catharine's Journal in which the editor says:—

"*Welland Canal.*—In our last number we gave a brief statement of the unprecedented and rapid increase of the trade of lake Erie, and the small proportion of it as yet secured for Canada, by the St. Lawrence. But we have no doubt that the efforts now making—by the improvement of our water communications—to divert this commerce into its natural channel, will, ere long, be crowned with success."

Did not our modesty interfere we would recommend our Canadian neighbors to take the Railroad Journal, when they would no longer talk such nonsense. The "natural channel" is that which takes the wheat where it is wanted and the wheat passing via the Erie canal is for consumption in this country. There are of course a few hundred thousand barrels shipped to South America, England and the West Indies, but not enough sensibly to affect the income of the Erie canal. Now how is the million of barrels shipped to Boston to reach that port via the St. Lawrence? It has already been explained over and over again, that the trade via the St. Lawrence is in *addition* to that of the Erie canal, and the insignificant amount of produce taking the former route shows the smallness of the demand in Montreal and is in no degree influenced by the cost of transportation from lake Ontario to Montreal—30 to 35 cts. per barrel—an amount insufficient to affect the demand to any extent. Were flour carried now for 15 cts. per barrel from Kingston to Montreal it would not add one hundred thousand barrels to the trade of the St. Lawrence. But twelve years unremitting attention to these matters has taught us the almost impossibility of projecting works to be executed at the expense of the public with any degree of intelligence and skill, or conducting them with the economy, order and method so necessary to insure success. *As long as the money holds out* the political adventurers will cry out for more and backed by their political engineers *will succeed* as they have in New York, in saddling the people with an enormous debt and a lot of preposterous works, such as the Chenango, Black river, Genesse valley canals and the enlargement of the Erie, on which 20 millions have been spent and which will require 20 millions more to complete them, the interest to be paid by taxation.

BEAUHARNOIS CANAL.

Some astounding developements have taken place with reference to this portion of the St. Lawrence canal. Those of our readers who see the "Civil Engineer," the organ of the profession in England, may recollect an article from the pen of Mr. Casey, on the "Canadian Board of Works," (Feb. 1843,) in which he places their integrity on a par with their capacity. We now see it openly announced in London that a notorious personage of the name of *Wakefield*, who figured some 16 years since in a most infamous abduction case, was paid $60,000 for securing the construction of the canal on the south bank of the St. Lawrence, through the property of a company at one of whose meetings the above statement was made by the directors! Log-rolling is nothing to this. We console onrselves to some small extent with the idea that the profession is not responsible for this barefaced bribery. That is, we hope that the Engineer, Mr. Hamilton H. Killaly, through whom this was effected, will turn out to be no engineer at all. Indeed we do not see how it is possible that he should be, when neither the Editor nor the readers of the "Civil Engineer" have answered Mr. Casey's inquiry of September last as to the standing of Mr. K. in his own country. Within a few days we have seen one of his most important papers and such a document never emanated from any *other* engineer—if he be one—as all will admit who see this extraordinary production. Taken in connection with the $60,000, the "modus operandi" of placing the canal on the south or Beauharnois side is traced with a pencil of light.

But we will always show fair play, and if any of our readers can refer us to any canal or railway in England or Ireland, however small, constructed under the direction of Mr. H. H. Killaly, we will cheerfully insert an account of it in our columns and thus answer in part Mr. Casey's advertisement of Mr. K. (for such it is) in the "Civil Engineer," the readers of which Journal are obviously at fault, though they of course comprise the entire profession in England and Ireland, and though Mr. Killaly speaks of his "long professional career." They certainly *ought* to be known to each other. We may perhaps introduce Mr. K. to the profession in the United States in another number by means of some extracts which, our readers will be forced to admit are somewhat different from anything they have ever seen.

PRINCE DE JOINVILLE'S PAMPHLET.

The Prince's pamphlet on the importance of a steam navy to France is published at length (translated) in the Civil Engineer's Journal for July. The editor very truly says that the Prince is a person of much common sense when he pleases and—when not speaking for "Buncombe" which is pretty nearly the American for "young France"—the tone, style and manner of investigation are those of a truly practical man, well versed in his profession and who has given much attention to the higher departments of the service. It is of interest to us as showing the important part which the civil engineer is to play in another war, and, still more so from the great stress which the Prince lays on the importance, indeed the necessity of encouraging private enterprize and not trusting to government establishments the difficult and complicated machinery of men-of-war steamers. We make a few extracts.

"One fact of immense import, which has been accomplished of late years, has given us the means of raising our fallen naval power, and of making it re-appear under a new form, admirably adapted to our resources and national genius.

"This fact is the institution and progress of steam navigation.

"Our navy could only be an artificial creation when the empire of the sea belonged to the one who put afloat the most seamen. Our ruined mercantile navy no longer furnished us seamen enough; we should have vainly struggled to avenge affronts, to efface melancholy remembrances; but when even temporary success had attested the courage of our seamen, numbers would in the end have stifled our exertions. The steam navy has changed the face of everything; now it is our military resources which are about to take the place of our impoverished naval personnel. We shall always have enough officers and seamen to perform the part still open to a seaman on board a steamer. Machinery will supply the place of hundreds of arms, and I need not say that we shall never want money to construct engines, still less that we shall never want soldiers when the honor of the country is to be maintained.

"With a steam navy, the most audacious war of aggression is permitted by sea. We are sure of our movements, unshackled in our actions. Time, weather, tide, no longer disturb us. We can calculate to the day and hour."

"In all, England now reckons one hundred and twenty-five steamers.

Of this number, seventy-seven are armed, and to these must be added two hundred steamboats of superior quality, fit for carrying heavy guns and troops, which the merchant navy could furnish to the State on the very day they were wanted.

That is not all: to form an idea of the real force of this steam fleet, we must have seen close at hand how formidable its equipment is, we must have seen the care and skilful foresight with which everything has been designed. The English war-steamers have not been designed warranted good for every kind of service without distinction, in their construction only one idea, one end has been in view—war. They conjoin with a marvelous fitness for sea purposes, high speed, powerful artillery and plenty of stowage for passenger troops."

"What they particularly wanted was to be employed on stations where they could be put in comparison with foreign vessels. This inconvenience together with the prejudices exclusively prevailing in favor of the sailing navy, was the reason why the progress of our steam fleet from 1830 to 1840 was so nil. Science however had progressed. The royal navy of England having leisure for experiments, and further, having under its eyes a merchant steam navy in which number and competition produced daily progress, turned out some magnificent vessels."

"By an excess of foresight too common with us, the administration has thought fit first of all to create repairing establishments for the new navy. In all our ports now rise magnificent factories enclosed in stately monuments. These factories are for the purpose of repairing the damage, and providing for the wants of the steam navy, and this navy is only in its infancy.

"However as these large factories cannot be left without employment nor the workmen without work; as besides in the nature of things, all the steamers we have are employed at Toulon, and that there are only steamers to repairs at that place, what has been done with the factories constructed in the ports of the ocean? They have been employed in manufacturing engines, instead of giving the contracts for them, as a premium to private industry.

"We had already Indret and its costly productions. Was it necessary to add to this luxury of establishments? Was it requisite to employ the money destined for the increase and improvement of the fleet, in raising monuments of which the immediate utility is far from being demonstrated?

"We have always been inclined to increase without limit the immovables of the navy, to the detriment of everything efficacious and active in the department. It would be good to try the other plan, and I am convinced that we should readily find the means of arming a true steam fleet and encouraging a useful trade, by requiring from private establishments, fine and good machines, such as they know how to produce.

"If I were here to trace the true state of our steam navy, if I were to say that of this number of forty-three steamers afloat borne on the budget, there are not six fit to compare with the English vessels, I should not be believed, and I should still have asserted the strict truth. The greater number of our vessels belong to that class good in 1830, when they were turned out, but now, most certainly much behind present improvement. These vessels subjected in the Mediterranean to a navigation without repose, have almost all reached a premature old age. As I pointed out just now they are no longer sufficient for the service of Algiers and the political missions on which they are sent, for want of better vessels. The officers who command them blush at seeing themselves weak and powerless, I will not say alongside the English only, but the Russians, the Americans, the Dutch, the Neapolitans, who have better steamers than ours."

"Perhaps the use of the screw, by leaving the steamer all the power of a sailing vessel, will some day produce a change in the state of things. Steam will then become a powerful auxiliary to our cruisers, but this alliance of sail and steam would change nothing as to what I have before laid down. The steamer destined to serve in squadron or on our coasts, should always have a high speed, by steam alone, as the first means of success."

Omitting the appeals to the worst passions of the French, their "love of glory" as they call it, but their insatiable desire for plunder as it is only too well known to be by most nations and certainly by the American commercial marine, omitting this which the Prince has probably introduced as a matter of necessity rather than of taste, we think his views compare very favorably—indeed they completely overturn the position of the spirited but unfortunate Captain Stockton, who had the egregious vanity to imagine and even to announce, just before the terrible disaster at Washington, that the discoveries and improvements introduced in the Princeton would change the entire system of naval warfare and would put the weakest nation on the ocean on a level with the most powerful! The Prince shows, though he does not admit it, that steam has actually increased the relative power of England, and it is easy for us to gather from his statements that, in six months, the United States would be more than a match for France, as regards *steamers*, owing to the skill and immense capabilities of our private engineering establishments.

HERAPATH'S RAILWAY MAGAZINE.

We are indebted to some kind and attentive friend—for such we must consider him—for copies of this spirited periodical, immediately on the arrival of the steamer. We have in this number an article on "Railway Legislation" and can give no stronger proof of the accuracy of the editor's views than, that all and more than all the evils he anticipates from the interference of the government *there*, are matters of fact *here* where the States have taken works into their own hands. In our next we may recur to this subject, to which we devoted much attention some time since. Indeed a long article was copied from the *Journal* into the III volume of the "Civil Engineer," in which the unhappy effects of government engineering were pointed out and where the editor of Herapath's Railway Magazine will find some of his worst suspicions borne out by our experience. There is little probability that any new works will be undertaken by the States, and at this moment Canada stands alone as the advocate of the "system" which, in the case of the Beauharnois canal, they have certainly carried out with great additions if not improvements. On the other hand, private enterprize here is recovering from the effects of its long struggle with the State governments and railways are rapidly extending themselves in all directions. Indeed all we ask is to be "let alone," and the country will soon have railways and canals of the first order wherever they are required, and that too without either the taxation of New York and Canada or the repudiation of Pennsylvania and Michigan.

OPENING OF THE LONG ISLAND RAILROAD TO GREENPORT.

On Saturday, Aug. 3d, the officers and directors of this company with a very large number of invited guests, among whom were the corporations of New York and Brooklyn, most of the notabilities of Long Island, Jas. De Peyster Ogden, prsident of the chamber of commerce, the officers and directors of the New Jersey railroads, and very many other citizens, amounting probably altogether to some five hundred persons, made an excursion to Greenport and back to this city.

The party left Brooklyn at 8 o'clock in three trains of cars; the leading train making only two stops, arrived at Greenport in 3 hours and 35 minutes; 6 minutes were occupied in taking on wood and water, thus reducing the the time occupied in running over the distance of 95 miles to 3 hours and 29 minutes. The engineer expressed an opinion that with the new locomotive now building by the company he will be able to run over the road in less than 3 hours.

Time occupied in running from Brooklyn to Jamaica 23 minutes, distance 11 miler.

	Hours.	Minutes.	Miles dis.
Hicksville,		56	26
Farmingdale,	1	6	31
Stopped for wood and water,		3	
To Deer Park,	1	21	37
Thompson station,	1	31	43
Suffolk station,	1	35	46
Medford station,	2	1	55
Carman's river,	2	13	61
St George's Manor,	2	27	66
Stopped for wood and water,		3	
Riverhead,	2	48	74
Greenport,	3	35	95

We should be pleased to give an account of the grades, curves, stations, engines, cars and cost of the road, such as is given of the Central road in this number. The trains now run daily to Greenport and the distance to Boston by this route is accomplished in about 10 hours. The company are constructing a tunnel in Brooklyn in order to dispense with the use of horses. They go now thirty miles an hour with sixteen ton engines. A pretty severe trial to any track and a speed they will find it difficult to keep up.

The number of passengers taking this route is very great and we only hope our anxiety for its success has made us overrate the difficulties to be overcome in order to maintain an average speed of 30 miles per hour.

RAILWAY SPEED.

In our last week's impression, we gave a circumstantial account of the opening of tha Darlington and Newcastle railway, which completes the line of communication between the latter town and London. The special train which conveyed a party of directors and friends from London to Newcastle on that occasion, accomplished the journey, 303 miles, in the short space of nine hours and thirty-two minutes, being an average of about thirty-two miles an hour, including stoppages; but as this naked statement would supply a very inadequate idea of the actual rates of progress on some parts of the line, we now give a tabular view of the performance. The train left the Euston square station at 3 minutes past 5 in the morning and reached Newcastle at 35 minutes past 2 in the afternoon. The following are the distances on the respective portions of the line, the time consumed in passing over each, and the rate per hour run:—

	Miles.	Hours.	Minutes.	Rate pr. hr.
London to Rugby (Birmingham line,)	83	2	11	38 miles.
Derby, (Midland Counties,)	49	1	22	36 "
Northampton, (North Midland,)	63	1	28	4[illegible] "
York, (York and North Midland,)	24	0	37	29 "
Darlington, (Great North of England,)	45	1	13	37 "
Newcastle,	39	1	20	20 "
	303	8	11	

Average 37 miles an hour.

The remaining time, 1 hour and 21 minutes, was consumed in stoppages. Of course, it would not have been prudent to run over the newly opened portions of the line at much more than the ordinary speed; but the rate of progress upon the older portions, considering the distance, is really astonishing, that on the North Midland especially; and we believe the performance altogether is quite unprecedented.—*Leeds* (*Eng.*) *Mercury.*

BEAUHARNOIS CANAL, AGAIN.

Little did we think when penning our brief article on this canal that we should so soon find such remarks as the following in a Canadian paper.

"It was our intention to have occupied our leisure during these dull times with an exposure of that most horrible and scandalous of all jobs, the Beauharnois canal, having acquired information to an extent never dreamt of by the guilty parties concerned in the nefarious business, but the truth is, we *dare not.* The *various participators* in the lare bribe of £12,500, occupy *too high a station in office and society to be safely exposed,* even when a journalist is doing a public duty and has truth on his side. Nothing but a committee of the Legislative assembly can bring this iniquity to light."—*British Whig, Kingston, Aug.* 9, 1844.

NORWICH AND WORCESTER RAILROAD.

For July, the increase of income on this route has been $9326, or about 75 per cent. over July 1843; and in the first seven months of this year, the gain has been $40,000, or 25½ per cent. This greatly exceeds the ratio of gain on the Western, and if continued through the coming five months, will, by December 31st, amount to $85,000, and added to the surplus of last year over interest and expenses (which was $25,000) will give a net revenue of $110,000, or nearly seven per cent. on the capital stock, and will leave a reasonable reserve fund besides.—*Bost. Trans.*.

CONTENTS:

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st. New York, at $2 a-year, in advance, or 3 copies for $5. | D. K. MINOR, Editor.

No. 10, Vol. 2. Third Series. | OCTOBER, 1844. | Whole No. 441. Vol. XVII.

READING RAILRAOD.

Much has been said, written and published in relation to this railroad, and its managers. Bold predictions have been made in relation to its durability under the trade which it is destined to bear; and as to its ability to compete successfully with the canal for the coal trade. From some cause, to a stranger wholly inexplicable, there exists in the minds of many of the wealthy citizens and business men of Philadelphia, a strong prejudice and opposition to the work. If doubts of its success, or predictions of its failure, or even curses loud and long could have suspended its progress, it would now be numbered among the things that were; and notwithstanding the great benefits which it has already conferred, and will hereafter confer, on the *coal consuming* community, there are thousands who would rejoice to have it prove a total failure. It is to be hoped, however, and it is confidently believed by those who look at it with a favorable eye, that its success is certain.

This work was projected and commenced during a period of great prosperity—but like many others, it was overtaken, before completion, by a general depression of trade and unparalleled derangement of the financial affairs of the country; and, but for the most determined perseverance and energy of its friends, it would probably have been suspended before it reached the coal region, thereby rendering the part completed in a great degree valueless. This, to many, desirable result, was avoided, and by great effort the road was opened to the coal region in 1842, in which year 49,000 tons and in 1843 230,000 tons of coal, besides other freight, passed over it. This year the coal tonnage will not fall much if any, short of 450,000 tons, which will make the aggregate of tonnage over the road since its completion about equal to 1,000,000 upon the single track mainly. In consequence of having but one track completed it has been necessary to keep up a higher rate of speed, with the coal trains, tran is considered proper, which has been to some extent injurious to the rails; yet, on an examination such as we were able to give, at the various stopping places in passing twice over it, we are of the opinion that most of the rails now in use on the first track will sustain a further tonnage two or three times greater than has already passed over them. The second track, more than half of which is completed and the remainder in a state of forwardness, which with six new locomotives of great power, and a large number of new iron cars of improved construction, will enable the company to increase their business largely this fall, and to be in readiness on the commencement of business next year to work at much greater advantage and economy than they have hitherto done.

The new track is laid with a rail of 60 lbs. to the yard, and of much better form than that first laid down, having at least double the thickness or amount of metal, in the *tread*, thus giving it greater strength and durability.

The new cars are of iron throughout, and of capacity to contain *five* tons instead of $3\frac{1}{3}$—the capacity of the wooden cars—and of superior form and construction, having springs at the connection, thereby relieving them to a considerable extent from the effects of the shock in starting the train, which is very severe when the train consists of *one hundred* cars with 375 to 400 tons of coal, which is now a common load for the new engines.

The company have now a good supply of locomotives of various kinds, many of which have been considered of great power; one made by Messrs. Baldwin, Vail and Hufty, took a train of 100 cars, or a gross load of 481 tons in February 1841, and another the "Monocacy," from the New Castle Manufacturing Co., took 100 cars with 335 tons of *coal*, at a load. These and others in use on the road, have been considered superior engines —but those recently put on, the "United States," the "New England," the "New York" and the "Ontario," from the manufactory of Messrs. Baldwin and Whitney, surpass any, it is believed, that have heretofore been constructed in this, or any other country. They are called 16 ton engines, but are somewhat heavier, and are on six wheels, 46 inches diameter, all connected as drivers and all in front of the fire box. Cylinders 15 inches diameter, and 18 inch stroke. The boiler has 137 tubes 12 feet long, $1\frac{3}{4}$ inch diameter. The calculated maximum load 750 tons—which one of these, the United States, has performed repeatedly, it is said, during the months of July and August; and with such ease that it is estimated that she will haul on a level 1000 tons, gross.

The company are also extending their wharves and depot at Richmond, on the Delaware, so as to accommodate a large business. Last year and the early part of this, they could accommodate and load at the same time, from 15 to 20 vessels, and by the opening of next season they will be able to load 30 to 35 at the same time; which, with the completion of a new branch road, from Mount Carbon, ten or twelve miles up the valley of the Schuylkill and a connection with the Little Schuylkill railroad at Port Clinton, by which a large additional trade, now given entirely to the canal, for want of connection with the railroad, will ensure a vast increase of business next year. Indeed they are now, in their unfinished condition, with but a track and a half, short of cars and locomotive power, performing more labor than *any other railroad* in the world! They are at this time hauling over 190,000 tons, *one mile daily*. Where is the other road doing as much? In a few weeks it will be increased to 250,000 tons; and next season to a much larger amount, and at rates much lower than have ever been known before; thus reducing the cost of fuel to a large section of country on the sea board, and along the navigable rivers and canals, to an amount not less than one and a half or two millions of dollars a year—which, in five or six years, would reimburse its entire cost—and contributing to the comfort and necessities of millions of people, and yet we find a greater hostility existing against it in its vicinity than to any other work in the country—to be accounted for, probably, on the same ground that the introduction of *improved machinery* is often resisted in the manufacturing districts, by the operatives—but in this case as in those, experience is sure to effect a change of feeling in the public mind; and the Reading railroad is destined to become one of the most successful enterprizes of the age.

BALTIMORE AND SUSQUEHANNA RAILROAD.

The enterprizing citizens of Baltimore, in their efforts to secure their full share of the western trade, have accomplished more in the way of *roads* and *railroads* than any other equal amount of population in this country except Boston. Before the era of canals and railroads, their turnpikes were at least equal, if not superior, both in extent and character, to those emanating from any other city of equal population in the Union: and when New York had completed her great canal, and Pennsylvania had commenced her improvements, Maryland, or rather *Baltimore*, dashed boldly into the then almost untried railroad system, and commenced two distinct lines, the Baltimore and Susquehanna and the Baltimore and Ohio railroads, for the accommodation of the western trade. From thus dividing her forces many difficulties have arisen, and, although much has been accomplished, the great object in view, viz. to reach the waters of the Ohio river, has not yet been attained; of course all the advantages anticipated from the outlay of so much capital have not been realized.

The route adopted by the Baltimore and Susquehanna railroad company had many obstacles to be surmounted, including two summits besides much of the way laying through deep ravines, requiring many sharp curves and a greater number of bridges, we believe, than on any other road in the country, there being over 80 bridges in 57 miles, to York. It was undoubtedly the intention of this company to turn in a westerly direction after crossing the Pennsylvania line and thus reach Pittsburgh by a continuous railroad; but not being able to accomplish that desirable object they directed their course towards Columbia, on the Susquehanna, where they connect with the Pennsylvania works—the canals westward and Columbia and Philadelphia railroad eastward and thus open an easy and pleasant communication between Philadelphia and Baltimore; and although the distance by this route is somewhat greater between the two cities than by that through Delaware, yet to those who travel to enjoy delightful scenery we would heartily recommend the route, by York, Columbia and Lancaster either going or coming, and thus enjoy the pleasure of passing through some of the most highly cultivated regions and beautiful farms of Pennsylvania, and at the same time through some of the wildest and most picturesque valleys in Maryland. Leaving Baltimore at 9 o'clock A.M. the cars arrive at Philadelphia at about 7 P.M. Fare, $3,50 through.

When in Baltimore a few weeks since, we were, through the politeness of the president of the company, invited to accompany the directors over the road to York and Columbia, which enabled us to form some opinion of the extent of their operations, their system of police and the character of their engines, cars, etc.

On leaving the office in North street, the cars are moved by horse power for more than a mile, until they arrive at the main depot and machine shop, quite out of the city. Here an exchange of horses is made and one of *iron* taken. The locomotives of this company are of an efficient class; taking heavy loads over their 80 feet grades, with great ease; but of these we hope to be able to speak more definitely hereafter. Their cars are of a superior description. The passenger cars have one safeguard quite new to us and which we would earnestly recommend to other companies, and especially to those who use the flat bar rail. They have put an *under floor* of inch oak boards to all their passenger cars, which will prevent accidents from "*snake heads*," from which some sad ones have occurred in this country. The cost is but trifling, yet the security afforded to the passengers, we are induced to believe from our own observation, is sufficient to render its adoption *imperative* on every flat bar road in the country.

The freight cars in general use on this road are superior, in many respects, to any we have seen, that is, they carry a greater amount of freight in proportion to the weight of the car, than on most roads. They have six wheels, the body is made light but strong, resting on *wood* springs, consisting of two pieces each 2 inches by six, and 13 feet long, of white ash plank. Other companies will do well to examine them and either adopt, or improve upon them. The success of railroads will depend much on the introduction of improvements in the various details in their management; and in no one particular is greater economy to be introduced, perhaps, than in the weight and construction of cars; many of those now in use are altogether too heavy in proportion to their capacity, especially on the Pennsylvania roads where the State furnishes roads and motive power and the forwarders own the cars or *section boats*, in which about *two* tons of freight are carried for *three* tons of dead weight, or car.

The charge for freight on merchandize, produce, etc., on this road is, from Baltimore to Columbia, 75 miles, $1 12½ per 1000 lbs., and on plaster 80 cents. The police of the road appears to be excellent. We have a copy of the regulations before us which appear to be well arranged to insure safety, if followed, and the best evidence that they are attended to, in our opinion is, that very few accidents have, as we are informed, occurred on the road.

PAPERS ON PRACTICAL ENGINEERING: NO. 2.

A special report on the Sea Wall, built in the year 1843, *for the preservation of Ram Head at the northwest end of Lovell's Island, in the harbor of Boston, Mass., by* Col. S. Thayer, *U. S. corps of Engineers.*

We are indebted to a friend for a copy of No. 2, of these most welcome and unexpected papers. The great variety of work executed under the superintendence of the U. S. engineers, the scientific acquirements of the corps and the circumstance of their having leisure to investigate and calmly note down the numerous details of construction so interesting to the profession, lead us to anticipate much good from the publication of these papers. Our readers are acquainted with the papers published by the Royal engineers to which, as well as to the Transactions of the Institution of Civil Engineers, their costly mode of publication is a most serious objection. The present number is by an officer as well known as he is highly esteemed.

By an act of congress, passed March 3d, 1843, the sum of $16,000 was appropriated for a "sea wall on Lovell's island, Boston harbor." The part of the island intended to be secured is called Ram Head, a small remnant of one (the northwestern) of the two eminences originally forming the island, or rather, probably separate islands, until in process of time, the water course between them became filled up by the debris proceeding from the destruction of the former. These debris, consisting mostly of very coarse gravel and pebblestone, have moreover been driven southerly in the direction of Gallop's island, and pushed far into the main channel, leaving the present width of the channel at this place about two hundred yards. These changes, viz: the abrasion of the island, and consequent invasion of the channel, have been steadily advancing up to the present time, and so rapidly of late years, as to render it almost certain, that the latter would be closed at no distant period, unless the evil could be arrested by the preservation of Ram Head. Such was the origin and object of the work about to be described.

The topography of the site, and the position, form and dimensions of the sea wall, generally, are exhibited in the sheets of drawings herewith submitted. The levels are referred to the plane of (extreme) low water, corresponding to that of the map of George's island, executed by Col. Kearny.

The beach, to the distance of several hundred feet, and in some directions to a much greater distance from the wall, is a little above the level of half tide; varying from seven to ten feet above the plane of reference. It consists of pebbles embedded in hard clay, and is protected from further abrasion by the large stones (boulders) covering its surface, probably remaining near where they fell from the bank as it receded, being too massive to be swept away by the sea. This beach may therefore be considered as *permanent.*

Above the foundation, which consists entirely of beton, the wall is faced up to the coping with blocks of granite in regular courses of about two feet each in thickness or rise. Every course consists of headers or stretchers placed alternately, their dimensions being as follows, viz:

Headers.—None less than four feet, or over five feet long, average about 4′ 8″; least width two feet, average width 2′ 3″; the widths being measured on the narrowest heads, which are always in the face of the wall.

Stretchers.—*Length.*—None less than six feet; average length about eight feet. *Width.*—No bed less than two feet.

The stretchers are so jointed, as to be three inches longer on the back than in front, thereby forming a dovetail joint with the headers. These last, being widest in rear, are thus also kept in place by the backing of the wall, which is composed wholly of beton. Thus all the materials of the wall are inseparably connected by a system of dovetailing.

The entire beds and joints are hammered full, and laid in contact, stone to stone, the cement mortar in which they are laid only filling the small cavities between the *touching points.*

Headers, two feet in thickness, in part five feet, and in part 4′ 3″ long, and averaging 3′ 9″ in width, constitute the coping course.

The number of stones in the wall (headers, stretchers, quoins and caps inclusive) is 903, amounting, when hammered, to 901·85 cubic yards, or to a cubic yard each on a general average.

The width of the wall at the upper surface (on which the coping rests) is 5′ 6″, and the average width, including the foundation, is about six feet.)

There are in the foundation 540·5 cubic yards, and in the backing of the superstructure 795·7 cubic yards, altogether 1336·2 cubic yards of beton, which added to the granite facing and coping above stated, make the contents of the wall 2238·07 cubic yards.

Cost of Masonry.

Stone in the rough,	$4097·21 ÷ 901·86 =		$4·54307	
Mortar materials,	175·26	"	0·19433	
Dressing,	2585·08	"	2·86639	
Laying,	567·74	"	0·62952	
Machines and tools,	404·09	"	0·44806	
Receiving and hauling materials,	338·02	"	0·37480	
Total cost per cubic yard,			———	$9·05617

Foundation Beton.

Mortar, 8·17 cub. ft.	Cement, 256·37 pounds = 3· cub. ft. stiff paste,		$1·2820
	Sand, 674 pounds = 8·2 cub. ft. loose = 6·75 cub. ft. perfectly compact,		0·1715
Gravel, 25·13 cub. ft.,			0.2397
Making mortar,	0·0647 days	0·2595 days	
Mixing beton,	0·1090 "		
Transporting do.	0·0545 "		0·3056
Packing do.	0·0313 "		
Tools, implements, platforms, runs, hauling sand, etc., etc.,			0·1121
Total cost per cubic yard,			$2·1109

Backing Beton.

9 cub. ft.	Cement, 281½ pounds = 3·28 cub. ft. stiff paste,		$1·4065
	Sand, 741 lbs. damp = 9 cu. ft. loose = 7·2 cu. ft. compact,		0·1892
Gravel, 24·1 cubic feet,			0·2298
Making mortar,	0·0648 days	0·3178 days	
Mixing beton,	0·1214 "		
Transporting do.	0·0555 "		0·3753
Packing do.	0·0761 "		
Tools, implements, platforms, etc.,			0·1121
Total cost per cubic yard,			$2·3129

Average cost of the whole beton (foundation and backing),

$2981·35 ÷ 1336·2 = $2·2312.

Entire Cost of Masonry.

Stone work,	901·86	*at*	$9·05617	$8167·40
Beton,	1336·21	*at*	2·3129	2981·35
Total,	2238·07	*at*	4·9814	$11148·75

A batch of mortar was composed as follows:

Cement = 1 cask 321¼ pounds (average) = 3·75 cubic feet stiff paste.

Sand = two wheelbarrow boxes heaped = 856⅔ pounds damp from heap = 10¼ cubic feet loose = 8½ cubic feet reduced to minimum bulk.

This dose of sand was about 50 per cent. greater than would have been used in mortar for ordinary masonry, or for beton in caps or arches. The result of the mixture was 10¼ cubic feet of stiff mortar = 11 cubic feet in a limber state, such as when used. There were made in all 1128 batches = 1128 × 10¼ = 11562 cubic feet = 428·22 cubic yards, costing as follows:

Cement = 362·400 pounds *at* ½ cent,	1812·00
Sand = 476·92 tons *at* 51 cents nearly,	243·24
Labor, including transport of mortar to beton bed, average distance 40 yards = 86·5 days.,	102·33
	$2157·57

Cost of cubic yard of Mortar.

Cement = 846·06 pounds = 9·9 cubic ft. stiff paste,	4·231
Sand = 1·11373 tons = 27 cubic ft. loose = 22¾ cubic ft. perfectly compact,	0·568
Labor = 0·2019 days,	0·239
27 cubic feet *at* 18⅔ cents,	$5·038

The mortar was made by hand, in a box 7′ long, 5′ wide, and 11½″ deep, which had been constructed for a different purpose, but answered sufficiently well for this. One half of the sand was first put in and spread, then a cask of cement, and over this the remainder of the sand. The water (salt) was then added, and the mixture effected in the usual way by two men, to whom a third man was occasionally added.

The batch of mortar above described = 10¼ cubic feet was mixed, for foundation beton, with eight barrows full of shingle = 31½ cubic feet and for backing beton, with 7 barrows full = 27½ cubic feet. With respect to the latter, however, it is to be remarked that the whole of the mortar was not mixed with the shingle, a certain portion, say about six per cent., being applied to the surfaces in contact with the beton in the wall. The shingle was of every size from that of a pea to pebbles of 6 inches diameter, and the different sizes so proportioned as to give a minimum void. Although this void was not accurately ascertained, yet, judging from experiments with other materials not dissimilar, and from the bulk produced by the mixture of given quantities of the shingle and mortar, I feel safe in stating it at somewhere between 20 and 25 per cent. of the volume of the shingle.

The process of fabrication was briefly as follows:

The shingle having been brought in wheelbarrows from the pile or depot near by, and spread on the platform (formed of rough boards) in a layer from 8 to 12 inches in thickness, (according as the materials are more or less coarse) the finest shingle at bottom, and all the pebbles at top, the batch of mortar is spread over it as evenly as possible. The mixture is effected by four men, viz: two with shovels and two with hoes, the former facing each other, and each commencing at a corner of one of the sides of the pile, work from the exterior towards each other, until they meet, throwing each shovel full so as to form an irregular ridge, the commencement of a new pile, at a convenient distance on one side. They then step back and recommence a new section (the width of the shovel) and operate in the same manner depositing this portion by the side of the other, until the whole mass is turned and formed with the aid of the hoes into a heap similar to the original. As each shovel full is turned up and spread, or rather scattered by a jerking motion, it is seized by the hoe and brought into proper form and position being thereby more intimately mixed. The heap is again turned in like manner, but in the opposite direction, when the mixture is complete, all the surfaces of the shingle being well covered with mortar.

It is scarcely necessary to observe, that the success of the operation depends entirely on the proper management of the tools, which, although not a difficult act, is seldom attained without the particular attention of the overseer. The ordinary gang, exclusive of mortar makers, was as follows:

For foundation Beton.

4 men bringing shingle and mixing.

2 men transporting beton, (each filling his own barrow) and mixing.

1 man at trench, levelling and ramming, to whom two others were occasionally added, in which case four men were kept constantly at the shovel and hoe, turning and mixing.

For Backing Beton.

2 men bringing shingle and mixing.

2 men wheeling beton and mixing.

2 men at the wall, one plastering the surface in contact with the beton, the other arranging the beton and ramming.

Each course of facing stones was backed up as fast as laid, the back of the beton being sustained by moveable boxings, each consisting of a couple of 2" planks about 20 feet in length, fastened together, edge to edge, with battens, and kept in place by *plank* or *joist* braces in rear. These boxings could be safely removed in several hours after the beton was packed.

ANOTHER RAILROAD ROUTE BETWEEN NEW YORK & BOSTON.

We have received a circular signed by the principal citizens of Middletown Con., in which they call the attention of the inhabitants along the line to the project of a railroad through Middletown to Norwich, and thence to Providence and Boston. They say that "at the last session of the legislature of the State of Connecticut, a charter was granted for a railroad in continuation of the Hartford and New Haven railroad, to the line of New York State, in order to perfect a continuous road from Boston to New York city, at all seasons of the year.

"Another charter was also granted, to connect the city of Middletown with the Hartford and New Haven railroad; and it is now proposed to continue this road from Middletown, east to Providence and Boston via Norwich, by occupying a part of the Norwich and Worcester road to the most convenient point diverging therefrom to the Providence and Stonington road; or by such other route as upon examination shall prove most practicable. This project, if carried out, will place Providence, Norwich, Middletown and the intermediate towns, forever on the great mail route from Boston to New York city."

Of the advantage and convenience to the people on the proposed line we have not a doubt. The following comparative statement of distances between it and the Springfield route shows a saving of 19 miles.

New Haven to Boston by proposed route.		New Haven to Boston, via Springfield, Ms.	
New Haven to Wallingford,	10 miles.	New Haven to Hartford,	37 miles.
Wallingford to Middletown,	13 "	Hartford to Springfield,	26 "
Middletown to Norwich,	32 "	Springfield to Worcester,	59 "
Norwich to Plainfield,	15 "	Worcester to Boston,	45 "
Plainfield to Stonington, R. I.,	24 "	Total,	167 "
Thence to Providence,	13 "		148 "
Providence to Boston,	41 "		
Total,	148 "	Difference in favor of proposed route,	19 "

Total extent of new road to be constructed on proposed route, 69 miles.

ON THE MENSURATION OF EXCAVATION AND EMBANKMENT UPON CANALS, ROADS, AND RAILROADS: BY ELWOOD MORRIS, CIVIL ENGINEER.

On directing the attention to public works, one is immediately struck with the vastness of the amount of money expended in excavation, embankment and masonry: forming on the roads and railroads, usually the chief, and on the canals nearly the only items of outlay. We have the authority of the Chev. de Gerstner, that the 3000 miles of railway this year in operation in the United States, cost sixty millions of dollars.* Of which, perhaps, forty millions were laid out in graduation and masonry alone.

When to this, we add the immense expenditures for similar objects upon the canals and roads of the Union, will it be too much to say that near one hundred millions of dollars have been disbursed in the earthworks, requisite to reduce the routes to proper levels, and the architectural constructions necessary to pass the streams.

This large amount of work having been done chiefly by contract, and paid for by the cubic yard, or perch, the vast importance of accuracy and uniformity in calculating the contents of excavation, embankment and masonry solids, must be palpable to all. Unfortunately, great diversity has existed, and still continues to exist, in the modes of mensuration adopted by engineers; they may, however, in a general way, be divided into two principal methods, and the modifications which flow from them; first, those which depend on *arithmetical* and second, those dependant on *geometrical*, average.

When we state that neither of these modes is exact, except in a limited number of cases, we merely mention what is well known to every engineer: but which is a reason not the less powerful, to induce us to seek more perfect methods.

The importance of this subject will, we trust, be a sufficient apology for laying before the readers of the Journal of the Franklin Institute a few observations, with the hope of drawing to it the attention of abler minds.†

We are aware, that it is urged by some, that the modes of measurement are immaterial, provided, the values of the unit of measure computed in a particular mode were known, and that mode generally adopted; and this argument would have great force if any single rule or method of mensuration was used in general practice. But while on some works the mode of computation uniformly errs in excess, on others it probably errs in deficiency, or, otherwise, according to circumstances; and this brings us back to the importance of a uniform and more exact mode.

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* See Journal Franklin Institute for September, 1839.

† A treatise on the mensuration of excavation and embankment, from the pen of a northern engineer, well able to manage such a subject, was lately announced as being in the press, it has not however (the writer believes) yet been published.

The work here referred to by Mr. Morris, is that of E. F. Johnson, Esq., C. E., which our readers will recollect, was published at our office in 1840. Ed. R. R. J.

The surface of the ground is regarded by the engineer, as being composed of planes, variously disposed with relation to each other; so that any vertical section, will exhibit a rectilineal figure more or less regular. This supposition, though not strictly correct, is sufficiently accurate for practical purposes, and avoids any necessity of entering into the complex calculations pertaining to warped surfaces.

The usual method of measuring excavation and embankment, is by taking vertical sections, perpendicular to the centre line of the canal or road, and at short distances apart, in which the elevation or depression of numerous points in the ground, above or below the bottom of canal or grade of road, is ascertained by the spirit level and rod, while their distances out, right and left, are measured (generally) with a tape line.

These elevations or depressions are commonly called *plus* or *minus cuttings*, or simply *cuttings*, and the distances of the several points from the centre line are denominated shortly *distances out.* The *cuttings* then are ordinates or perpendiculars drawn from the plane of grade or bottom, to intersect the surface of the ground; and the *distances out*, are the horizontal distances of those perpendiculars from the centre line, (measured at right angles) or the abscissa of those ordinates, which, by deduction, give the distances apart of the separate cuttings.

The details of the operation of *taking the cuttings* require great nicety, but are so well known to practical engineers as to render unnecessary a description at length. We may, however, mention a general rule which must not be neglected if accurate results are desired; viz. *At every change of slope transversely, single cuttings and distances out, must be taken, and at every longitudinal change, sections of cuttings.*

Upon rough ground it is customary to make the lateral distances apart of the cuttings uniformly ten feet, which materially facilitates the subsequent calculations. We may here observe that the cuttings and distances out, are commonly taken in feet and tenths, and the regular stations of one hundred feet, are divided by cross sections (or sections of cuttings) into shorter lengths if the ground requires, as it almost always does.

Some engineers have suggested the division, and we believe some have had their rods and tapes divided, into yards and decimals; and some retaining the rod and tape as usual, have made their regular stations fifty-four feet, and have spaced their cross sections where they required to be nearer, so that their distances apart should be some aliquot part of 54 feet. These methods, though they somewhat expedite the office work where the quantities are ascertained by the process of arithmetical average, are not, however, generally adopted by the profession. A foot being usually the unit of lineal measure, a hundred feet a regular station, and the cubic yard the unit of the solidity of excavations and embankments.

The isometrical diagram, fig. 1, plate 1, represents a regular station of embankment on irregular ground, with an intermediate cross section at 50 feet or midway. Base or width of road surface = 30 feet, slopes 2 to 1, *a*, *b*, *c*, *d*, *e*, *f* and *g*, are cuttings, *minus cuttings*, in this case. **1**: **2**: and **3**: are the *sections of cuttings*, or cross sections. C, C, is the centre line.

Earth work on roads and canals is usually laid off in divisions called *sections* of half a mile or more in length, and when a sufficient number of transverse sections of the ground have been obtained, or technically when the "*cuttings are taken*," the transverse profiles or cross sections are drawn upon paper, their areas calculated, and the solid contents of the excavations and embankments computed; generally by one of two rules, viz:

No. 1: *By arithmetical average.*—Multiply the sum of the end areas by their distance apart, and divide the product by 6 and by 9; the result will give, *approximately*, the number of cubic yards in the given length of excavation or embankment.

No. 2: *By geometrical average.*—Multiply the sum of the end areas, and the square root of their product, by the distance apart, and divide the product by 9 and by 9. The result will be, *nearly*, the number of cubic yards in the given length of excavation or embankment.

All the dimensions in both cases being in feet and decimals.

Of these rules, No. 1, gives a result always in excess, except when the excavation or embankment solid, happens to be a prism or cylinder, or when the sums of the right and left distances out, are the same for both the end areas used.

And, No. 2, though accurate when applied to prisms, cylinders, pyramids and cones, or their frustra, fails on application to the prismoid or wedge as well as to embankment or excavation solids, on irregular ground, where the difference is great between the areas of adjacent transverse sections.

Such is a brief sketch of the modes in common use for measuring excavation and embankment on roads and canals; of which we may observe, that the method, (No. 1,) and all others founded upon the same principles, necessarily lead to errors, often of magnitude, and particularly in deducing "deficient embankment," as is very well shown by Mr. Macneill, in the introduction to his excavation and embankment tables published in 1833. It is true, that engineers in this country would seldom fail to arrive at much closer results than Mr. Macneill has instanced; because, being well aware, that this very convenient rule (No. 1,) always gives results which are in excess in some ratio to the difference of any two areas averaged, they take care to place their cross sections so near together that this difference may be small, and consequently by closely pursuing this course are enabled to reach results proportionally more exact. Indeed, the writer has often known sections of cuttings on sidehill, to be taken but 10 feet apart longitudinally, and in some extraordinary cases among rocks even at a less distance.

The rule No. 2, though not liable to so many, nor such strong objections, is still obnoxious to some: and where greater, indeed almost precise, accuracy is attainable without much more labor, we cannot but think it highly desirable, and accordingly propose to develope a method much superior, as it appears to us. But before doing so, the writer distinctly disclaims any attempt at novelty, as to the principles employed; for they have been long known to those versed in mensuration, and have also been applied to the matter in hand by the eminent engineer before alluded to (J. Macneill, Esq., C. E., etc.,) in his publication in 1833. It is believed, however, that as a *general process*, the mode about to be laid down has not yet been used on any work.

Upon the general supposition that any given length of excavation or embankment is a solid bounded laterally by plane surfaces, and terminated at both ends by transverse sections, or planes, perpendicular to the centre or guiding line of the excavation or embankment; the contents of that solid may be accurately computed by aid of the "prismoidal formula," used by Mr. Macneill, who gives a very good demonstration of it as applied directly to one of the solids under consideration. Mr. Macneill's tables, though carefully made out, and undoubtedly useful in a level country, are unfortunately not of very ready application to common cases, owing to the variable transverse figure of the ground not having been (and which indeed is scarcely capable of being) taken into the account in the tabular arrangement employed by that distinguished practical writer.

The "Prismoidal Formula" referred to, is as follows:

Parallel sections each perpendicular to the guiding line of the excavation or embankment.

Let b = the area of the base, or of a cross section at one end of a given length of excavation or embankment.

" t = the area of the top, or other end section.

" m = the area of a section midway between the two, and deduced from them.

" h = the height of the solid, or perpendicular distance between the end sections.

" S = the solidity.

Then the general formula $= \overline{b + 4m + t} \times \frac{1}{6}h = S$.

This is the rule for the capacity of a prismoid, demonstrated in almost every treatise on mensuration. And it is also *the general formula* for the mensuration of all solids, whose bases and tops, or edges, lie in parallel planes, and whose sides are bounded either by planes or right lines; and from it can be directly deduced the common rules for the solidity of prisms, etc., as will be shown hereafter.

* It applies to a prism or cylinder as a prismoid, (so to speak) of which the two end sections are equal: to a cone or pyramid as a similar solid, one of whose end sections is nothing; and for the same reason it is applicable to the wedge. As the full demonstration of this remarkable property would occupy much space, we prefer the inverse method of deducing from the general formula, the common rules for the solidity of prisms, pyramids, etc., the truth of which have been already proven by the writers on mensuration; this will be a proof of the general rule, perhaps quite as satisfactory to the reader, and will, at least, have the recommendation of brevity.

General formula $= \overline{b + 4m + t} \times \frac{1}{6}h = S$.

1. *Prisms or Cylinders.* *

Here $b = m$, or $4m = 4b$, and $t = b$, substituting these values, general formula becomes $\overline{b + 4b + b} \times \frac{1}{6}h = S$, or $6b \times \frac{1}{6}h = S$, or finally $b \times h = S$, which is the common rule, usually expressed thus,

"Multiply the area of the base by the height of the prism, and the product will give the solid content."

By figures referring to the diagram, fig. 2, plate 1.

By General Formula.	By Common Rule.
$10 \times 8 = 80 = b$	$10 \times 8 = 80 = b$
$10 \times 8 \times 4 = 320 = 4m$	$48 = h$
$10 \times 8 = 80 = t$	$b \times h = \overline{3840} = S.$
480	
$8 = \frac{1}{6}h$	
$3840 = S.$	

2. *Pyramids and Cones.*

Here $t = o$, $m = \frac{1}{4}b$, or $4m = b$, substituting these values the general formula becomes $\overline{b + b + o} \times \frac{1}{6}h = S$, or $2b \times \frac{1}{6}h = S$, or finally $b \times \frac{1}{3}h = S$, which is the common rule usually stated in words thus,

* This subject is noticed by (I believe) Sir George Head, in a work on England, speaking of a system of education.

" Multiply the area of the base by one third of the height, and the product will be the solid content."

By figures referring to the diagram, fig. 3, plate 1.

By General Formula.

$$\begin{array}{rr} 10 \times 8 = & 80 = b \\ 5 \times\ 4 \times 4 = & 80 = 4m \\ 0 \times 0 = & 0 = t \\ & \overline{160} \\ & 8 = \frac{1}{6}h \\ & \overline{1280} = S. \end{array}$$

By Common Rule.

$$\begin{array}{rr} 10 \times 8 = & 80 = b \\ & 16 = \frac{1}{3}h \\ & \overline{1280} = S. \end{array}$$

3. *The Wedge.*

Here let e = length of the edge, l = length of the back, and d = depth or thickness of the back.

Then in the general formula, $t = o$. $b = l \times d$, $m = \frac{l+e}{2} \times \frac{d}{2}$ or $4m = \overline{l+e} \times d$, substituting these values, general formula becomes $\overline{l \times d + \overline{l+e} \times d} \times \frac{1}{6}h = S$, or $\overline{l \times d + l \times d + e \times d} \times \frac{1}{6}h = S$, or finally $\overline{\overline{2l+e} \times d} \times \frac{1}{6}h = S$, which is the common rule usually expressed thus,

" To the length of the edge, add twice the length of the back ; multiply this sum by the breadth (or thickness) of the back, and then by one sixth of the height of the wedge ; the product will be the solid content."

By figures see the diagram, fig. 4, plate 1.

By General Formula.

$$\begin{array}{rr} 10 \times\ 8 = & 80 = b \\ 20 \times\ 4 \times\ 4 = & 320 = 4m \\ 0 \times 30 = & 0 = t \\ & \overline{400} \\ & 8 = \frac{1}{6}h \\ & \overline{3200} = S. \end{array}$$

By Common Rule.

$$\begin{array}{r} 10 \times 2 + 30 = 50 = 2l + e \\ 8 = d \\ \overline{400} \\ 8 = \frac{1}{6}h. \\ \overline{3200} = S. \end{array}$$

To the frustra of either of the above solids, the general formula is equally applicable, to prove which we observe, that the frustrum of a prism is still a prism, and the frustrum of a wedge is a prismoid; it only remains then to show the application to

4. *The Frustrum of a Pyramid.*

Here, for the sake of simplifying the demonstration, suppose the frustrum to be of a pyramid having a square for its base. Let a = a side of the base of the frustrum, and c = a side of the top. Then in the general formula $b = a^2$ $t = c^2$ and $m = \frac{a+c}{2} \times \frac{a+c}{2}$ or $m = \frac{\overline{a+c}^2}{4}$ hence $4m = \overline{a+c}^2 = a^2 + 2ac + c^2$. Substituting these values the general formula becomes $\overline{a^2 + a^2 + 2ac + c^2 + c^2} \times \frac{1}{6}h = S$, or $\overline{2a^2 + 2ac + 2c^2} \times \frac{1}{6}h = S$, or $\overline{a^2 + ac + c^2} \times \frac{1}{3}h = S$.

But $ac = \sqrt{a^2 \times c^2}$ substituting which the formula becomes $\overline{a^2 + \sqrt{a^2 \times c^2} + c^2} \times \frac{1}{3}h = S$, which is the common rule usually expressed thus,

" The sum of the areas of the ends and the square root of their product, multiplied by one third of the height (or perpendicular distance between the ends) gives the solidity of the frustrum."

What is true of frustra of pyramids is also true of those of cones, though owing to the properties of the circle, the rule for the solidity of conic frustra is generally differently stated: it will be observed that the common rule above deduced for pyramidal frustra is identical with rule No. 2, sometimes used to find the contents of excavations and embankments.

By figures see the diagram, fig. 5, plate 1.

By General Formula.	By Common Rule.
$20 \times 20 = 400 = b$	$20 \times 20 = 400 = a^2$
$16 \times 16 \times 4 = 1024 = 4m$	$\sqrt{400 \times 144} = 240 = \sqrt{a^2 \times c^2}$
$12 \times 12 = 144 = t$	$12 \times 12 = 144 = c^2$
1568	784
$8 = \frac{1}{6}h$	$16 = \frac{1}{3}h$
$12544 = S.$	$12544 = S.$

Now there is no excavation or embankment solid such as we have supposed, that cannot be divided into prisms, prismoids, pyramids, or wedges, or some combination of them, having a common length or height, equal to the distance between the end areas or cross sections. And the height or length being common to all, it will be evident on reflection, that if a given portion of excavation or embankment be composed of any number of the solids named, the area of one end section will equal the sum of the areas of the bases or tops of those solids, the other end area the sum of their tops or bases, and the area of the mid-section will equal the sum of the areas of their middle sections; and, hence, if (as has been proved) the capacities of the separate solids are reducible to one general rule, the solidity of a whole body composed of such solids, and having the height as one common dimension, may therefore be computed by the same rule.

The general process, then, the adoption of which we suggest as a valuable succedaneum to those in common use, will be to compute by the general formula from the sections usually taken in the field, in the following manner: draw the sections in a book, leaving between each two space enough for the middle section, which will be subsequently deduced from those drawn; on each left hand page should be placed either three sections, (including the mid-section) or some multiple of three, depending on the character of the ground, and the size of the leaf; the right hand page being left open to record the calculation upon. The scale we would recommend to be twenty feet to the inch.

To prevent misapprehension, we will here observe, that in speaking of excavation or embankment, the centre line is always supposed to be a tangent, that being the universal presumption, in practical calculations; altho' upon curves, owing to the convergence of the cross sections, (they being taken on the radii,) this hypothesis is not exact, and consequently occasions some error, not often, however, of much importance, though cases will sometimes arise (where the primary angle of deflection is unusually large) that ought to receive correction for curvature.

Though not absolutely indispensable, it will be found convenient in using the prismoidal method of calculation, as well as conducive both to expedition and accuracy, to observe the following rules in "*taking the cuttings,*" as far as the character of the surface may admit, viz:

1. On sidehill, at each section of cuttings where the work runs partly in

filling, and partly in cutting, ascertain the point where grade or bottom strikes ground surface.'

2. On every tarnsverse section take a cutting at both edges of the road, or, at the distance out right and left of one half the base.

3. Always take a cross section, whenever either edge of the road or base passes from excavation to embankment or vice versa.

4. On sidehill, if the ground admits, take the cuttings (not otherwise provided for) uniformly at ten feet apart.

5. Wherever the ground admits, so place the cross section as to be at some decimal division of 100 feet apart, as 10, 20, etc.

Excavation and embankment solids naturally divide themselves into three classes or cases, with modifications, and under one or another of these cases or their modifications, will fall nearly every kind of ground; though on a very intricate surface, such as a rocky hillside, cases may arise, requiring additive or deductive solids, but the engineer will find little difficulty in managing such, without violating, or interfering with, the general process.

Case 1. Prisms.

Embankment or excavation, either on level ground, or on ground inclined transversely, and level longitudinally, at the same distance out.

Modification 1: all excavation, or all embankment. *Modification* 2: both filling and cutting.

Case 2. Prisms, Prismoids and Pyramids.

Embankment or excavation, on ground inclined longitudinally in one plane, and level transversely.

Modification 1: all excavation, or all embankment. *Modification* 2: passage from excavation to embankment, or the reverse.

The above two cases do not often exist in practice, that following being of the most general occurrence.

Case 3. Prisms, Prismoids, Pyramids and Wedges, or a combination of them.

Excavation or embankment on ground inclined *both* longitudinally and transversely.

Modification 1: all excavation, or all embankment. *Modification* 2: cutting and filling both. *Modification* 3: passage from cutting and filling to either cutting or filling. *Modification* 4: complete passage from excavation to embankment on sidelong ground.

The general formula admits of a modification, more convenient for use in computing excavation and embankment. It is as follows:

$\frac{b+4m+t}{6} \times h = S$, in lieu of $\overline{b+4m+t} \times \frac{1}{6}h = S$; this modification we shall employ; and now proceed to give examples in figures of each case, but it may be as well previously, to make some remarks relative to deducing the middle section between any two which have been taken in the field and sketched in the section book.

To average for the cuttings of the middle section, commence either at centre or at grade, if there be a grade point upon the cross section, and having regard to the inclination of the ground, proceed each way, averaging the cuttings as they occur, for a corresponding cutting of the middle section, and their distances out, or rather their distances apart, for a corresponding distance apart; and if there be more cuttings in one section than in the other, the surplus cuttings (of the same kind) on each side, all average with the *outer* cutting on that side, and their distances apart divided by two (or averaged with 0,) give the corresponding distances of the cuttings which answer to them upon the mid-section. But the averages may be made in any other way demanded by the transverse slopes of the surface, provided all the cuttings are used, and that lines drawn to join any two cuttings averaged, do neither meet between the end sections nor cross. In the mid-section will always appear the same number of cuttings as are contained in that end section which has the most; and its correctness admits of verification thus,

1. ½ sum of distances between the extreme cuttings of the end sections equals the distance between the extreme cuttings of the mid-section. This proves it horizontally: to verify it vertically,

2. Where the number of cuttings of both kinds is the same in each end section, ½ sum of all the cuttings of the end sections, equals the sum of all the cuttings of the middle section.

3. Where the number of cuttings in the end sections is different, to prove the cuttings of excavation, ½ sum of the cuttings of the end sections, equals the sum of the cuttings of the mid-section; *minus*, least outer cutting left of centre multiplied by ½ the difference in the number of cuttings in the end sections on the left; *plus*, least outer cutting right of centre multiplied by the difference in the number of cuttings on the right.

Though this last rule is long in words, it is short in practice, and of course only refers to the excavation or plus cuttings in proving excavation, while the same process applied to the minus cuttings will verify the embankment of the middle section.

The exemplifications which will be given apply to the graduation of a road, or railroad, but the principles apply equally to a canal, as the tow path and berm banks above bottom are constant quantities.

In all the following examples the slopes are considered to be the same on both sides of the centre, which is supposed to divide equally the surface of grade, or the base as it will be called. The sections numbered 1: and 3: will uniformly be presumed to be those taken in the field, while No. 2: will represent the middle section deduced from the end sections, 1: and 3: the distance between which, will, for convenience, be assumed at 30 feet in every case. Excavations, as to figure, are merely embankments inverted, and hence, as a matter of course, the same principles apply to both.

In all the examples, the results obtained by rules No. 1 and 2, will also be set down for the sake of exhibiting how great in some cases the differences are: the base will be assumed at 30 feet, the slopes at 2 to 1, and C, C, will represent the centre line of the road.

Example of Case 1: *Modification* 1: *fig.* 6, *plate* I.

$h = 30.$

	Multipliers.	Areas.	Cubic yds.
1.	$\frac{30+54}{2}\times 6$ . . . =	252	
2.	$\frac{30+54}{2}\times 6\times 4$ . . . =	1008	
3.	$\frac{30+54}{2}\times 6$ . . . =	252	
	6)	1512	
	30 ×	252	= 280
	By rule No. 1		= 280
	By rule No. 2		= 280

Embankment.

	Multipliers.	Areas.	Cub. yds.
1.	$15 \times 4 =$	60	
2.	$15 \times 4 \times 4 =$	240	
3.	$15 \times 4 =$	60	
		6)360	
	$30 \times$	$\overline{60} =$	$66\frac{2}{3}$
	By rule No. 1	=	$66\frac{2}{3}$
	By rule No. 2	=	$66\frac{2}{3}$

Excavation.

Multipliers.	Areas.	Cub. yds.
$15 \times 2 =$	30	
$15 \times 2 \times 4 =$	120	
$15 \times 2 =$	30	
	6)180	
$30 \times$	$\overline{30} =$	$33\frac{1}{3}$
By rule No. 1	=	$33\frac{1}{3}$
By rule No. 2	=	$33\frac{2}{3}$

Example of Case 2: *Modification* 1: *fig.* 8, *plate* I.

	Multipliers.	Areas.	Cub. yds.
1.	$\frac{30+54}{2} \times 6 =$	252	
2.	$\frac{30+46}{2} \times 4 \times 4 =$	608	
3.	$\frac{30+38}{2} \times 2 =$	68	
		6)928	
	$30 \times$	$\overline{154\frac{2}{3}} =$	171·8
	By rule No. 1	=	177·8
	By rule No. 2	=	167·0

Example of Case 2: *Modification* 2: *fig.* 9, *plate* II.

Multipliers.	Areas.	Cub. yds.
$\frac{30+62}{2} \times 8 =$	368	
$\frac{30+46}{2} \times 4 \times 4 =$	608	
$0 \times 15 =$	0	
	6)976	
$30 \times$	$\overline{162\frac{2}{3}} =$	180·7
By rule No. 1	=	204·4
By rule No. 2	=	136·3

Example of Case 3: *Modification* 1: *fig.* 10, *plate* II.

	Multipliers.	Areas.	Cubic yds.
1.	Add $37 \times 14 = 518$		
	$11 \times 10 = 110$		
	$18 \times 5 = 90$		
	$13 \times 6 = 78$		
	796		
	Deduct $\overline{16^2 + 4^2} = 272$		
	524 =	524	
2.	Add $17·5 \times 10·5 = 183·75$		
	$15· \times 28·5 = 427·50$		
	$23· \times 6· = 138·$		
	$19· \times 5·5 = 104·50$		
	$7· \times 14· = 98·$		
	951·75		
	Deduct $\overline{18^2 + 5^2} = 349·$		
	Multiplied by 4, 602·75 =	2411	
3.	Add $19 \times 21 = 399·$		
	$16 \times 20 = 320·$		
	$12 \times 14 = 168·$		
	$10 \times 12 = 120·$		
	$8 \times 15 = 120·$		
	1127·		
	Deduct $\overline{20^2 + 6^2} = 436·$		
	691 =	691	
		6)3626	
	$30 \times$	$\overline{604\frac{1}{3}} =$	671·5
	By rule No. 1	=	675·0
	By rule No. 2	=	672·9

Excavation.—Multipliers.	Areas.
1. 5 × 1 = 5	
4 × 10 = 40	
8 × 25 = 200	
245	
Deduct $\overline{10}^2$ = 100	
145	= 145
2. 4·5 × 1·5 = 6·75	
5· × 7· = 35·	
10·5 × 17·5 = 183·75	
13·5 × 11· = 148·5	
374·	
Deduct $\overline{13}^2$ = 169·	
4 × 205	= 820
3. 4 × 2 = 8	
4 × 6 = 24	
13 × 10 = 130	
17 × 22 = 374	
536	
Deduct $\overline{16}^2$ = 256	
280	= 280
	6)1245
Mean area =	207·5

Embankment.—Multipliers.	Areas.
16 × 7 = 112	
6 × 5 = 30	
142	
Deduct $\overline{8}^2$ = 64	
78	= 78
11·5 × 5·5 = 63·25	
12·5 × 4· = 50·	
10·5 × 3· = 31·5	
7·5 × 3· = 22·5	
14· × 6· = 84·	
8·5 × 2·5 = 21·25	
372·5	
Deduct $\overline{11}^2$ = 121·	
4 × 151·5	= 606
15 × 11 = 165	
17 × 8 = 136	
13 × 6 = 78	
7 × 6 = 42	
12 × 5 = 60	
7 × 2 = 14	
495	
Deduct $\overline{14}^2$ = 196	
299	= 299
	6)983·
Mean area =	$163\frac{5}{6}$

Excavation.	Cub. yds.	Embankment.	Cub. yds.
Mean area, 207·5 × 30	= 230·6	Mean area, $163\frac{5}{6}$ × 30	= 182·
By rule No. 1,	= 236·1	By rule No. 1,	= 209·4
By rule No. 2,	= 232·0	By rule No. 2,	= 196·6

Example of Case 3: Modification 3: fig. 12, plate IV.

Embankment.—Multipliers.	Areas.
1. 15 × 31 = 465	
12 × 10 = 120	
11 × 10 = 110	
9 × 4 = 36	
6 × 6 = 36	
2 × 5 = 10	
777	
Deduct $\overline{18}^2$ = 324	
453	= 453
2. 5·5 × 12·5 = 193·75	
11· × 5· = 55·	
10·5 × 5· = 52·5	
9·5 × 2· = 19·	
7· × 13· = 91·	
5· × 2·5 = 12·5	
423·75	
Deduct $\overline{14}^2$ = 196·	
4 × 227·75 =	911
Carried forward	1364

Excavation.—Multipliers.	Areas.
Excavation =	0
5· × 1· = 5·	
3· × 4· = 12·	
5·5 × 3· = 16·5	
10·5 × 10·5 = 110·25	
12· × 10· = 120·	
263·75	
Deduct $\overline{10}^2$ = 100·	
4 × 163·75 =	655
Carried forward	655

	Brought forward	1364
3.	$8 \times 20 = 160$	
	$3 \times 5 = 15$	
	175	
	Deduct $\overline{10}^2 = 100$	
	75 =	75
		6)1439
	Mean area =	$239\frac{5}{6}$

Brought forward	655
$5 \times 4 = 20$	
$6 \times 8 = 48$	
$11 \times 6 = 66$	
$21 \times 21 = 441$	
$24 \times 20 = 480$	
1055	
Deduct $\overline{20}^2 = 400$	
655 =	655
	6)1310
Mean area =	$218\frac{1}{3}$

Embankment.	Cub. yds.
Mean area, $239\frac{5}{6} \times 30$	= 266·5
By rule No. 1,	= 293·3
By rule No. 2,	= 263·8

Excavation.	Cub. yds.
Mean area, $218\frac{1}{3} \times 30$	= 242·6
By rule No. 1,	= 364·
By rule No. 2,	= 242·6

Example of Case 3: *Modification* 4: *fig.* 13, *plate* III

	Excavation.—Multipliers.	Areas.
1.	Excavation =	0
2.	$2·5 \times 1· = 2·5$	
	$3·5 \times 2·5 = 8·75$	
	$5·5 \times 2·5 = 13·75$	
	$9· \times 5· = 45·$	
	$12· \times 2·5 = 30·$	
	$10·5 \times 18· = 189·$	
	289·	
	Deduct $\overline{9}^2 = 81·$	
	$4 \times 208· =$	832
3.	$3 \times 2 = 10$	
	$7 \times 5 = 35$	
	$11 \times 5 = 55$	
	$18 \times 10 = 180$	
	$24 \times 5 = 120$	
	$21 \times 36 = 756$	
	1156	
	Deduct $\overline{18}^2 = 324$	
	832 =	832
		6)1664
	Mean area =	$277\frac{1}{3}$

Embankment.—Multiplers.	Areas.
$11·5 \times 10 = 115·$	
$10·5 \times 10 = 105·$	
$9· \times 4 = 36·$	
$7·5 \times 10 = 75·$	
$6·5 \times 5 = 32·5$	
$6· \times 5 = 30·$	
$5· \times 5 = 25·$	
$5· \times 2 = 10·$	
428·5	
Deduct $\overline{12}^2 = 144·$	
284·5 =	284·5
$11·5 \times 2·5 = 28·75$	
$10·5 \times 2·5 = 26·25$	
$9· \times 1· = 9·$	
$7·5 \times 2·5 = 18·75$	
$6·5 \times 1·25 = 8·125$	
$3· \times 2·5 = 7·50$	
$2·5 \times 2·5 = 6·25$	
$1· \times 2·5 = 2·50$	
107·125	
Deduct $\overline{6}^2 = 36·$	
$4 \times 71·125 =$	284·5
Embankment =	0
	6)569
Mean area =	94·83

Mean area,	$277\frac{1}{2} \times 30 = 308{\cdot}1$	Mean area,	$94{\cdot}83 \times 30 = 105{\cdot}4$
By rule No. 1,	$= 462{\cdot}2$	By rule No. 1,	$= 158{\cdot}$
By rule No. 2,	$= 308{\cdot}1$	By rule No. 2,	$= 105{\cdot}4$

Objections may possibly be urged against the hypothetical generation of intermediate ground by means of middle sections, and it is difficult to free this subject wholly from exception; but with a given number of transverse sections taken in the field, if close attention is paid to the inclination of the ground as developed by the end sections, and occasionally where it is very complex, if the figures are simplified by introducing additive or deductive solids, we have not yet met with any other practical method, giving results equally satisfactory.

Various expedients are known to engineers for facilitating the computation of the areas of cross sections, to attempt an account of which, though it might be interesting to students, would prolong this paper to an inconvenient length.

The above examples embrace, as we have stated, specimens of the principal varieties of excavation and embankment; and a little attention to the calculations and the modes of deducing the middle sections between those usually taken in the field, will enable any one to apply the "Prismoidal Process" to the mensuration of earth work upon canals, roads or railroads. When the mean areas are computed, it will be much more expeditious to get out the cubic yards from the table of cubic yards previously made out (supposing the stations regularly 100 feet,) for each foot and tenth of mean area, from 0·1 up to the largest which commonly occur: such or similar tables in manuscript are in the possession of many engineers, but those who have them not can in a few days construct a set by simple addition, and verify them by observing how the cubic yards for the preliminary areas of the first hundred, are subsequently repeated in the same decimal place.

Indeed, Mr. Macneill's tables (if extended to tenths of feet) might be used; by constructing a supplemental set to show by inspection the height or centre cutting in level ground, of two sections with the given base and slopes, to be respectively equivalent in area, to the end sections of any given length of excavation or embankment; or these heights could be ascertained by the aid of an ingenious formula given by Mr. Macneill, and being found might then be wrought with in entering the tables according to the directions laid down: either of these proceedings, by determining a true mean cutting at each end, would obviate the necessity of a middle section, but neither, it is believed, would be altogether as satisfactory.

We desire to be understood as suggesting the application of the preceding process only to those exact calculations, required by the *final estimates* of sections; for running estimates or those on lines of location, less accurate but more speedy methods will answer every purpose.

Oldtown, Md., November 20th, 1839.

CHESAPEAKE AND OHIO CANAL.

This stupendous undertaking has made little progress for some years, as our readers generally know. In the last report the company "only ask the State to waive these unproductive liens to such an amount as may be necessary to finish the work to a profitable terminus, on its own resources. We do not think it possible that this application will again be refused by the legislature. It cannot be rejected, unless the people of Maryland have made up their minds to throw overborad their heavy investment in the Chesapeake and Ohio canal without an effort to save it, and fasten upon themselves and their posterity a permanent system of direct taxation."

One of the main objects of the report is to show that the interests of the company demand the continuation of the canal to the mines, and that they should not stop their works at dam No. 6, and depend on the railway as a feeder. This is sound reasoning and we sometime since attributed the success of the Delaware and Hudson canal company, to the circumstance of their owning all *from the mines to tide water.* It appears that only 18 miles are required to complete the canal to Cumberland when a large business is certain. The amount estimated as sufficient to finish the canal to that point is $1,500,000, and the company appear to be sanguine as to the practicability of raising this sum. The total cost of the canal thus far exceeds $12,000,000 and before even 5 per cent. can be paid on that sum, an immense business must be done.

The very low rates at which the Baltimore and Ohio railroad company offered, last winter, to carry coal has greatly alarmed them, and they appear disposed to deny the accuracy of the calculations of the company. They even publish a correspondence with a young English engineer travelling in this country who positively asserts, that the company "cannot carry coal and iron (except at a loss) for one and one-third cents per ton per mile; and experience has taught us in England that railroads cannot compete with canals in the carriage of heavy goods." A short article from Herapath's Railway Magazine in this number, will perhaps answer the latter position. With respect to the cost, the weight of authority is immensely in favor of the railway; but we are spared the necessity of discussing this point as we fully agree with the canal company in the importance of carrying their canal as near the mines as practicable. We also consider canals in that comparatively mild latitude far more efficient works than in New York and northern Pennsylvania where they are, with very few exceptions, incomparably inferior to *well located* common roads, a species of communication almost unknown in this country of rivers, lakes, railways and canals.

We see no allusion to the company working their own mines. To this circumstance we attribute the success of the Delaware and Hudson canal company. The coal in the cars costs them about 40 cents per ton—the mere labor of mining—and the difference between that sum and the price at which the coal is sold—$3,50 per ton—goes to pay the cost of transportation and dividends. If the Chesapeake company cannot adopt this plan, and secure to themselves the additional value which they confer by conveying the coal to market, we see little prospect of that undertaking ever becoming successful; and, unless we are much mistaken, they have more to expect from this course—working their own mines—than from any other plan they can adopt. Notwithstanding the low price of coal, we understand that at least one new route to the anthracite region is in agitation, with what success we know not. But if the Delaware and Hudson company divide ten per cent. while the Lehigh and Schuylkill are totally unproductive, might not a work similar in its operations to the first prove a good investment?

BALTIMORE AND OHIO RAILROAD.

We recently observed in a Cincinnati paper, a statement that B. H. Latrobe Esq., chief engineer of the Baltimore and Ohio railroad, was then in Ohio making a reconnoisance for the route of a railroad from the Ohio river to Cincinnati, to be a continuation of the Baltimore and Ohio railroad. The importance of the early completion of the railroad to the Ohio is becoming more and more evident every day to all who give the subject a thought, and it is truly surprising that a work of such vital importance as well in a national as a local point of view, should be thus delayed for want of the necessary legislation.

The enterprize and energy of the citizens of Baltimore stand out conspicuous in the magnitude of her public works. They were among the *earliest* in this country to engage in the construction of railroads, yet they hesitated not to embark more largely in them than any other city in the Union at that period; and of course, as with those who commence most new enterprizes, they have paid somewhat dearly for their experience, yet they have overcome the main difficulties. The *mountains* before them, with their present experience are as nothing in comparison with what they have overcome in their early want of knowledge of what could be accomplished with locomotive engines, in the prejudices of the community and in a powerful competitor for the right of way. Let them therefore press upon the legislatures of Maryland and Virginia the importance—the *necessity*—indeed, of early and liberal legislation which shall insure the completion of the road to the Ohio at the earliest period possible.

The net revenue last year, when, as now, only about half completed and terminating in a small village near the mountains, was nearly $300,000, and this year it will be very nearly if it does not exceed $400,000. An income which will enable them if the shareholders will forego their dividends for a few years, to raise the necessary funds to complete the work; and thus secure to Baltimore *the* great thoroughfare for *travel*, and an immense amount of transportation between the Atlantic seaboard and the valley of the Ohio and Mississippi thereby giving her the relative position occupied by her previous to the completion of the canals of New York and public works of Pennsylvania. Even now when nearly one half the distance between Baltimore and the Ohio is performed, the travel in stages, and the transportation in wagons, it is immense. The long line of post coaches, with their sleek horses and merry drivers, drawn up before the hotels when the cars arrive at Cumberland, reminds one forcibly of old times on the route between Albany and Buffalo. The huge mail bags and ponderous trunks are piled on and the passengers stowed away eight or nine inside and often one with the driver, when crack goes the whip and away goes No. one, two, three and so on until they number seven, eight or nine and often, indeed, ten or twelve in a string, bound for the Ohio, at Wheeling or Pittsburg—the distance being about 130 miles and is performed in about 24 hours steady driving—whereas the distance from baltimore to Cumberland 178 miles, is performed in less than ten and may be done in *eight*, hours in the comfortable cars of the railroad company, with very little fatigue. Notwithstanding the amount of travel on this route, the enterprizing proprietors, Messrs. Falls and company, have, we were informed and should judge from what we saw, always a supply of good coaches, so that there is no delay at the termination of the railroad, as at Chambersburg on the Pennsylvania route, where passengers frequently have to lay over a day for a seat.

The passenger cars on this road are unusually spacious, and the seats are so constructed as to enable those who have been riding all night in the stage to rest and sleep if they desire, and also to prevent easy access to their coat pockets by those whose fingers are habitually that way inclined. Their connection is also both simple and safe. An iron rod, 1¼ inch diameter passes the whole length, under the bottom and through a plate of spring steel in the centre, which serves both as spring and buffer, to prevent unpleasant concussions at starting and stopping; these rods are then connected by a small bar of wood which is ample to sustain the direct pull of the train but very likely to break when the locomotive runs off the track and thus avoids carrying the cars off with it. We commend this mode of connection to other companies as well worthy their adoption.

Cast iron wheels, cast on a *chill* are used for their locomotives, in preference to wrought tyre. They are much cheaper and are spoken of as equally safe and less likely to slip on the rail. They also use the steel journal and chilled boxes in preference to the plain iron journal and composition boxes—by which there is a great economy of oil. As an evidence of the truth of this, we examined a car at Newcastle, on the Frenchtown road, having steel journals and chilled boxes which were filled with palm oil in the spring of 1843, and, though it has been used, we were informed, as much as any other freight car on the road, (zixteen miles in length,) yet there is still an ample supply of oil in the boxes to last the season, or until January next.

The travel over this road will, within five years from the time of its completion, give a gross income of over $1,000,000 per annum; and the freight and U. S. mail an equal or greater amount. Indeed it is difficult to fix a limit to the amount of business which will pass over it; connecting as it will at the shortest portage, the Atlantic and its vast seaboard and, indeed, *all Europe* on one side with the vallies of the Ohio and Mississippi and *Oregon* on the other.

Notwithstanding the great increase of business the present, over the past, it will be still greater next year. The company now have a contract, operations under which are to commence by the 1st of November next, for over fifty thousand tons of freight from one concern annually. To accommodate this large increase of business they are now having made at the manufactory of Ross Winans, Esq., *six* locomotives of the heaviest class, and a large number of *iron* cars for coal. These engines are now nearly completed and will probably be in use most of them by the 1st of November; they are to weigh about 45,000 lbs. each and to have eight wheels of 33 inches diameter, all connected as propellers or drivers, and to be geered by spur and pinion wheels, so as to make about one and a half revolutions for each revolution of the main crank or shaft immediately operated upon by the steam power. This will give the engine a speed equal to four feet driving wheels without cog gearing; and enables the proper speed of the engine to be maintained without working the cylinders faster than is judicious, while driving wheels of very small diameter are used.

When engines have eight propelling wheels, with axles parallel to each other (as is the case with these) the safety and facility with which they will pass curves and through turn-outs, is materially increased by the use of small wheels. They resist, much more effectually, the increased tendency of the engine to run off the track occasioned by so large a number of axles in a parallel position to each other; yet this parallel position of the axles is necessary in order that all may be connected, in the most simple manner, to wit, by cranks and connecting rods from one to the other.

The cylinders are 17 inches diameter and 24 inch stroke and so arranged as to cut the steam off at half stroke and work the other half expansively, or to work full stroke, at the pleasure of the engine driver as the varying grade of the road or different loads require. They are also provided with a variable exhaust, that is, the exhaust pipe in the chimney may have its apperture contracted or extended at pleasure, thereby giving the conductor control over the steam-generating power of the engine, which can in no other way be so effectually had. By this means, together with the variable cut off, these engines are probably capable of exerting greater power than any other engines heretofore built either in this or any other country; they can also, at a moment's warning, do the work of the lightest class of engines with greater eeconomy even, than with those light ones now in general use. This is highly important on any road, but especially so on undulating roads where the duty of an engine is constantly changing from heavy to light and light to heavy, etc. The boilers will have about 1000 square feet of fire surface and 12 square feet of fire grate; to be arranged for the use of Cumberland coal. The tubes are of iron—welded by hand—2 inches in diameter, 8½ feet long and 212 in number."

The company are also constructing a large number of coal cars, on a plan which it is believed will effect a considerable saving in the cost of transportation. The body is of peculiar form, combining the strength of the cylinder and the cone; resting on springs and placed on six wheels; weight designed to be 2½ tons and to carry 7 tons of coal, or at least ten per cent. more coal in proportion to the weight of cars, than those now in use on the road, which are believed to be equal to the best in use on other roads—weighing about 3½ tons and carrying 7 tons of coal. These cars are so constructed, being upon springs, as to avoid much of the heavy concussion to which such heavy loads are liable, on a railroad at the usual speed; and they are also constructed with a special view to adjusting themselves to the curves on the road, by means of steel bearings or springs, placed edgewise, the ends made fast to the frame and the centre to the box which receives the journal of the axle and thus the three axles are allowed to conform to the curve and then to return to their position on a straight line, or to conform to a reverse curve.

Railways and Canals.—In the appendix to a statement issued on behalf of the Grand canal company of Ireland, in the matter of the proposed railway to Cashel, there are given some curious details as to the effect of railways on canal property. Thus, the Grand Junction canal, which forms the first 90 miles of water communication between London and Birmingham, had, in the three years immediately preceding the opening of the railway, an annual revenue from tolls, ranging from £174,722 to £198,000, regularly increasing. Since the railway has been fully in operation, this revenue has varied from £121,139 to £113,012. The Rochdale canal is 33 miles long, and throughout the entire distance the Manchester and Leeds railway runs parallel to it. In the three years previous to the opening of the dailway the tolls renged from £62,059, to £59,258; in the last three years they have varied from £31,533 to £27,165. The Kennet and Avon canal, and the Wilts and Berks canal, are both affected by the Great Western railroad, and the tolls of the former have fallen since the railway was opened from £46,703 to £32,045, and of the latter, from £19,328, to £8,477. The Fourth and Clyde Navigation has gone down from £62,516 to £42,218; and the Union canal, which connects Edinburgh with the Fourth and Clyde canal has had its net profits reduced by railways from £12,000 to £4,284. The market price of canal stock, has, of course, suffered in proportion. Thus, shares in the Grand Junction canal have fallen from £330 to £148 per share; Warwick and Birmingham, from £330 to £180: Worcester and Birmingham, from £84 to £55; Kennet and Avon, from £25 to £9; and Rochdale, from £150 to £61½; while Coventry canal shares, which at one time were as high as £1,200 per share, have fallen as low as £315.—*Herapath's Journal.*

ENGINEERING EXTRAORDINARY.

In accordance with our promise we submit to our readers a specimen of what we have ventured to call extraordinary engineering. We should have alluded to this matter long since had we sooner received a copy of the evidence, of which the principal extract given in this article is a very favorable specimen.

It appears that a parliamentary committee was appointed to examine the accuracy of the statements of the chairman of the board of works of Canada, who asserted that a canal round the "Cedars" rapids on the north side would cost above £100,000 more than a canal on the south side of the St. Lawrence. The only engineer giving evidence against the board—Mr. Casey—said that, the lockage being the same on both sides and the incidental works not materially different and not very important on either side, the difference must be sought for in the earthwork. But the total cost of this by his estimate little exceeded £100,000 and at the prices of the board of works actually fell short of that sum. On seeing the estimates of the board he pointed out how they made out their case. We give one of his objections and an extract from Mr. Killaly's answer or defence, which, though not *exactly* a refutation of Mr. Casey's charge, is quite as much so as any other part of his paper.

"In looking over the estimates just submitted by the board of works, in order to answer a comprehensive question put to me some days before those documents were received, I perceive that the line on the north side, on which the board base their estimates, by which they are enabled to show a difference of £100,000 against that side, and by which a reluctant assent to the location of the canal on the south side has been wrung from the right honorable the secretary for the Colonies, is far, very far, inferior to *another* line connecting the same points, and *well known* to the board of works.

"By the 'inland route,' surveyed by directions of the commissioners, in 1833, for a canal 100 feet bottom, by 10 deep, one-sixth larger than the present canal, there are—

Excavation,	cubic yards,	2798913
Embankment,	"	310139
		3099052
Less one-sixth,	"	516508
Total quantity by route of 1833,		2582544
By the route of the board of works, there are—		
Excavation,	cubic yards,	3076000
Embankment,	"	289066
Total quantity by route of 1842,		3365066
" " " 1833,		2582544
Difference in favor of route of 1833,	cubic yards,	782522

N. B. See "note" to document 22.)

This, at one shilling per yard, would amount to nearly £40,000; but I pass this by at present.

"The entire investigation rests, and *necessarily* so, on the assumption, that the board have, in their comparison, brought forward the *best* line on *each* side; for there is no more justice in charging one line with difficulties, which it is known can be avoided, than in giving another line credit for facilities of which it is known it cannot avail itself. You will please observe that I refer exclusively to surveys made by government, in 1833 and 1842, the former of which are confirmed by my examinations of this year. The difference is sufficiently remarkable, both as to amount and direction, and I beg leave respectfully, but earnestly, to call your immediate attention to it."

Mr. Killaly says:

"Before looking at those voluminous documents, I had expected to find in them, at least, some testimony bearing upon the question at issue, worthy of my most serious attention; but a very cursory examination of it has been sufficient to convince me that the evidence itself is of a character to preclude me or any other professional engineer, from attempting to analyse it, with a view to useful results. That portion of it, adduced in support of Mr. Simpson's charges, consists, for the most part, of matter which I may term a sort of ignorant gossip, almost wholly irrelevant to the subject. It is not indeed, wanting, in bold assertions of opinion; but those are made in language which is alone sufficient to prove to a man of experience that the witnesses by whom they have been made are profoundly ignorant of the very nature of the question, with respect to which they speak so confidently. The evidence is curiously characterized by vagueness, self-contradiction, confusion of ideas, gross exaggeration and positive misstatements.

There is but one point in which the witnesses are constant and consistent with themselves, and with each other—they all display, in a manner that must be obvious to any observer, a keen anxiety to establish Mr. Simpson's charges, by means of reckless assertion. I think I may safely add, judging from internal evidence alone, that the testimony of the witnesses has been concocted among themselves, or that their minds have been under the guidance—not to say direction—of some one or more persons, whose business it has been to get up a case in support of Mr. Simpson's accusation against me. These witnesses would have seem to have been, as it were, well drilled for the occasion. From this description I do not except either the written or verbal testimony of Mr. Casey, the engineer, employed by Messrs. Simpson and Harwood, and brought forward by Mr. Simpson as a witness against me. This gentleman himself states, (I use his own words,) "the object of my examinations and report was not to furnish an estimate "of the probable cost of a canal on the north side, but merely to show that "the Hon. H. H. Killaly was wrong, in leading the public to believe that "a canal on the north side would cost £100,000 more than the south side;" and accordingly up to this very day, he had not made any estimate in full of the cost of constructing a canal on the north side: on the south side he states he has not been for seven years; and, in answer to a question, he says that when he came before the committee he was not aware of so important a point as the scale upon which the present canal is being constructed. These two statements are characteristic, in all respects, of the whole of his testimony, namely—the absence of any valuable or even available information, with respect to the particular subject which he pretends to examine. He might well say that his only object was to criticise a report of mine; for the greater part of his entire testimony consists of a sort of literary strictures on my report to the governor-general, of the 1st of August last, and is far more fit to form articles in a newspaper opposed to the government, than to be submitted to a committee of the legislature, with a view of guiding their judgment upon a scientific point. I am sure that, in my long professional career, I never met with anything, purporting to be the production of an engineer, which so clearly evinces a determination, *fas aut nefas*, to make out and bolster up a case for the employers, and so utterly undeserving of serious notice."

Mr. Simpson's main charge is that "vessels which the canal would be capable of bearing, will be incapable of getting in and out." (Ev. p. 59.) Mr. Killaly says (p. 60,) there are "three entrances of from 600 to 1200 feet in width each and with a depth of water averaging from 12 to 20 feet." Now the pilots and numerous other persons in the neighborhood and two members of parliament, Messrs. Chesley and McLean, testified that in place of *channels* there were *shoals* with 3½ to 8½ feet in the *deepest* places! Mr

Casey says "*no trace of a single such channel can be found.*" This objection is answered as follows:

"The other witnesses brought forward by Mr. Simpson, although they do not pretend to science, like Mr. Casey, are disqualified, by their utter ignorance of the subject, from offering any opinion to which I can pay respect. They consist of pilots, wharfingers, farmers, a stage-coach proprietor, a store-keeper, a doctor, a timber merchant, residing at Bytown and the agent of an insurance company; the latter being Mr. Simpson's step-son; and the whole of them, not excepting the merchant, at Bytown, are deeply interested persons."

We fully agree that Mr. C.'s scientific pretensions do not enable him to turn 3½ into 12 feet of water, though we still consider pilots, wharfingers and even members of parliament capable of sounding water 4 to 8 feet deep. Yet after all this, Mr. Killaly says there are "two channels with *not less* than 8½ feet water," while Mr. Chesley says (p. 12) "I found in not less than 40 places a depth not exceeding 3½ feet." This is one of those misstatements—we use exceedingly mild terms—which admit of but one explanation.

Mr. Killaly's only argument is, that those daring to differ from him may have some direct or indirect interest in the question at issue; and, having shown or asserted this, he considers their evidence *proved* unworthy of credence. The extent to which he believes in this ennobling principle is boundless and openly avowed; it would be merely ridiculous and contemptible but for the vast power vested in his hands which he has exercised in constructing works of the most absurd dimensions. The difference in his defence and that of Mr. Brunel or of Mr. Samuda is distressing, and powerfully illustrates our remarks in a late number on the importance of *character* to the engineer who aims at anything higher than his salary. How different would have been the state of the public works and of the finances of the Province, had the services of a professional man been obtained with the skill and charecter of an engineer and a gentleman! Even a flying visit from Mr. Brunel, Mr. Rennie, Mr. Vignolles, Mr. Stephenson or any other experienced British engineer might have saved Canada from spending immense sums on works which are not merely worse than useless themselves, but which act so powerfully in preventing the undertaking of works really needed by the country, and which would again by their success lead to the rapid extension of similar communications wherever the wants of the community were such as to justify the necessary outlay. A case in point has just occurred. Suppose that, instead of building a canal to rival the St. Lawrence—see the fable of the frog and the ox—a railway had been carried to the lines about 80 miles at half the cost of 12 miles of ship canal along a navigable river. Then the Province would have saved $800,000 direct, a considerable annual sum in repairs, would have possessed a work at least supporting itself from the beginning and which would soon have paid 4 per cent. on its small cost. Then we should not have seen the late important railroad convention at Boston take place *without an allusion to a* *communication with Montreal via the Connecticut and Passumpsic rivers.* The object *then* would have been to carry the line as for north as possible, *now* they propose striking the south-east corner of Vermont. So that by utterly neglecting the cheap railway for the extravagant ship canal, the immediate benefits of the former are all lost to the present generation and its actual completion either delayed to a distant period, or it may be, altogether prevented. Such is the inevitable result of placing the public works—the most important of all interests in a new country—in the hands of political adventurers as ignorant of, as they are indifferent to, the interests of the confiding people on whom they batten.

We also find that some months after the work had been commenced the board was ignorant of "the nature of the bottom" of the shoals to be excavated, (p. 23) and, to cap the climax, that the board had *never met!* (p. 12). There was therefore nothing to interfere with the little arrangements of Messrs. Killaly and *Wakefield* whether of an engineering or financial nature. We are informed that the latter is generally considered to be the author of the paper from which we have made extracts, and it is every way worthy of "*his* long professional career." Of the "career" in which the former has displayed *his* "great scientific acquirements," (p. 40) we shall one of these days be able to speak with equal confidence.

For the American Railroad Journal and Mechanics' Magazine.

READING RAILROAD FOR 1845.

The advantages under which this railway will operate in 1845, and which it has not in 1844, although it will have delivered in this last year 400,000 tons besides the travel and merchandize, may be enumerated as follows:

1st. Full connection with *all* the mining points in the Schuylkill region.

2d. Motive power improved by Baldwin's *jointed* locomotive to *treble* its former power, with *less* wear and tear to machine and road.

3d. A full complement of cars adequate to the delivery of one million of tons per annum.

4th. Ample wharf accommodation for venting two millions of tons per annum, if required.

5th. The toll on coal in place of $1 to 1,25 per ton, will be raised to $1,37 to 1,50 per ton.

6th. *A double track* of solid railway the whole length of the line, imparting to all these advantages despatch and regularity; and as their final and collective consequence, producing an economy never before realized on any other railway in the world, moving such a mass.

It is now certain that 8 to 900,000 tons of coal will descend the Schuylkill avenue in 1844, and with only a moderate increase, it may be expected that 1,000,000 of tons will descend it in 1845. Of this quantity the railway will have the carriage of at least 7 to 800,000 tons, to which it will be fully competent. The result for that year, on the above premises and assuming that the proprietors of this road will see the advantage of *exclusively* *and at once* adopting Baldwin's improved motive power, would then be somewhat as follows. It is a case, which will be found an *exception* to the prudent rule of stopping to count the cost.

Coal, 800,000 tons (equal to 2700 tons per day for 300 days) at an average of $1,40 per ton,		$1,120,000
Travel and merchandize, $15,000 average per month,		180,000
		1,300,000
Expenses.		
Transporting coal at 25 cts. per ton,	200,000	
do. travel and merchandize at 25 per cent.	45,000	
Maintenance of way at $700 per mile of double track,	70,000	
General charges,	65,000—	380,000
		$920,000
Interest on $6,500,000 of loan at 6 per cent.	390,000	
do. 1,000,000 do. 5 per cent.	50,000—	440,000
Capital, 2,000,000 (equal to 24 per cent. for contingencies and dividend,)		$480,000
$9,500,000		

In explanation of what is meant by Baldwin's improved motive power, subjoined is an estimate of its cost per ton, compared with that of the old mode of transportation as collected for *this road.*

Items of expense.	Common 8 wheel 12 ton engine. Wooden cars.	Amount.	Jointed 6 wheel 16 1-2 ton engine. Iron cars.	Amount.
Engine drivers pay,	2 days, $2 per day,	$4,	same	4,
Fireman's do.	2 " 1,25 "	2,50	do. 2	5,
Conductors do.	2 " 1,30 "	2,60	do.	2,60
Brakeman's do.	6 95 "	5,70	do. 8	8,
Fuel,	wood and coal mixed	18,	do.	22,
Oil for engines,	2 galls. 86 cts.	1,72	do. 2 1-2	2,12
Repairs engine & tender,	180 ms. pr trip 6 cts.	10,80	do. 5 cts.	9,
Repairs cars,	185 ts., w'd c'rs 9 cts.	16,65	500 tons, iron cars 5 cts.	25,
Oil and grease for cars,	do. 1 1-4 cts.	2,31	do. 12 1-2 cts.	7,50
Supplying water,		50		85
Renewals of sundries,		1,72		4,28
Prop'n of assist. engine at 1 mile 42 feet grade,		2,50		2,65
Cost of a trip of 2 days or of 180 miles,		$69		$93,
Gross load of train,	340		775	
Number of cars hauled,	56 of 1 1-3 tons each,		100 of 5 tons each.	
Net weight of coal,	185		500	
Making a cost per ton of,	37·30 cts.		18·60 cts.	

The improved jointed Baldwin engine of 16½ tons is guaranteed by the builders to haul 500 tons at a trip as its regular load and to that it will ultimately be appointed. These engines could thus be made to deliver *one million* of tons running *three hundred and sixty thousand* miles, while with the old ones, it would require *ten hundred thousand* miles, that is, in the one case barely *one* ton is carried to the mile run, while in the other, it is nearly *three* tons. The above comparative table of items shows that, on this new system of transportation, that 25 *cents per ton for motive power and wagons* is a full charge for the road.

It is not long since that ridicule was the sure portion of him who asserted that the freight of coal on this road would not cost over 55 cts. per ton, while now, thanks in good part to Messrs. Baldwin and Whitney, it has been reduced down, to from 20 to 25 cts. per ton. It is gratifying to know that this valuable invention is properly appreciated, and that they now have their hands full in the manufacture of these admirable machines, from 8 tons up to 20 tons, for many of the railroads in the United States. Their workshop now gives employment to 350 hands.

The character, capacity and general appointments of this railway are therefore such, that if it ultimately costs ten millions of dollars it will be a cheap machine at that rate; and if from the untoward circumstances of the times through which it has been completed, this cost has been largely but unavoidably swelled, the expense of working it, has been more than proportionally cheapened, as compared with the original estimates.

Philadelphia, Sept. 1844. F.

RAILROAD CONVENTION.

A convention of citizens from Vermont, New Hampshire and Massachusetts was held in Boston, at the Tremont Temple, on Friday the 20th of September, for the purpose of calling the attention of the citizens of ***Boston*** to the continuation of the ***Fitchburgh*** railroad to Connecticut river, and thence to Burlington, Vt. There were many delegates present, representing the whole line to Burlington; and for a part of the way ***several*** routes were represented. *Abbot Lawrence*, Esq., of Boston, was called to preside, and on taking the chair, he made an address very appropriate to the occasion, which occupied but a short time in its delivery—as he said time was precious—and was to the point. He spoke of the advantages which Boston had derived from railroads, and of the importance to Boston of extending the system where it can be done, and especially into Vermont and to Burlington, that there may be a direct, easy and rapid communication with the capital of Canada. He said that on reading the report which had been put into his hands, he came to the conclusion that it was his *duty* as a citizen of Boston to subscribe $10,000, that he owed it to the people of Boston and therefore he decided to take that amount of stock; but on reading the letters of the Hon. Charles Hudson, in relation to the advantages of the road, a gentleman in whom he had the utmost confidence, he had come to the conclusion to subscribe $20,000 ***more*** as an ***investment***, and he was ready to do it.—When a little sectional feeling seemed to show itself in the discussion, he urged the gentlemen to avoid anything which might defeat or defer the object of the meeting, as he thought the present was ***the*** time to press forward this work, so important to Boston. A committee of fifty gentlemen were appointed to take the matter in hand and obtain subscriptions to the stock, which will undoubtedly be done, notwithstanding there has been over $1,250,000 of railroad stock already subscribed in Boston since January, 1844. Had New York but a few men like ABBOT LAWRENCE to ***lead***, we should soon have a railroad to Albany and another to ***lake Erie***.

AMERICAN RAILROAD IRON.

We recently visited the Mount Savage iron works near Cumberland in Maryland, mainly for the purpose of ascertaining what progress they had made in the manufacture of railroad iron. We found the work fairly commenced, a large quantity made and they were then about to commence working a double set of hands—that is to say, day and night. The rails then on hand, which are of the "bridge" form, 48 lbs. per yard, or a part of them, were to be laid on their own road, to connect with the Baltimore and Ohio road at Cumberland, about ten miles, which will thus open the way to send the bitumenous coal to market at a cheaper rate than it has hitherto been afforded at.

The works of this company now in operation, and nearly ready for use, appear, to one unused to such operations on a large scale, quite extensive; yet we were informed that only a small part of the contemplated works are built. Two large smelting furnaces are completed, one was then, and the other would be in a few days, in blast. A large rolling mill with eight or nine puddling furnaces in full operation and with which they were making railroad and other iron at a rapid rate. There was also nearly completed a large building for nail works and another for a cupola furnace. Dwellings for about 500 laborers, and a large storehouse completed and in use, constitute the present establishment, forming quite a village in the midst of the forest and surrounding hills which rise several hundred feet above the lofty chimneys in every direction.

The position for the works is admirably chosen, at the base of the hill, where it is so steep that a short bridge serves to connect the mouth of the furnace with the building in which the ore is prepared; and still the descent from the ore bed is so great that they are brought down to the furnace mainly by gravity.

The quality of the coal of this region is admitted to be at least equal, and by *many* deemed superior, to any other bituminous coal used in this country; and the iron ore found in its immediate vicinity is considered by good judges of superior quality--and the supply of both is believed to be inexhaustible—therefore we are induced to believe that at no distant day, the "Mount Savage Iron Works," will become celebrated, as well for the quality as the quantity of it iron--and especially for it railroad iron—and that, with other establishments, especially in Pennsylvania, which are now preparing to engage in the manufacture of railroad iron, we shall be able in the course of a year or two at farthest to make all the iron—and it will not be a small quantity—which we shall require in this country.

We shall refer again to these works in our next number and to the subject of the manufacture of railroad iron in this country—a subject in relation to which much will probably be said and written within the next twelve months.

CONTENTS:

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st New York, at $2 a year, in advance, or 3 copies for $5. | D. K. MINOR, Editor.

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NORTHERN RAILROADS.

The highly respectable meeting which took place at Boston on the 20th ult., of which we gave a sketch in our last, offers strong evidence of the estimation in which railways are held by an intelligent community as well acquainted with their working as any other—more so than any other in this country we may safely assert. The most striking feature was the calm, business-like view taken of the project, the care with which the cost had been ascertained, the thorough examination of the sources of income and lastly the additional traffic which might reasonably be expected from the—sooner or later—inevitable extension of the road to Burlington on lake Champlain. There was no false excitement, no promises of 20 per cent dividends; but the object was to state everything connected with the proposed undertaking so clearly and fully, as to enable every one to judge with confidence whether it offered sufficient inducement to warrant a permanent investment. Indeed it is with this view only that railways are constructed in Massachusetts, and the success which has thus far attended them is of course the most powerful possible argument for their still further extension.

The income of the road as well as the comparative merits of different lines in this respect were very ably discussed in three letters of the Hon. Mr. Hudson, which, though not free from error, are, on the whole, at least equal to any other papers which we have seen, having for their object the exposition of the advantages of a contemplated public work. They attracted much attention in Boston and have had great influence with those desirous of investing their means in railways. Their effect will therefore not be limited to the extension of the Fitchburg railway, but will be generally felt in their influence on the railway system of the commonwealth, "the only successful system of public works in this country," whose success we may safely ascribe to their being conceived in the spirit which pervades Mr. Hudson's letters, "the adaptation of expenditure to income" as one of our correspondents defined it when discussing the merits of another system of public works on the same principles.

There is great reason to believe that the stock of a railway through Massachusetts to the Connecticut river will be very shortly taken up. At the above meeting held in Boston, delegates attended from all parts of the country which any of the proposed lines were likely to pass through. Although a strong spirit of rivalry showed itself among them, we are glad to know that the best spirit prevails among those to whom we must look for the means. The great object of the road appears to be to strike lake Champlain at Burlington by the best route. On this point there is of course great diversity of opinion, but it appears to us that the greatest influence will favor a route avoiding New Hampshire, not only on account of the "peculiar institutions" of that benighted country, but also with the object of striking the Connecticut river as low as possible so as to secure the trade of that valley to the greatest possible extent and then to take a north-west course to Burlington. We alluded in our September number to the advantages of this route over that direct to Montreal by lake Memphremagog and the "Eastern Townships," and we find our views more than borne out by the views given by the numerous able speakers at this meeting. The direct line to Montreal was scarcely alluded to, and as they propose crossing the Connecticut near the south line of the State, it leaves the advocates of that line under the necessity of building a road up the valley of that river the whole length of the State of Vermont. So far therefore as Boston is concerned the line to Burlington will receive an undivided support and we consider its construction pretty certain.

The main sources of income relied on are the travel and trade of the country on the line of road. In addition to this however they will secure ultimately a large portion of the trade of lake Champlain and of Lower Canada now coming to New York. They look forward also to a new route to the west via Ogdensburg, and to the allowance of a drawback on foreign goods exported to Canada. But the trade and travel of the country itself will yield a fair income for the capital invested.

It is fortunate that the powerful aid of Boston is now enlisted in favor of allowing a drawback on exports to Canada and within a year or two the requisite permission will be wrung from congress. Then the trade of Upper Canada, the most valuable portion, will centre mainly in New York, while the trade and travel of the Lower Province will naturally centre in Boston when the railway to Burlington shall be completed. We again express our surprise at the indifference with which the completion of the line to Whitehall is regarded in Boston as well as in New York. We say in Boston for it would materially aid their Western railway, though it would not be able to compete with the line from Burlington either in cost or time. By this latter route Montreal will be brought within 24 hours of Boston, while it would appear impossible to reduce the time between New York and Montreal to less than 36 hours. The railway from Syracuse to Oswego will bring the entire shore of Ontario within from 30 to 36 hours of New York and will complete the main lines of "Northern Railroads."

The excitement is by no means confined to the States of Massachusetts and Vermont, but extends to New Hampshire, Canada and even to Maine. The Portland Advertiser contains a well written letter signed 'P,' which gives a general sketch of the public works of Canada and draws attention to the advantages of a railway from Montreal to Portland, the entire distance being 246 miles, or only 20 miles further than from Boston to Burlington. The writer also says that "Boston may be reached by the way of Portland as easily as by Concord, and by 29 miles less of road to be built." He has made some mistakes in the dimensions of the Welland canal, but, on the whole, makes out a good case for Portland were the question simply, which is the best route from Montreal to an Atlantic port open throughout the year, irrespective of way business, of existing railways, of established lines of steamers, of the interest and competition of Boston, etc. We have already stated that, in our opinion, the capitalists of Boston will give a decided preference to routes in their own State, hence a rival route to the north must not only not depend on that city for capital, but must actually be able to enter into competition with its numerous powerful companies for the traffic of the north. It is useless to look to Montreal at this time. Ship canals are the order of the day there and railways are considered beneath their notice. Boston holds the balance in this matter, and will unquestionably select that route which offers the greatest immediate return and the greatest ultimate benefit to that commonwealth of citizens, far surpassing in enterprize and energy all the other States of the Union and, in proportion to wealth and population, rivalling England itself.

PUBLIC WORKS AT AND NEAR LIVERPOOL.

Probably there are no places in the kingdom, not even excepting the metropolis, where a larger amount of money is in process of expenditure in the construction of public works than there is at this moment in Liverpool and Birkenhead. Almost in every direction on both banks of the Mersey huge preparations meet the eye; and, without entering into details, which would necessarily occupy much space, some idea of their extent may be gathered from an outline of the expenditure. In some of the following items the estimates include the cost of land. In Liverpool there are the following works now in progress: Assize courts (corporation,) cost **£80,000**; new gaol (corporation,) cost **£100,000**; Albert dock and warehouses (dock committee,) **£600,000**; new North Dock Works, including land and junction with Leeds canal (dock committee,) **£1,500,000**; reservoirs, Green-lane, and corresponding works (highway commissioners,) **£50,000**; Industrial Schools at Kirkdale (select vestry,) **£30,000**; gas extension (new gas company,) **£140,000**; Shaw street park (private shareholders,) **£2,500**; making a gross total of **£2,500,000**. All this is, of course, independent of many other works, some in progress and others in contemplation, with prospects of almost immediate commencement. Among those in progress may be reckoned Prince's park, now forming by Mr. Richard Vaughan Yates, at the south end of the town; the new Presbyterian church in Myrtle street;

the female orphan asylum, the Catholic female orphan asylum; the new northern hospital (towards which Mr. W. Brown recently contributed £1000;) St. Martin's schools, the Catholic magdalen asylum at Much Woolton, and St. Mary's Catholic church, in Edmund street. Besides other works in contemplation, we may mention the Daily Courts, on the site of Islington market (now discontinued;) the intended additional railway tunnel to the north end of the town, by the Liverpool and Manchester railway company; an additional merchandize station for the Grand Junction railway company; the enlargement of the Lime street terminus; and some improvements on the Bridgewater property. These various works altogether will probably absorb not less than another million. So that, in the whole, between three and four millions of money will have to be raised and expended before the various present designs for the promotion of charity, the convenience of commerce, and the improvement of the town, are completed. But, if much is going on in Liverpool in this way, more, in proportion to population and means, is doing on the Cheshire side of the water, at Birkenhead. Here indeed a town is rapidly rising, which will not be excelled in useful or ornamental elements by any place in the kinghom; and the progress of which, in buildings, as well as inhabitants, during the last four or five years, has been unprecedented. The magnitude of the public works in progress at Birkenhead may be inferred from the following abstract which is taken from the estimates: New market (commissioners,) £20,000; town hall (commissioners,) £10,000; park (commissioners,) £25,000; docks in Wallasea pool (commissioners, as trustees,) £400,000; dock warehouses on the margin of Wallasea pool (private company,) £600,000; tunnel from Monk's ferry to Grange lane (Chester and Birkenhead railway,) £20,000; making a gross total of £1,075,000; and, further, a proposal has been made which is now under the consideration of the finance committee of the Liverpool corporation, to buy the freehold of all their Wallasea estate, and pay for it in ready money! Besides the works named as being in progress, a cemetery and infirmary are contemplated, to which may be added a design for the erection of one or more churches. On the two former we believe it is intended to expend about £15,000. In these items me have said nothing about the sums being expended in sewerage and laying mains for water and gas; they are very large, and in this present year they will exceed any of the past. After these statements, it will be admitted, we think, that there are very few, if any, places where the progression in works of a public nature is greater than in Liverpool and Birkenhead; and that, if there is any rivalry between them, it should only be as to which shall best accommodate the public.—*Manchester Guardian.*

Extraordinary Steamboat Expedition.—Five weeks ago Messrs. Ditchburn and Mare, the iron steamboat builders at blackwall, received an order to build another steamer for the Waterman's steam packet company, without delay, and entered into an engagement to complete her ready for the conveyance of passengers in five weeks. The plans and drawings were at once made, the keel laid down, founders, shipwrights, joiners, carpenters and others set to work, and on Saturday evening last, four weeks and four days only after the order was given, and the keel prepared, the new stemer, which is called *Waterman* No. 12, was launched and conveyed to Debtford, to have her engines and machinery fitted in her, Messrs. Penn and Son, of Greenwich having, in the same space of time, made and finished two oscillating engines, of sixteen horse power each, with boilers and machinery. At ten minutes before five o'clock on Monday evening, and twenty-four hours before the expiration of the five weeks, the steam was up for the first time, and away started the vessel down the river, at a great speed. She is capable of carrying three hundred and fifty passengers and is a very handsome vessel of her class. *Waterman* No. 12 commences running between Woolwich, Greenwich and the Adelphia pier to-morrow. The fare to Greenwich has been reduced to 4*d*., in consequence of the low fares charged by the Gravesend steamers.—*Railway Mag.*

Stonington Railroad.—The total receipts for the year ending Aug. 31, 1842, were - - - - - - - $95,435 47

For the year ending Aug. 31, 1843, - - - 113,889 31

For the year ending Aug. 31, 1844, - - 154,724 02

This shows a very satisfactory increase in the business of the road, notwithstanding the competition of rival routes.

GENERAL DEMONSTRATION OF THE PRISMOIDAL FORMULA, USED IN EXCAVATION, EMBANKMENT, AND MASONRY CALCULATIONS: BY ELWOOD MORRIS, CIVIL ENGINEER.

In the number of this Journal, for January, 1840, the writer endeavored to develope a mode of measuring excavation and embankment solids, which upon the general *Hypothesis that the surface of all ground is composed of planes, longitudinally and transversely, and free from twisted surfaces,* may be regarded practically as accurate.

This method was made to depend essentially upon two points.

1st. That the formula, expressing the capacity of a prismoid, is the *fundamental rule,* for the mensuration of all right lined solids, whose terminations lie in parallel planes, and is equally applicable to each.

2nd. That any solid, whatever, bounded by *planes,* and parallel ends, may be regarded as composed of some combination of prisms, prismoids, pyramids and wedges, or their frustra, having a *common altitude,* and hence capable of computation by the general rule alluded to.

From these premises, the inference was drawn, that any such solid, (the middle section of which, parallel to the ends, could be ascertained) was susceptible of accurate determination: and consequently as the mid-section of any given portion of excavation or embankment, can be correctly deduced from the data, usually taken in the field, that therefore the capacity of these solid portions might be thus calculated. And we may here observe, that the same method is evidently applicable to masonry calculations, with even greater facility, as structures of masonry are usually composed of symmetrical solids.

The remarkable property of the prismoid, above alluded to, was established in connection with prisms, pyramids, wedges and frustra of pyramids, by a sinple inverse algebraic process, displaying the relation between the common rules, laid down by the writers on mensuration, and the prismoidal formula. But this formula, admits of a direct demonstration by the aid of the integral calculus, and of a more connected proof that it is the *fundamental rule* for the solidity of all right lined solids terminating in parallel planes.

As the paper on mensuration, before alluded to, relies upon the establishment of this property, it has occurred to the writer that it might be agreeable to some of the readers of this work, to have a direct developement of the principles, which that essay reduces to practice; and with this view, I propose, first, to establish the truth of the prismoidal formula, and then to trace up the dependence upon it, of the ordinary rule for the mensuration of other solids.

General Demonstration of the Prismoidal Formula.

Fig. 1.

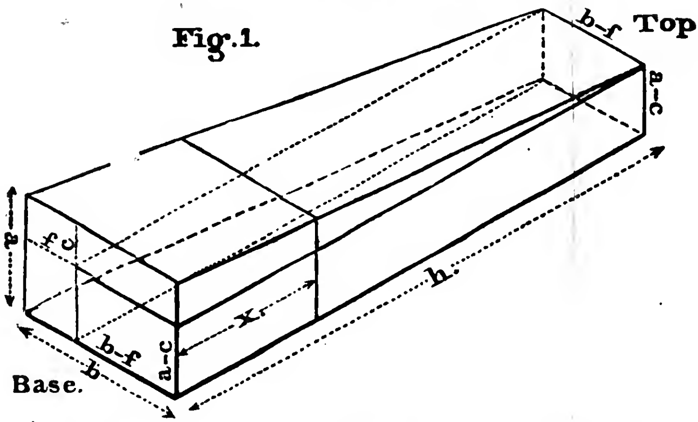
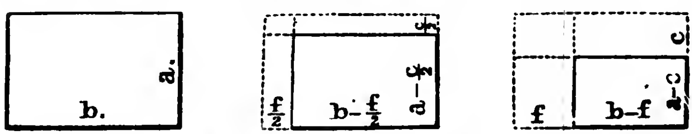


Fig. 2. Base = b. Fig. 3. Mid. sec. = m. Fig. 4. Top = t.



Let fig. 1 represent a prismoid; fig. 2, the base; fig. 3, the mid-section; and fig. 4, the top. All the dimensions being designated, as marked upon the several figures.

The area of the base will be, (see fig. 2,) $a \times b = ab$.

The area of the mid-section will be, (see fig. 3,)

$$\left(b - \frac{f}{2}\right) \times \left(a - \frac{c}{2}\right) = \left(\frac{2b - f}{2}\right) \times \left(\frac{2a - c}{2}\right)$$

$$= \frac{4ab - 2af - 2bc + fc}{4}$$

Whence four times the mid-section: $= 4ab - 2af - 2bc + fc$.

The area of the top will be, (see fig. 4,) $(b - f) \times (a - c.)$

$$= ab - af - bc + fc.$$

Any transverse section of this prismoid, parallel to its base, or top, will be a rectangle.

The lengths of the sides forming the rectangle of the top, are supposed to be less than those of the base, which correspond to them by the quantities f and c, respectively. And it is evident from inspection, that the sides of the rectangular sections, proceeding from the base towards the top, *diminish* as the distance of the section from the base *increases.*

Let x, be the distance of any section from the base, supposing it, o. course, to be parallel to the base or top, then the diminutions in the sides of this rectangle, will be to the total diminutions in the ratio of x to h, or as $\frac{x}{h}$.

∴ Therefore, generally, the area of any rectangular section of a prismoid, at any distance, x from the base, will be

$$= \left(a - c\frac{x}{h}\right) \times \left(b - f\frac{x}{h}\right) = \left(\frac{ah - cx}{h}\right) \times \left(\frac{bh - fx}{h}\right)$$

Whence expanding $= \left(\frac{abh^2 - bchx - afhx + fcx^2}{h^2}\right) =$ area section.

Wherefore the element of solidity, or differential of the solid,

$$= \left(\frac{abh^2 - bchx - afhx + fcx^2}{h^2}\right) dx.$$

Whence $\frac{abh^2dx}{h^2} - \frac{bchxdx}{h^2} - \frac{afhxdx}{h^2} + \frac{fcx^2dx}{h^2}$.

The integral of which will represent the capacity of any frustrum of a prismoid, whose length $= x$.

$$\int\frac{abh^2dx}{h^2} - \int\frac{bchxdx}{h^2} - \int\frac{afhxdx}{h^2} + \int\frac{fcx^2dx}{h^2}$$

$$= \frac{abh^2x}{h^2} - \frac{bchx^2}{2h^2} - \frac{afhx^2}{2h^2} + \frac{fcx^3}{3h^2}.$$

In point of fact, this integration produces a constant quantity, C, but as this $= O$, when we estimate the capacity of the solid, from the base, as we propose to do, we may neglect it.

Reducing to a common denominator, we have,

$$\frac{6abh^2x}{6h^2} - \frac{3bchx^2}{6h^2} - \frac{3afhx^2}{6h^2} + \frac{2fcx^3}{6h^2}$$

which is the general expression for the solidity of any frustrum of a prismoid, whose length measured from the base $= x$. Now to transform this expression, so as to apply to a whole prismoid, we must suppose $x = h$, and let $s =$ solidity:

Then substituting h for x in the above expression we have,

$$= \frac{6abh^3 - 3bch^3 - 3afh^3 + 2fch^3}{6h^2}$$

Or dividing by $h^2 = (6ab - 3bc - 3af + 2fc) \times \frac{h}{6} = S.$

Which expression may be transformed into the following,

$$\Big((ab - bc - af + fc) + (4ab - 2bc - 2af + fc) + (ab)\Big) \times \frac{1}{6}h = S. \text{ (A.)}$$

We will call this equation A, and it is equivalent to

$$\Big((\text{Area of top.}) + (\text{four times area mid. sec.}) + (\text{area of base})\Big) \times \frac{1}{6}h = S.$$

See the areas of these sections as heretofore deduced. The above equation A, is in fact, the general formula.

$(b + 4m + t) \times \frac{1}{6}h = S$ at which we desired to arrive, and the truth of which is established by the foregoing investigation.

To trace up now the dependence of the usual rules for the capacity of certain solids, upon the general formula, it may be premised, that of all right lined solids, bounded laterally by longitudinal planes, and terminated in two transverse parallel planes, we distinguish but *four* independent species, viz:

1. Prisms, which on account of the analogy subsisting between them, include cylinders.

2. Pyramids, which include cones, because cones, and pyramids of a common altitude, and equal bases, are equal.

3. Wedges.

4. Frustra of pyramids, which by analogy include frustra of cones.

To show that the general formula, is the *fundamental rule* for determining the solidity of these several solids, and by a necessary consequence, for the mensuration of any right lined solid whatever, made up of any combination of the four species, having *a common altitude*. We will take up,

1. *Prisms.*

These are in fact, prismoids, of which the end sections are equal and similar: and as all sections of a prism, parallel to the base, must be also equal and similar, therefore the sides of those sections do not diminish, and f and c, the diminutions of the prismoid, when it becomes a prism, vanish, or become $= 0$.

Substituting then in equation A, zero for f and c, we have,

$$\left(\left[a\,b - (b \times o) - (a \times o) + (o \times o) \right] + \left[4\,a\,b - (2\,b \times o) - (2\,a \times o) + (o \times o) \right] \times (a\,b) \right) \times \frac{1}{6} h = S.$$

$$\text{Which is equivalent to } \left((a\,b) + (4\,a\,b) + (a\,b) \right) \times \frac{1}{6} h = S.$$

$$\text{Whence, } (6\,a\,b) + \frac{1}{6} h = S.$$

Or, finally, $a\,b \times h = S$. which is the usual rule for finding the solidity of a prism, or cylinder.

2. *Pyramids*

A pyramid may be considered as a prismoid, whose sides diminish by such a ratio, that if the solid were prolonged from the small end, the sides of the rectangular sections, would vanish at the same moment, or concur upon a point, (the vertex of the pyramid;) considering the prismoid at this instant, it is evident that the diminutions f and c, of the sides of the base, become equal to the sides themselves, and if the base of the pyramid be any rectangle $a \times b$, we must, therefore, in equation A, substitute a for c, and b for f; and we have,

$$\left((a\,b - b\,a - a\,b + b\,a) + (4a\,b - 2b\,a - 2a\,b + b\,a) + (a\,b) \right) \times \frac{1}{6} h = S.$$

$$\text{Whence, } \left((o) + (a\,b) + (a\,b) \right) \times \frac{1}{6} h = S.$$

$$\text{Or, } (2\,a\,b) \times \frac{1}{6} h = S.$$

$$\text{Or, finally, } a\,b \times \frac{1}{3} h = S.$$

Which is, in fact, the common rule laid down in the books, for finding the capacity of a pyramid, or cone.

3. *Wedges.*

If we imagine the sides of the successive sections of a rectangular prismoid, to diminish by such a ratio, that if the solid were prolonged from the small end, they would not all vanish at once; then it will be found that when one pair of sides of the rectangular section disappears, the other pair will coincide, and become a right line, the solid in point of fact, will run to an edge, and the prismoid will be transformed into a wedge. Let the base, or back of any wedge, be any rectangle $a \times b$, and suppose in the prismoid fig. 1, the side a, to vanish, then it will become a wedge, of which $(b - f,)$ = the length of the wedge; a = breadth or thickness of the back; b = the length of the back. And as the side, a, is supposed to vanish, it will at the instant of disappearing, become equal to c, its diminution.

Substitute, therefore, in equation A, a for c, and we have,

$$\Big((a b - a b - a f + a f) + (4 a b - 2 a b - 2 a f + a f) + (a b)\Big) \times \frac{1}{6} h = S.$$

$$\text{Whence, } (3 a b - a f) \times \frac{1}{6} h = S.$$

$$\text{Or, finally, } \Big((b - f) + 2 b\Big) \times a \times \frac{1}{6} h = S.$$

But $(b - f)$ = "length of edge;" a = "breadth or thickness of back;" and $2 b$ = "twice the length of the back."

Consequently, this expression is in fine, the common rule laid down, by writers on mensuration, for ascertaining the capacity of wedges.

4. *Frustra of Pyramids.*

We may regard these solids as prismoids, whose sides diminish by a regular proportion to their own lengths, such, that if the solid were prolonged from the small end, all the sides of the rectangular section, would vanish at once, and the solid become a pyramid. Therefore f and c, the total diminutions in the sides of the frustrum, or the quantities by which the sides of the top are less than those of the base, must have the same ratio as the sides themselves.

$$\text{Or, } f : c :: b : a.$$

$$\text{Consequently, } b c = a f, \text{ and } f = \frac{b c}{a}.$$

Now in equation A, substitute $b c$ for $a f$, and $\frac{b c}{a}$ for f, and we have,

$$\Big((a b - b c - b c + \frac{b c^2}{a}) + (4 a b - 2 b c - 2 b c + \frac{b c^2}{a}) + (a b)\Big) \times \frac{1}{6} h = S.$$

$$\text{Whence, } \Big(6 a b - 6 b c + \frac{2 b c^2}{a}\Big) \times \frac{1}{6} h = S.$$

$$\text{Or, } \Big(3 a b - 3 b c + \frac{b c^2}{a}\Big) \times \frac{1}{3} h = S.$$

Which may be transformed into

$$\Big((a b - 2 b c + \frac{b c^2}{a}) + (a b - b c) + (a b)\Big) \times \frac{1}{3} h = S.$$

But $\Big(a b - 2 b c + \frac{b c^2}{a}\Big)$ is the area of the top, when the prismoid becomes a frustrum of a pyramid. And $(a b)$ = area of base, while $(a b - b c)$ =

$$\sqrt{\left(a\,b \times (a\,b - 2\,b\,c + \frac{b\,c^2}{a})\right)}$$

the square root of the product, of the end areas.

Wherefore, the above expression, is merely the usual rule for the capacity of frustra of pyramids, or cones, expressed in Algebraic language.

Besides the applications we have above given, of the prismoidal formula to the measure of solidity; it may be employed by simply substituting lines for surfaces, in the measurement of the superficies of triangles, parallelograms and trapezoids.

For a triangle may be regarded as a rectangular pyramid, of which one side of the base equals zero.

A parallelogram, as a rectangular prism, without thickness.

And a trapezoid, as a wedge on a rectangular back, the side of which is perpendicular to the direction of the edge, or in fact, the thickness of the back = O.

The prolific formula, of which we have been treating, has also, some other applications in mensuration, such as to determine the solidity of an Hemisphere, a Sphere, a Spheroid, either oblate or prolate, a Paraboloid, an Hyperboloid, and by a slight transformation, to calculate the surfaces of several bodies. But as all these are foreign to the present purpose, the writer does not propose to engage in their discussion.

Oldtown, Md., May 25th, 1840.

Reduction of Tolls.—It will be seen by the advertisement of the superintendent of transportation of the Baltimore and Ohio railroad company, that the charge for the transportation of flour from Harper's Ferry, Frederick and all points east of those places, has been materially reduced. From Harper's Ferry the charge will hereafter be 25 cents per barrel, and from Frederick and the Monocacy, the rate is reduced to 20 cents. We are heartily glad that this measure has been adopted, and we have no doubt that in due time it will prove itself to be both wise and profitable.

CANADIAN CANALS.

The two following tables contain numerous details which will prove interesting to our readers. They are from an official report for which, among other documents we tendered our thanks to the Hon. Mr. Woodbridge, U. S. senator from Michigan, in a late number of the *Journal*. The estimates are in 'currency' or four dollars to the pound. They amount to nearly 5 millions of dollars but do not include the sums expended before the establishment of the board of works, about four millions of dollars, making the total *estimated* cost nine millions for 88½ miles of canal, 59 locks and 537 feet lockage. This is about $100,000 per mile or more than the cost of the Reading railway complete for a down trade of one million tons per annum besides up freight and passengers in both directions 'ad libitum.' That is, the mere cost of these canals exceeds that of the Reading railway with a double track, buildings, engines, cars, wharves, etc., etc., for a trade about twice that of the Erie canal. We do not find a word of the revenue of the works in operation, the tolls charged and to be charged, or of the mode in which these canals are to cheapen transportation. The difference in dimensions are to us very curious, there being no less than five different widths at bottom and six at the surface. The favorite dimensions for locks are 200×45×9, though the locks of the Welland canal are only 150×26½× 8½ or in the ratio of 10 to 23. Now the Welland canal receives the New York trade as well as the Canada trade; the former exceeds the latter in amount; all freight in *both* directions must go by the Welland, while the river takes all the down freight from the St. Lawrence canals and the Rideau competes for the up freight. It appears therefore to us that the ratio should be inverted, that is, that the St. Lawrence canals should *at most* equal the Welland canal in dimensions of locks with a smaller channel to pass the nearly empty boats going up.

We believe the toll to be 20 cents per barrel of pork or $1,40 per ton, which would make the toll alone for 28 miles equal to 5 cents per ton per mile, a high price for the *total cost* of transportation on a railway doing a medium business. But great as is this charge and large the amount of produce passing the Welland canal, it will be long before it will have paid expenses and interest, even without any new rival.

It will afford us great pleasure to publish any communications giving a more favorable view of the prospects of these canals, for, in addition to their obvious disadvantages of immense cost and northern position, we confess that the communications of our correspondent on the "Canals of Canada" have not been without an influence which the case of the Beauharnois canal has not changed for the better. A statement of the income, expenditure, rates of toll, of transportation and of speed on these canals would be very acceptable. They are the only works of the kind in Europe or America, and their success or failure must powerfully affect the prosperity of the Province in general as well as the cause of public works there for many years to come.

There is one circumstance to which much importance is attached in this report: the low *cost per cent* of superintendence. This serves merely to cloak the most extravagant expenditures and gross professional incapacity. Suppose more competent men with twice the salary had executed better works for one half the sum; then the *cost per cent* for superintendence would have been four times as great though the public would have saved nearly half the total expenditure.

A low rate of superintendence estimated on the cost *may* prove economy in management; it *may* also prove great extravagance, the employment of cheap and incompetent engineers or, admitting their capacity, it shows generally that the work executed at the least cost per cent for superintendence either requires less engineering or has been more or less neglected. For example, it is about as easy to stake out a canal 10×140 as one 4×40 like the Erie canal though the difference in cost is nearly ten times. The whole system of these government canals rests, however, so exclusively on the "ad captandum" that it appears almost ungenerous to pull away this last leg left them to stand on.

WORK.	Appropriation. £	S.	D.	Estimate. £	S.	D.	Exp. to Sept. 1843. £	S.	D.	Time for completion.
Welland canal,	500,000	0	0	495,360	0	3	129,562	12	0	December, 1845
St. Lawrence canals,	768,535	11	2							
Prescott to Dickenson's landing,				168,124	8	11	243	4	0	December, 1845
Cornwall, to the time of opening the canal in June, 1843,				57,110	4	2	57,110	4	2	Compl'ted the banks being strengthened.
Cornwall, to repair breaks in the banks since the above period,				5,102	18	9	5,102	18	9	
Beauharnois,				247,521	18	4	68,856	13	0	May, 1845
Lachine,				250,333	6	8	16,109	12	11	December, 1845
	1,268,535	11	2	1,223,558	17	01	276,985	4	10	

CANALS.	Length in miles	No. of locks.	Lockage in feet	Size of locks. Length of chamber.	Width.	Depth on mitre sill.	Width of canal. At bottom	At surface	REMARKS.
				Ft.	Feet.	Feet	Ft.	Ft.	
The Welland canal,									This canal has two entrances in lake Erie, Ports Maitland & Colborne; and also communicates with the Grand river navigation at Dunnville. The lake at Port Maitland is open some weeks earlier in the spring than at Port Colborne or Buffalo.
Main trunk from Port Colborne to Port Dalhousie,	28	31	328	150	26 1-2	8 1-2	45	81	The whole of these works are under contract; several of the locks will be completed this season, and the entire line will be available in 1845. The navigation of the old canal being preserved uninterrupted in the mean time.
Junction branch to Dunville, } not added below.	21	1	6	150	26 1-2	8 1-2	35	71	
Broad creek branch to Port Maitland, }	1 1-2	1	6	200	45	9	45	85	
The St. Lawrence canals,									
Galops and Port Cardinal,	2	2	7	200	45	9	50	90	The surveys and other details of these works are now prepared, and they will be advertised immediately, and ready for navigation in 1845.
Rapid Plat,	4	2	11 1-2	200	45	9	50	90	
Farren's Point,	3-4	1	3 1-2	200	45	9	50	90	
Cornwall, passing the Long Sault rapids,	11 1-2	7	48	200	55	9	100	150	Completed, and in operation. The banks are being strengthened.
Buharnois, do. Coteau, Cedars and Cascades road,	11 1-4	9	82 1-2	200	45	9	80	120	In progress. The work rapidly advancing, and will be ready for navigation in the spring of 1845.
Lachine, do. Lachine rapids,	8 1-2	5	44 1-2	200	45	9	80	120	Surveyed but not yet put under contract.
Total from lake Erie to the sea.	66	57	525						The whole distance from lake Erie to tide water is 520 miles.

All these canals will be completed before the opening of the navigation in the spring of 1846.

There are a great number of minor works which swell the total estimated cost to £1,761,721, exclusive of large sums expended on the Welland, Cornwall, Lachine, Chambly canals and perhaps some minor works, which in the aggregate must reach five millions of dollars. The total cost will therefore be twelve millions of dollars as *estimated*, but if they are *completed* for fifteen millions the Province will be much more fortunate than the State of New York has ever been since the opening of the Erie canal. Whether those works will soon or ever be completed is a question we do not hazard an opinion on, but in any event we think the information conveyed in the tables will be generally acceptable to our readers.

(A considerable sum, about $260,000, is to be expended in deepening lake St. Peter, between Mantreal and Quebec, but this will not affect the western trade, for, should that ever become very important, the trans-shipment will of course take place at Quebec, as it will only cost half as much to run the light barges with their heavy cargoes to that port as to bring heavy sea vessels to Montreal to load them.)

ALLAN'S MINERALOGY.

The deep cuttings and tunnels on the numerous public works of the present day afford the fairest opportunities for the study of mineralogy as well as of geology. By means of the latter science we acquire a knowledge of the peculiar earths or rocks likely to be encountered in certain localities, and mineralogy teaches us the chemical constituents of these substances. In a general reconnoissance of a country such as *ought* to precede all instrumental examinations the general arrangement of the strata is the great consideration; but when the construction is to be commenced, the properties of the various earths to be removed and of the stones to be used in building must attract the attention of the engineer. In these important investigations he will be materially aided by the very valuable edition of Phillips' Mineralogy, edited by Francis Alger, Esq., a scientific gentleman of Boston and lately published in this city. This is not one of those re-publications to which the American editor contributes only the sanction (!) of his name in large capitals on the title page; but it is just what it professes to be, the best English elementary treatise on mineralogy with the latest European additions to the science as well as the numerous and very valuable contributions of the extensive geological surveys which do honor to the States by which they have been authorized. The publishers say:

"Phillips's Mineralogy has proved the most popular treatise on the science ever published in Great Britain. Prof. Brande, of the Royal Institution, London, thus speaks of it. 'One of the most useful practical works on mineralogy, and, in our language at least, the most available for the use of the student, is Mr. Allan's edition of the elementary treatise by the late Mr. Wm. Phillips.' Its circulation in this country has also beeu very extensive. The present edition comprises three hundred more pages, and one hundred more figures of crystals, and about one hundred and fifty more species and important varieties, than are contained in Allan's edition. Notwithstanding these additions, the price of the book is considerably less than Allan's, or any other recent treatise on the subject.

"For the convenience of those who may wish to arrange their cabinets on a chemical system, several hundred extra copies of the formulas have been struck off, and will be sold at the cost of printing. These can be conveniently cut apart and pasted upon the specimens.

"We would add, that this work has been approved by Prof. Webster, and adopted by him as a text book in Harvard college; the splendid cabinet in that institution, having recently been re-arranged by him, in accordance with the same system."

THE LONDON AND BIRMINGHAM RAILROAD,

Is 119 miles in length. It cost £6,002,452, or thirty millions of dollars. It is well managed. The expenses, proportioned to the receipts are only 32 per cent. with a mixed traffic of passengers and freight. The receipt from the former, proportioned to the latter is as three to one.

The receipts for	1842	were	£809.247
"	1843	"	818.522
Six months	1844	"	405,768

These receipts average £813,000 per annum for 3 years and are double the amount received per annum in this State, for tolls on all our canals, of six times the length of this road. The original cost of these canals, were not half the cost—a little over one third—of this road of 119 miles.

This road contends successfully with a canal (the Junction) that runs side by side with it. The receipts and value of the canal has fallen off full 50 per cent. while the railway stock is £225 for 100 paid, and divides regularly ten per cent. per annum.

The British government allow this road £14,700 per annum, or at the rate of $600 per mile per annum, for her penny mail which now nets the government $3,000,000 per annum. J. E. B.

NEW PROPELLER.

A friend and frequent contributor obliges us with the following particulars of the mode of construction and performance of Aldrich's vertical submerged paddle wheel.

"We were indebted to the proprietors of the Atlantic Works for a pleasant excursion down the bay, on an experimental trip, in the Orion, a vessel of 150 feet between extreme points, 140 feet keel, 25 feet beam and 10 feet hold, 350 tons.

"Messrs. Allaire and Aldrich who accompanied us, stated that the form of the vessel was not such as they would have desired for the engine, for speed, and they were limited as to space, to make her an effective freight-carrying vessel. The owners of the hull selected their model, and if the small vertical wheel did not work, it was to be taken out with the engine, and the loss was to fall on these enterprising mechanics. It is therefore gratifying to record that this essay was perfectly successful, taking into view the fact that everything was new. The boiler generated foam faster than steam, which, forcing itself into the cylinders, caused us to stop several times, to blow off water. This defect we believe is common with new boilers. It was difficult to keep up, from this cause, 30 to 40 revolutions. To give full effect to the wheels, it is desirable, and they can be made to revolve from 55 to 60 times to the minute.

"To give you some idea of our speed and the distance run, I would state that we left the Atlantic Works at 11, A. M., with Mr. Henderson, pilot, and run down the bay and past the Hook to 'south the Cedars,' a distance of 25 miles, the tide favoring us, but with a strong wind against us. On our return, we marked the time from Fort Hamilton up to the Dry Dock wharf, opposite which we arrived at 4.20 P. M, making 12 miles in the hour. The average of the above is ten miles, with a two mile current, if we take off 45 minutes for stops, to blow off the water in the cylinders, and to get up fires of anthracite coal.

"The wheels are made water tight, of boiler iron, seven feet five inches diameter, twenty inches wide. On the species of drum are placed iron buckets, 14 inches deep, thus making the whole wheel but 9 feet 9 inches, to propel a vessel of 350 tons. One of the great merits claimed for this wheel is, that it is placed within the frame of the vessel, in a species of water-tight bunker, and is no impediment, except the revolving motion of this small wheel, when thrown out of gear.

"The whole apparatus is placed in a space of about 22 feet square. The boiler is 18 feet long by 6 feet diameter. There are two cylinders, 20 inches in diameter, with a thirty inch stroke, one on each side of the boiler acting directly on the crank.

"It was the wonder of all on board, when the steam was once raised to 42 revolutions, to notice her performance."

The engine and paddle wheels were from the well known establishment of Mr. Allaire. One of the advantages of this wheel is that it may be made so as just to float without bearing on the boxes. The present wheels bear on the upper box. It will be distinctly seen that the friction is reduced to a minimum when working, and, when sailing, with the wheels out of gear, the retardation must be very small—insignificant as compared with the ordinary paddle wheel or Ericsson's propellers. The breadth of beam is not increased; this is a great consideration with sea-going vessels as well as with canal boats, unless the vertical wheels work too near the bottom to be applicable to the latter.

The Allaire works are very extensive and are to be considerably increased. They employ above 200 men and do all the work connected with steam engines and other heavy machinery within themselves. It is on such establishments that we must rely for steam ships to extend our commerce in peace and to defend our harbors in war. It is of the want of such establishments in France that the Prince de Joinville complains so loudly and without which he very properly concludes, that rivalry with England either in peace or in war is impracticable. A very slight inspection of the Allaire works will convince any one of the expense, skill and method necessary in such concerns and of the difficulty attending their establishment in the first place. Luckily this country now boasts many such, considerably in advance of other nations—England of course excepted—both as regards skill and capacity. We give in this number an example of quick work in England, than which nothing can better illustrate the importance in every point of view—commercial as well as military—of these large and well conducted private engineering establishments.

GREAT WESTERN RAILWAY OF ENGLAND.

That some idea may be formed of the cost of this work compared with railways in this country, I would state from the last report, that 119 miles exclusive of the Cheltenham and Oxford branches, cost £6,705,112, or $33,525,560. The following, in round numbers, at $5 to the £1, compose the items of this immense expenditure.

	Total.	Per mile.
Law expenses and procuring act of incorporation,	$950,000	$8.500
Land for road bed, - - - - -	3,960,000	33,560
Engineering, - - - - - -	775,000	6,568
Grading, - - - - - -	18,835,000	159,610
Superstructure, - - - - -	5,600,000	47.457
Motive power, - - - - - -	3,018,750	25,582
Incidental and office expenses, - - -	386,810	3,276

or at the rate of $284,000 per mile.

On this immense expenditure this road now pays 7 per cent. The company procure loans at an extended period at 3½ to 4 per cent.

The capital authorized is, - - - - -	£3,673,603
Authorized to borrow, - - - - -	3,679,343

The width of the track is seven feet. The average velocity with the mails, for which the government pay $400 per mile per annum, is 35 miles per hour.

On the London and Birmingham road the British government pay $600 per mile per annum for a less rate of speed, but for a greater service. The mail service on other roads and branch roads in England, varies from $200 to 600 per mile per annum.

The total receipts for 1842, were - -	£669.535
" " 1843 " - - - -	707.522
6 months, " 1844 " - - -	369,250

The expenses, proportioned to the receipts, were 39 per cent. in 1842; 36 in 1843; 34 in 1844. The receipts from passengers, proportioned to receipts from freight and the mails, was as 3 to 1. The whole number of passengers transported during 1843, was 1,629,150. The average number daily, 4500. The number of miles travelled in 1843 = 53,942,124.

This immense business, = £740,000 per annum, is more than double the average tolls received on all the canals in the State of New York for three years past. These receipts do not equal the average amount received per annum —£813.000—for the last three years from the London and Birmingham railroad (119 miles) in length. An amount, that shows the importance of that road and the Western railroad to the travelling and trading community of Great Britain. The average speed of railways, over coaching, is in the ratio of 4 to 1, when stops are included. The rates of freight, both by canals and teams have been reduced, since the introduction of railroads. This great improvement has enabled the British government to introduce the penny postage system, with a nett profit of $3,000,000 per annum, rapidly increasing.

☞ Will the government of the United States profit by this example and secure in time, the right to use the several State incorporations, on equitable terms, compared with the service they can render the government.

J. E. B.

Mr. C. Williams, "a farmer of old Suffield, Mass.," has published a very sensible letter on the Massachusetts and Vermont railroad, in which he draws attention to the saving which would result from connecting Brattleboro' with Boston via Springfield and the Western railroad in place of extending the Fitchburg road to that village. He says:

"It may be well, for a moment, before it is concluded that the valley road is an object without inducement, and to be abandoned for the sake of a connection with the Massachusetts and Vermont road. by means of a branch road, to count the cost of the two enterprizes, and the comparative probabilities of their completion. The Northampton and Springfield road may be practically considered as completed. The distance from Northampton to Greenfield by railroad line is 18¾ miles, of which eleven miles are straight over a sandy plain, where the deepest cut will not be more than eight, and the heaviest filling twelve feet. The rest of the line has but little curvature and is very feasible. The estimated cost of the road with a T rail of fifty eight pounds to the yard is $275,000, and the road can be completed in one season.

"The distance from Greenfield to Brattleboro' is 19 miles, and the cost of a railroad cannot exceed $20,000 per mile, or about $380,000 for the whole distance.

"Thus it appears that the cost of connecting Greenfield with Boston by the Western railroad, will be $275.000 and of connecting Brattleboro' $655,000; the distance from Brattleboro' to Boston by Springfield, being 154 miles.

The cost of connecting Brattleboro' and Greenfield with Boston, by means of the Massachusetts and Vermont railroad, will be according to the estimate, by way of Northfield, $1,655,303, to which add the cost of a branch to Greenfield, $222,000, and we obtain the cost of uniting these towns with Boston, $1,877,303. Distance from Brattleboro' to Boston by the Fitchburg railroad, via Northfield, is 117 miles. Outlay necessary to save the distance of 37 miles upon a railroad, which may be run in less than two hours, $1,222,303.

WOODEN RAILWAYS FOR IRELAND.

The late elaborate report of the Irish railway commissioners of 1838 has no doubt elicited many plans for applying and supporting an economical system of intercommunication by railroad in Ireland. Among the most deserving of attention of these is one contained in a letter recently addressed to the Irish railway committee of the house of commons by Mr. Bridges, in which that gentleman applies himself with much practical knowledge of the subject, to prove that a system of wooden tramways, equally expeditious and more safe, more durable, and conisderably more economical than the iron railway, might at once be introduced into Ireland, to the mutual benefit of the English, Scotch, and Irish capitalist, merchant and laborer. In conveying to our readers a notion of this plan we shall avail ourselves of portions of Mr. Bridge's letter, and thus describe its details:

"The rails, or rather trams of 7 to 8 inches scantling, are indurated and protected against the ordinary destructive agencies of fire, rot, and insects, by a very philosophical process, to wit, the injection, by successive exhaustion and pressure, of two solutions, mineral and alkaline, which, by decomposition, transmute the timber into a new and incorruptible substance. These trams are laid down on the principle of the 'double way' of the ancient tramroads, which is also the modern principle of the Great Western railway; that is to say, they are let into wooden transverse sleepers, and secured thereon by wedges, forming one great frame of longitudinal and cross sleepers, on the level surface of the ground. The tires of the wheels are perfectly flat, and before and behind each carriage two guide wheels (the Prosser guide wheels) are fixed at an angle of 45 degrees, revolving upon independent axles; a deep groove in their circumference embraces the upper and inner edge of the trams, and the friction being thus thrown upon the oblique axle, the carriages are guided with perfect safety, and without any perceptible abrasion of the rails. The friction and oscillation, and general wear and tear involved in the use of the conical tire and the flange, are thus obviated; and the friction of attrition is converted into a friction of rotation. All the wheels, moreover, are on separate axles, so that in a curve, the inner and outer wheels adapt themselves necessarily to each sinuosity; on the present system of common axles, the outer wheel revolves while the inner one is dragged along upon a curve. Upon a level, experiment has proved that one-fourth less power is required to move an equal weight upon a railway of this construction than upon the flanged wheel carriage of an iron rail; at the same time, the bite of the wood affords a greater power of ascending gradients, and the bevel wheels give the facility of traversing the sharpest curves. A machine of seven tons can thus mount and descend gradients of less than 1 in 20, and traverse curves of 500 feet radius at the rate of 25 miles an hour. On the one hand, the durability is attested by the fact that wood properly prepared has recovered the deflexion occasioned by the pressure of 140 tons upon a segment of an iron wheel three inches in the tire, and that an experimental traffic equivalent to seven years of an ordinary line did not obliterate the sawmarks upon the wooden trams, which on the contrary actually polished the bevelled surface of the guide wheels. While the guide wheel is equally applicable to the ordinary iron railway, a peculiar advantage, besides that of primary economy, in the use of the prepared longitudinal beams, is to be found in the action of the deliquescent salts which entre into their preservative composition, and which effectually prevent slipperiness from frost, and from the opposite extreme of intense summer heat.

"The superiority of longitudinal sleepers over stone blocks and chairs, is demonstrated by the successful experiment of the Great Western railway; and the *rationale* of such a mode, and its peculiar adaptation to the circumstances of Ireland, in spite of the abundant stone of that country, are well exhibited by Mr. Vignoles, in the appendix to the Irish railway report, (appendix A, No. 1.) The rigidity and the vis inertiæ of stone supports, indeed, may be held to be one among the many causes in operation which induce such a fearfully rapid wear and tear upon some of the existing railways.

"The comparative saving in the mere superstructure of wooden and iron railways may be thus tabularly exhibited:

Wooden Rail.			*Iron Rail.*		
5280 cubic feet, 2*s.* per ft.,	528	0	With rails 60 lbs. to the yard it will cost for rails, chairs, bolts, etc.,	2400	0
Paynizing,	62	8	Labor and carriage,	300	0
Wedges, labor and carriage,	300	0	Contingencies,	240	0
Contingencies,	240	0	3520 sleepers, at 3*s.* 6*d.*	616	0
3520 sleepers, at 3*s.* 6*d.*,	616	0		£3556	0
	£1746	8			

Balance in favor of wood in supersuructure alone, £1809 12*s.*

"Besides this, there will be at least one-fourth less cutting, and a continuous saving in wear and tear of machinery, carriages, etc., which may be two-thirds less in weight, with equal tractive power. But the immense saving in construction, in superstructure, earthworks, embankments, masonry and purchase of land, is even of less importance than the immense moral and social advantage which the system involves, of connecting towns and villages in all directions, which the present mode altogether excludes from the benefits of more rapid intercommunication. On the present system, a saving in the expense of embankments, necessarily involves an additional cost of working. A better illustration of this cannot be found than in a comparison of the two surveys of Sir John Macneill, in his valuable report on the North Irish line (report, appendix, No. 4.) There are scarcely any gradients or curves in the Irish railway report, which need be avoided by the guide wheel system of wooden railways. By such a system, a line from Shrewsbury through Wales, to Port Dynllaen, even more direct than that suggested by the commissioners, might, in the first place, be thus constructed for less than one million sterling, bringing Dublin within 12 hours of London; and thereafter the Irish metropolis might be brought into rapid communication with every town in Ireland, at an average cost of £4000, or £5000 per mile.

"To sum up the benefits to be anticipated from the adoption of the new system.

"First, as regards the details of expenditure:

"Tunnels, deep cuttings, embankments, and bridges will, in most cases, be entirely obviated, seeing that gradients of 1 in 20, and curves of 500 ft. radius, may be readily surmounted at a speed of 25 or 30 miles per hour: the purchase of land is reduced in amount; the material is greatly cheaper than iron: engines and carriages may be reduced to one-third of the usual weight, with greater tractive power; the annual wear and tear is also reduced, and as the rails are laid down on the existing face of the country, no disfigurement of the ground is necessary upon private estates, which are ordinarily deteriorated to an extent for which no amount of compensation can be an adequate equivalent; and, at the same time, as a necessary consequence, the crossings from one part of an estate to another may be maintained in every direction. It is to be noted particularly that the system involves no central rail, or indeed any complexity to preclude its adoption on existing iron railways.

"Second, as regards the public interest:

"Safety is insured by the use of the guide-wheels, which, being adapted to the upper and inner edge of the rail, and attached at an angle of 45 degrees, preclude the possibility of an overturn, while, by their peculiar construction, scarcely coming into play except when a great centrifugal influence arises, there is no calculable amount of abrasive action on the tram.

"Cheapness of transit to all classes, is of course induced by the reduction of primary expenditure; and ease and comfort are in an eminent degree secured by the avoidance of those causes of oscillation which are involved in the use of the conical tire on the iron system.

[We do not pledge ourselves to the absolute correctness of the statistics of the above plan; but we thought the subject of so interesting a nature as to warrant us in laying it before our readers.]

"An experiment to test the adaptation of the guide-wheels to iron railways has just been made upon the Hayle line, and has completely succeeded. The groove of the guide-wheels was reduced so as to pass over the chairs in which the iron rails are fixed. A loaded truck fitted with guide-wheels, and divested of the flanges on the bearing wheels, was propelled with a fourth less power than one equally laden, but with the common flange-wheels; proving that an engine can take a train of carriages fitted with the Prosser wheels one-fourth heavier than with the flange-wheels now in use. Moreover, the oscillation, when going at full speed, was found to be almost insensible. This will produce a corresponding saving in the wear and tear of carriages and engines, as well as add greatly to the duration of the rails; and the adoption of the guide-wheels to existing or projected iron railways is worth the attention of those engineers who are unwilling to adopt the wooden rail till it has been fully tested by practice on the lines that have determined to make use of it."—*English paper.*

HARRISBURG AND LANCASTER RAILROAD.

We have the report of this company dated September 6, 1844, giving a detailed account of the state of their affairs. We extract the following statement of the business and cost of working the road. It will be seen that the repairs of the track laid with the heavy rail were only $68·38 per mile, an amount unprecedentedly low, but of which no explanation is given.

"The whole revenue of the fiscal year is as follows:

From passengers,	$53,639 40	
" freight,	18,067 17	
" mails,	5,400 00	
" rents,	170 12	
" sale of old materials,	123 01	—$78,891 35

"The expenses proper of the road and company may be condensed from the statements of the treasurer and superintendent, as follows, viz:

1. Maintenance of way and expenses of real estate and fixtures,	$8,094 47
2. Locomotive power,	15,165 88
3. Cars,	3,562 42
4. Carrying mails to post offices, removing snow from track, damages for killing cattle,	579 28
5. Insurance, taxes, attorneys' fees and legal expenses,	465 48
6. Salaries of superintendent, clerk, collectors and conductors,	2,721 58
7. Salaries of president and secretary, and travelling expenses of board and officers,	2,163 24
8. Office rent, office expenses, postages,	406 07
9. Printing, stationery, engraving bonds and sundries,	369 54
	$33,527 96

"The interest upon the company's debts, if they were all funded, would be per annum, ... $35,200 00

"The miles travelled by passengers are 1,445,316, being equivalent to 40,147 through passengers.

The revenue from passengers is $53,639 40, equal to $1·34 on an average for each through passenger, or $3\frac{71}{100}$ cents per mile.

"The number of passenger and baggage carried over the road, (reduced to four wheeled cars) is 5820, equal to 209,520 miles, and the average number of passengers to four wheels, is 6·79.

The whole eastward freight in lbs., is - - - -	23.219,021
The whole westward freight in lbs., is - - - -	[illegible]2,268,944
Total eastward and westward, - - - -	35,487,965
The eastward tolls amounted to, - - - - -	$9,944 79
The westward tolls amounted to, - - - -	8,122 38
Total eastward and westward, - - - - -	$18,067 17

Red. to 4 wheel cars.		
	The number of freight cars cleared, is - -	9,003
	The miles run by freight cars are, - - - -	259,291
	The equivalent number of through cars, - - - -	7,203
	The average load per car in lbs., - - - -	3,942
	The average receipt per car in dollars, - - - -	$2 01
	The average receipt for each through car, - -	2 51
	The average receipt for each mile run by freight cars $6\frac{27}{100}$ cents.	

"The maintenance of way and expenses of real estate and fixtures have cost $11\frac{18}{100}$ cents for each mile run by locomotive engines.

"The locomotive power, which includes repairs of engines and tenders; fuel for locomotives and machine shops; oil, cotton waste and rags; wages of enginemen and firemen; wages of laborers engaged in pumping water for engines, tending switches, sawing wood, watching bridges and depots, amounts to $20\frac{24}{100}$ cents per mile, run by locomotives.

"The whole expenses proper of the road and company, amount to $46\frac{28}{100}$ cents per mile run by locomotives, almost exactly the same as last year.

"The expenses of the passenger and baggage cars have been unusually heavy; the stock having been greatly improved in condition during the past year. The distance run by our cars has been increased 50 per cent. in consequence of the arrangements with the Eagle line; it is equal to 313.500 miles run by 4 wheeled cars. This item, exclusive of oil, which is found by the Eagle line, costs $1\frac{13}{100}$ cents for each mile run by 4 wheels.

"The greatest distance run by one engine, is by the Charles B.

Penrose, being in miles, - - - - - -	19,836
The least distance is by the Flying Dutchman, - - -	2,664
The whole distance run by all the engines, - - -	72,432
"This is divided as follows, viz:	
Engines without cars, - - - - - -	1,080
Passenger trains exclusively, - - - - -	33,696
Freight trains exclusively, - - - - - -	18,192
Mixed trains, carrying freight and passengers, - - -	18,864
Trains carrying road materials, - - - - -	600
Total, - - - - - - - -	72,432

"The average cost per mile of the repairs of 18 miles of iron track, between Dillerville and Elizabethtown, including roadway, bridges, and superstructure, labor and materials, is - - - - $68 38

"The average cost per mile of the repairs of 18 miles of flat bar track, between Elizabethtown and Harrisburg, including roadway, bridges and superstructure, labor and materials, is - - - - $356 24

"It appears from this that the repairs of the plate rail track cost per mile more than five times as much as those of the track laid with the H rail; without taking into consideration the wear and tear of engines and cars, the loss of time and the reduced loads which can be transported over the former. These items amount in the aggregate to vastly more than the interest on the cost of a good track on the remaining half of the road. The board look forward confidently to the early construction of this important improvement, which will enable the company to increase their freight business very materially, and will add greatly to the comfort and convenience of travellers. We do not now press its consideration, because we deem all matters of minor importance to the great measures which we have so much at heart, and which we again earnestly urge upon the stockholders, viz. the funding or redemption of the floating debt, and the cancellation of the assignment. When these obstacles are removed, the construction of a new track between Elizabethtown and Harrisburg will be of easy accomplishment, and will follow as a matter of course.

EDWARD MILLER, *President.*

We give also, the statement of the numerous items included in the expenses of the year as per account of the superintendent.

1. Repairs of 18 miles of track, between Dillerville and Elizabethtown, including roadway, bridges and superstructure, labor and materials,	$1,230 80
2. Repairs of 18 miles wooden track, between Elizabethtown and Harrisburg, including above items,	6,412 33
3. Repairs and improvements of depots, machine shops, warehouses, water stations and weigh scales,	451 34
4. Repairs of locomotive engines and tenders,	5,276 56
5. Repairs of passenger and baggage cars,	3,562 42
6. Wood—fuel for locomotives,	2,874 23
7. Coal—fuel for stationary engine and machine shops,	399 96
8. Oil, cotton waste and rags,	913 11
9. Wages of enginemen and firemen,	3,286 25
10. Wages of laborers engaged in pumping water, tending switches, sawing wood, and watchmen,	2,415 77
11. Carrying mails to post offices,	490 03
12. Removing snow from track,	61 70
13. Insurance on Harrisburg property,	93 75
14. Attorney's fees and legal expenses,	131 98
15. Printing and stationery,	90 86
16. Salary of superintendent,	900 00
17. D. Lapsley, trustee, hire of engines and cars,	1,800 00
18. Old debts—incurred prior to assignment,	157 63
19. Damages for killing cattle,	27 55
20. Taxes,	239 75
21. Salaries of collectors, conductors and clerk,	1,821 58
22. Sundries,	17 12
23. Balance of check rolls of prior year,	555 05
Total disbursements, etc.	$33,209 77

Corresponding with trustees' statement.

BALTIMORE AND OHIO RAILROAD.

We have the eighteenth annual report of this company. It commences with the affairs of the "main stem," then follows the Branch to Washington, and thirdly it discusses the difficulties to be overcome in carrying the road to the Ohio river. It is accompanied by important tables and in an appendix are given the answers of the company to questions put by the legislature as to the lowest rates of transportation during the last winter, and which were published at that time in the *Journal.*

The two first parts will be given entire or nearly so in our next number as no remarks of ours could do justice to them, but as the continuation of the line to the Ohio necessarily involves much local detail of routes of little interest to the profession generally, we give a few extracts.

"The board have to regret that the obstacles which, since 1842, have retarded the further extension of the railroad continue to operate; and have prevented any efficient progress in the actual prosecution of the work, beyond Cumberland, towards the Ohio river.

"The board continue to regard the extension of the road to that point, as the paramount object not only of their duty, but of the authorities of the State and city, and of those public spirited individuals by whom the enterprize was originally projected, and has been subsequently fostered. They cannot doubt that it will be so regarded by all who desire the ultimate prosperity of the city of Baltimore, the welfare of the State at large, or the preservation of the large amount of capital which has already been expended.

Although upon a just interpretation of the various acts constituting the Maryland charter, the right of the company to extend the road within this State, may still exist; and although it is quite feasable to extend it to the Ohio river, without using any more of the territory of this State, the extension could not be made without further permission from the State of Virginia, or that of Pennsylvania; and, even in Maryland some additional modifications of the charter might be desirable.

The original charter by ***Pennsylvania***, as early as 1828, required as a condition of the grant, in case the railroad should not terminate on the Ohio river in the vicinity of Pittsburg, that the company should, at the same time, construct a lateral road so as to connect that city with the main line. The time allowed by this act expired in the year 1838, and although in the year 1839 the legislature renewed the grant, it did so upon new conditions in favor of the Pennsylvania trade, which, after full investigation, it was deemed inexpedient to accept. Nor is it probable that these restrictions will be relaxed, unless the company would consent to abandon any other point on the Ohio river, and to terminate the road at the city of Pittsburg; *or at Brownsville on the Monongahela river.*

The charter by the State of Virginia, passed in 1827, granted, within that State, most of the privileges conferred by the Maryland law; and allowed the road to strike the Ohio river at any point not lower than the Little Kenhawa: but, in a subsequent act, passed in April 1838, renewing the grant for a longer period, the company was required to construct the railroad to the city of ***Wheeling***. This law also authorized a subscription by the State of ***Virginia*** to the stock of the company of one million of dollars and a like sum by the city of ***Wheeling***.

"Until recently, the construction of the road from Cumberland to Wheeling, without using part of the territory of Pennsylvania, was deemed, by those supposed to be best acquainted with the subject, altogether impracticable; and it is not unreasonable to conclude that this impression, after the act of Virginia of 1838, limiting the termination of the road to Wheeling, had a material influence in imposing the onerous conditions of the Pennsylvania law, passed in the following year.

"The act of the State of Virginia of April 1838, also contained a limitation in point of time, and contemplated the completion of the road on or before the 4th of July 1843.

"The stockholders are already acquainted with the obstacles arising out of the condition of the money concerns of the country, and the consequent derangement in business of all kinds, which rendered it absolutely impossible to finish the road, at least without numerous sacrifices, within the period mentioned in the Virginia law.

"It has therefore become necessary, prior to any resumption of the work, to obtain from the State of Virginia some further time, within which the board may be enabled to use the privileges granted by the charter of 1827.

"Under those circumstances, the board directed their attention to the advantage of a more southern termination of the road, than that contemplated by the Virginia act of 1838.

"Accordingly, in the summer of 1843, they directed a particular reconnoisance, by the chief engineer, of the country between the Potomac and Ohio rivers, at various points upon the latter between Wheeling and Parkersburg, in order to ascertain the facilities of extending the railroad through Maryland and Virginia, and through Virginia alone, without touching Pennsylvania: and also to ascertain the most practicable and advantageous connections with the trade of the State of Ohio, and, through it, of the Western States in general.

"The general result of the reconnoisance has satisfactorily shown the practicability of constructing the railroad through the States of Maryland and Virginia, without passing into Pennsylvania, or through the State of Virginia alone, (avoiding both Pennsylvania and Maryland,) by various advantageous routes from several points on the Potomac at and west of the Soth Branch, to sundry points upon the Ohio river, between Wheeling and the mouth of the Little Kenhawa.

"All the routes embraced by this reconnoisance, through Maryland and Virginia have three principal terminating points upon the Ohio river, namely: the mouth of Fishing creek, the mouth of Middle Island creek, and the mouth of Little Kenhawa at Parkersburg.

"By extending the road along the Ohio river, any other intermediate point within the above range, such as *Sisterville* and *Marietta*, might, if desirable, be made the terminus.

"These routes might commence either at Cumberland, or at the crossing of the north branch of the Potomac, six miles below." * * *

"It has been observed that the chief object of the introduction of railways was the transit of merchandize: and, although in the course of their operations it has become apparent that passenger travelling will be the business of greatest value, the original design has lost none of its positive importance. On the contrary, the successful application of locomotive power, to the transportation of merchandize and heavy burthen, has satisfactorily shown the adaptation of proper lines of railways to all the purposes of commerce. Recent improvements in the construction of the ways; in the locomotive power and in the cars and other machinery; greater economy in the cost of transportation, added to the steadiness and uniformity of their operations in all seasons of the year, and to the increased velocity easily maintained without injury to the way, have satisfactorily shown, both in the United States and in Europe, that railways, particularly those of great length, may be profitably employed as thoroughfares both for passengers and burthen. On both sides of the Atlantic they are universally used for both purposes, and are to a great extent becoming preferred lines of communication.

"Within the last twelve years little if any capital has been employed in the construction of canals, either in this country or in Europe, except perhaps where necessary to avoid obstructions in navigating rivers, or to unite navigable waters for the purposes of a continuous navigation; while during the last twenty years, in constructing and perfecting a system of railways, an expenditure has been incurred, equal to, if not exceeding the cost of all the canals existing in both countries.

"In England, railways have been long in use, in connection with the most extensive collieries; and as a part of the works of the Delaware and Hudson coal company in New York, a railway is employed with decided advantage for the transportation of their heavy burthen."

We are sorry to be able to show the board in error in one of their positions: "within the last twelve years" the State of New York has spent 20 millions on canals and, adding the sums spent in that time in Ohio, Indiana, Illinois, Pennsylvania, Maryland, Virginia and Canada on canals also, we shall have a total expenditure of fifty millions, worse than thrown into the Atlantic—spent on monuments of folly and corruption. This large sum has been laid out in the most efficient way conceivable to prevent the undertaking of other works—it is in fact an anti-improvement fund of the most formidable character. To it we are indebted for the wretched restrictions imposed on the people of this State, who are not only subject to a direct tax of $700,000 per annum to support the canals and meet their liabilities, but are also debarred from the use of railways for the transportation of freight. For the pitiful act of last winter allowing them to carry freight during the suspension of navigation, but paying canal tolls, is little better than an insult to the community. But little better is the conduct of the legislatures of New Jersey and Maryland in taxing passengers on railways. The Baltimore and Ohio company are unable to reduce their rates of fare between Baltimore and Washington because the State receives 20 per cent. of the fare, and the consequence is that numerous lines of stages are in successful operation and great numbers of passengers are induced to take the steamboats of the Chesapeake. Fancy for a moment a tax of 20 per cent—say 40 cents—on each passenger travelling on the Hudson!

For a long time the great difficulty was to raise the means for carrying the railway to the westward; now the obstacles which oppose its progress are those raised by the legislatures of the States of Virginia, Pennsylvania and Maryland.

A careful perusal of these reports will convince most persons, that all we require in this country, to secure the construction of all really useful communications is to be "let alone."

BOSTON AND ITS RAILROADS.

Who that has visited Boston and witnessed the enterprize of its inhabitants, the public spirit of its men of business, and the rapid increase of its public works, does not see the giant strides with which it is overhauling its proud sisters, New York and Philadelphia? Though by no means the first city to embark in the construction of railroads for the purpose of opening a more rapid and easy communication with the interior and distant parts of the country, yet she is now by far the best accommodated with these *time and money-saving machines*, of any city in the Union. There are at this time no less than six distinct railroads, radiating from Boston into five different States; and several of these roads have branches to important manufacturing town or shipping ports, whose centre of business is Boston. There is at this time near twelve hundred miles of *connected* railroads terminating in Boston; and they are still extending the main lines, and increasing the number of branches, in various directions, to other important towns, so as to *insure* a steady, rapid and permanent increase of the business and therefore of the population and wealth of Boston.

We were delighted when attending the convention of citizens of Massachusetts, Vermont and New Hampshire, at the Tremont Temple in September last, to observe the spirit of the Boston capitalists in relation to the extension of the Fitchburg railroad northward to Vermont and Canada; and especially with the noble liberality of the president of that convention, who said that "on reading the report of the Engineer" who surveyed the route from Fitchburg to Brattleboro', "he felt it to be *his duty* to the the business men of Boston, to subscribe *ten thousand* dollars towards building the road." Who ever heard a New York capitalist speak of promoting public works as "*a duty* to the business men" of New York? Echo answers, who?

The best—the *true* spirit pervaded the Boston merchants on that occasion, and *fifty* men were appointed to present subscription papers to the merchants and business men for their quota of the $1,000,000 to complete the capital required to build the road to Brattleboro'; and of their success in obtaining it in due time there was not a reasonable doubt, notwithstanding about $1,500,000, had already been subscribed in Boston since January last, to other railroads, branching from those already constructed and terminating in Boston. It is true that, in thus opening their numerous avenues into the interior and to distant parts, they are promoting their own permanent interest by the rapid increase of business, and consequently the value of real estate; and therefore it may be said that they are entitled to no credit for their liberality—that may possibly be so—yet they are entitled to much credit and we wish we could say the same of the citizens of New York—for their *sagacity* in making the discovery—and of profiting by it.

EASTERN RAILROAD.

This road consists of three distinct corporations; one in Massachusetts, one in New Hampshire and one in Maine. Its entire length is 105 miles, and its cost $3,788,218 17.

The management of the whole line being in one company, or rather two companies, having the same man, D. A. Neal, Esq., of Salem, for president of each, there is no jarring of interest, but all things appear to be well managed. They divided 6½ per cent. in 1843, and judging from what we saw and learned in passing over it, and from the monthly reports of business this year to 1st July, the net profits will exceed 8 per cent. The number of tickets sold per day is about 1500 and the average price less than 55 cents each which shows that a very large part of the travel is *Way* travel. During the past winter several thousand cords of wood were brought over this road from Maine to Boston at $2 a cord, thus demonstrating in a convincing manner the value of railroads, not only to large cities but also to those who have anything to send to market—even wood.

The machinery and cars on this road are of a superior order and the conductors attentive and affable. The road is in tolerably good condition; the rail is of the T pattern, supported by cast iron chairs of peculiar construction, being much higher than those in general use, designed to aid in keeping the track free from snow.

When this road was commenced, the majority of the inhabitants of Salem doubted its being a good investment of capital, and some even proposed, as we were informed, after it was fairly commenced, to abandon it. Yet now, notwithstanding a rival road, the Boston and Maine road, through Andover, Dover and Exeter to Portland, or to North Berwick where it unites with this road, it is esteemed a good investment, and the people are actually talking of another railroad from Salem to Boston, intermediate between this and the north road through Andover; thus showing in the most conclusive manner that railroads above all other modes of communication, create their own business.

An effort will soon be, if it has not already been made, to extend this road on to Brunswick and Bangor, thereby opening a more easy communication between Boston and the interior of Maine. This is a measure certain to be carried into effect, and at an early day.

The following extract from the report of the directors in July last, will show the estimation in which the stock is held by those who know its value.

"To meet the increased and increasing traffic, six new merchandize cars have been put on the road, and one of the heavy engines so altered as to be better adapted to the rails, and a part of the cost has been carried to construction account. A new engine of great power has recently been received and is now on trial, and a new passenger car will shortly be placed on the track, the bill of which, about $8,500, when paid, will be carried to the same account, and will it is believed be all the additional working apparatus that is required for our present business.

"The 1950 new shares held by the company, as per last years report, were disposed of shortly after the annual meeting, at par."

BOSTON AND MAINE RAILROAD.

This road embodies more distinct interests than almost any other road of equal length. The distance from Boston to Portland by this route is 109 miles and there are no less than *five* corporations embraced in it; 1st the Lowell road is used for 15 miles; then that part in Massachusetts, reaching to the New Hampshire line; then that part in New Hampshire; then the line in Maine from New Hampshire to South Berwick, where it unites with the Portsmouth, Saco and Portland road, on which the cars run thirty-three miles. This road passes through an excellent country, filled with flourishing villages most of which have grown up within a few years by means of their manufactures. They divided six per cent. last year and the net income will probably exceed 7 per cent. this year. The prosperous condition of this company has induced them to construct about 20 miles of new road from Boston to a point on their present road near Ballardville and thus become independent of the Lowell road, to whom they now pay for the use of 15 miles of their road. When this extension shall have been completed, as it will be early next year, there will be *six* distinct lines radiating from Boston reaching into adjoining States. The termination of this road with an extensive depot. is to be nearer the centre of the city (within 1000 feet of State street) than either of the others. The general management of this road appears to be good, the cars are easy and neat, but there is occasionally delay at the junction, as there will often be, where two roads rely upon the same power to perform a part of the service.

The superstructure is laid as follows:

"The earth excavations, and embankments are levelled off, and one and a half feet of sand, or gravel, is then filled on to the road; the subsills of plank are then laid longitudinally, and the sleepers of chestnut, cedar or hackmetac are laid transversely, partly two and one half feet, and partly three feet apart. Iron rails of the T pattern are then laid, supported at the joints by cast iron chairs, and spiked to the sleepers; sand or gravel is then filled in between the sleepers."

The averrge width of grade is 14 feet, and the greatest curvature 1050 feet radius.

This and the "Eastern railroad" through Salem and Portsmouth, may be considered rival lines, yet the managers of both appear to be actuated by a desire to accommodate the people, and at the same time benefit their stockholders, rather than to destroy each other, and they have therefore entered into an amicable arrangement by which the fares on the two roads are uniform.

LOWELL RAILROAD.

This is, we believe, justly considered one of the best built and most productive railroads in the country. We passed over it a short time since and found it in excellent condition and well managed. This was the first railroad built in this country parallel with a canal, and now the canal is scarcely thought of, although it is still in use, as we inferred from what we saw. The business of Lowell must be greatly facilitated by this road, as must be that of other manufacturing towns by its continuation—the Nashua and Concord road; and it appears singular to those at a distance that the people of New Hampshire will stand so much in their own light as to prevent its extension across the State to some point on the Connecticut river from whence it may be extended to Burlington Vt., or to Canada; but so it is, and they, like the people of this city will be compelled to do in self-defence what they should have done as a matter of policy, before others got the start of them;

and then the Lowell railroad will reap the rich harvest, to which, by its favorable position it is entitled.

We were disappointed in not obtaining documents which would enable us to speak definitely in relation to its current business as compared with previous years; but from what we learned it is safe to anticipate a greater dividend than was paid last year, which was 8 per cent.

HARLEM RAILROAD.

This road was opened on Saturday last, 26th inst., to White Plains Westchester county, the distance of about 27 miles from the City Hall. The president, directors and invited guests of the company left the City Hall a few minutes past 1 P. M., and reached the terminus of the road, near the village of White Plains a little after 3. The route of the road is for several miles along the valley of the Bronx, crossing it five times in seven miles. So far as we could judge the new part of the road is substantially built and the rail of good pattern and well laid. From the statement of the president we learn that they have now ample power both of horse and steam, with a full supply of good cars, to work the road efficiently, which we hope will be done both for the benefit of the stockholders and the convenience of the community.

Soon after our arrival at the terminus of the road, all were invited to take seats at the tables, which were under the charge of chief engineer *Downing* and of course well supplied with *steam.* The president of the company, *David Banks*, Esq., took the chair, and was supported on his right by the chancellor of the State, and on his left by the vice chancellor, with several members of the judiciary and of the common council of this city on either side, who appeared to take a deep interest in the important business of the day, and to enjoy in prospect the benefits to result from the extension of the road to that point. The president made a lengthy statement in relation to the present condition of the company and alluded to the probable connection with the Housatonic railroad and to the possible extension to Albany *direct*, but he did not, nor did any other gentleman who spoke, take the broad ground which we have long contended for, that there must, *will* and SHALL be a railroad directly to Albany and above all to *lake Erie;* and that it is not only the interest but also the *duty* of the capitalists, owners of real estate and the business men of New York, to come forward at once and subscribe for the stock; and we were somewhat disappointed in not hearing these important topics discussed by some of the able and deeply interested friends of railroads who were toasted and responded to the compliment.

Many toasts were given and speeches made, complimentary to the gentlemen who now have the management of the work, and we hope they may not only feel encouraged, but also in duty bound to adopt *immediate* measures to extend the work to Albany. It is now more than *eleven* years since the Harlem railroad was commenced, during which time the city of Boston has constructed or contributed mainly to the construction of nearly *five hundred* miles of railroad, by which she reaches directly *five* different States, and shares with New York the benefit of her great canals and the immense trade of the great west. It is not, then, we trust, expecting too much of those who have given new impetus to the works on the Harlem railroad, when we say to them, gentlemen the *people* of New York look to you and others of like enterprize, for the extension of this work, and not only this but one of still greater importance; so that we may, when our noble rivers are in icy fetters bound, penetrate the interior. Shall they be disappointed?

A more favorable period could not perhaps be desired than the present for the resumption of operations on these two important roads. There are now in almost every direction, long lines of railroad successfully engaged in the transportation of freight as well as passengers; and it is no longer a doubtful question of their ability to compete successfully with canals for heavy freight. It has also become matter of history that railroads create business for themselves; and that when judiciously located between important points, and especially through a productive agricultural and manufacturing region, they not only contribute largely to the business facilities of the people and particularly to the *poor*, with whom *time* is capital, but also insure to those who own the stock a liberal, and what is better, a constantly increasing return. Rivers increase in volume as they receive the successive tributaries which flow into them, and are of course important or insignificant in proportion as their course is extended and through a region affording abundant streams. So with railroads between important points, and through fertile regions, abounding in the elements of a varied and extensive business and terminating in large cities, they become useful to the people and profitable to their owners in proportion to their length and the number of branches and latteral roads, which are sure to connect with them from year to year, when once in operation. Then it is that those links in the long chain of road, which are nearest to its principal termination, become the most important and most profitable. Why not, then, gentlemen of the Harlem railroad, make *your* road the last link in those important chains which are sure to reach, not only Albany and lake Erie, but also the *Canadas* and the great *far off west?* These and nothing *but these* are terminations worthy of the efforts of the *city of New York!*

READING RAILROAD.

Since our last number the second track of this road has been completed, and we have to regret our inability to be present at the celebration of its opening in accordance with a polite invitation to be there. It matters little, however; the day was auspicious, the company large and merry, and the performance all that, and even more than the most sanguine friends of railroads had claimed for locomotive power. We only wish that the whole city of New York, or at least *every business man* of it, could have been there to see the "*Ontario*" locomotive, with its 150 iron cars, containing

764 *tons of coal*, or a quantity sufficient to load the largest packet that ever sailed out of this port previous to the introduction of locomotive engines into the United States—moving on at the rate of 8 or 10 miles an hour—towards the Delaware. What would the *British army* have said if, while they were revelling in the luxuries of winter quarters in a large city, and WASHINGTON and his brave Continentals were freezing and starving at Valley Forge, they had discovered the approach of such a power with such followers? There would have been, it strikes us, more swearing than there ever was in Flanders; and *possibly* the sight of such a performance might have aroused the good citizens of New York to the performance of their duty and to the construction of *the great work* which is to add so much to the *wealth*, the *comfort* and the *reputation* of their city.

IMPROVED RAILROAD CAR TRUCK FRAMES.

We observed at the Fair, in Boston, a model of an improved *truck frame* for railroad cars, which we ascertained was from the manufactory of Messrs. *Davenport and Bridges* of Cambridgeport. The peculiar advantages of this plan are its simplicity and durability. The entire frame is of wrought iron and it is put together and firmly secured by only *eight* bolts, instead of over sixty, as in most wooden frames; and what is also important, it is both *lighter* and *cheaper* than the wooden frame, and when by any accident it shall be broken, the fragments are still good wrought iron, and worth half as much as when new, and in the bar. On visiting the manufactory of these gentlemen we found that in other respects, as well as that above alluded to, their cars are of a superior quality and worthy of the examination of railroad companies wishing to purchase substantial cars.

BRATTLEBORO' RAILROAD.

We learn by the Boston papers that $930,000 of the million required to complete the railroad from Fitchburg, Mass. to Brattleboro', Vt. has been taken in Boston since the convention in September last. This is as we anticipated from the spirit evinced by the Bostonians at that meeting, and increases the amount subscribed in Boston to railroad stocks since January last, to nearly $2,500,000.

☞ The Baltimore and Ohio railroad company have lately reduced the freight for the transportation of flour from Cumberland to Baltimore from *sixty* cents to *fifty* cents a barrel, and from Harper's Ferry to Baltimore to *twenty-five* cents.

The following notice leads to the supposition that the old projected line across the centre of Vermont is to be again brought into the field.

"Notice is hereby given that the books for subscription to the capital stock of the Vermont Central Railroad, will be opened on the 29th day of this month, at 1 o'clock, P. M., at M. Cottrill's in Montpelier, and at Howard's hotel in Burlington.—*October 12th*, 1844.

352

PROSPECTUS for an ENLARGED RAILROAD JOURNAL.

☞ After the 1st of January next, this Journal will be issued weekly, in quarto form, of 16 pages, as from 1832 to 1838. The quantity of matter given will be three times that of the present Journal, and the price will be increased from two, to three dollars, *in advance.*

The immense amount of capital expended on railways in this country; the great number of new works projected, and sure to be undertaken before long; the actual value of railways as permanent investments and the general interest taken in them by the public, demand at least a weekly Journal devoted mainly to the dissemination of railway information. In England there are at this time *four* such Journals, exclusive of the scientific works. There, however, the openness with which all is carried on, and the interest taken at their frequent meetings by the *stockholders* who are not directors, furnishes an immense quantity of matter for the railway press. Occasional extracts from the discussions at these meetings will be of use here in stirring up the individual stockholders to a knowledge of their rights. Our limited space as well as the sphere of our discussions for the last few years has kept our circulation almost entirely among Engineers; but we now propose, without rendering it less useful or interesting to them, to add much valuable information wanted by a new and very large class of readers whom we hope to reach.

The object of our journal, when first established, was rather to collect information which might be useful to those embarking in, or having the superintendence of, such novel undertakings; as at that time there were only 92 miles on five different railways in operation, and locomotive engines were scarcely known in this country. Then details of construction occupied the prominent place; whereas now, the *management* of railways, their *cost, income* and *dividends*, will especially receive our notice; though all improvements, whether actual or projected, will of course continue to receive our unremitting attention. We now intend to bring out a weekly paper which shall not only be useful to the Engineer, but we hope indispensable to that large portion of the community who look to railways as offering a safe, permanent and productive investment of capital; or, we may say more briefly, that we aim at a Railway Journal for *stockholders*, and those taking a general interest in the progress of railways and other public works, as well as for Engineers who have the superintendence of construction and the management of railroads.

We shall publish in each number carefully corrected tables, showing the statistics of the various railroads both in this country and in Europe, together with accurate reports of the weekly sales of stocks; and we shall speak freely in relation to the management of railroads as we may from time to time feel called upon.

We design also to make it useful for advertising Railway, Steamboat, Canal and other means of travel and transportation, as well as for the manufacturers of Locomotive Engines, Cars and all other Machinery.

AMERICAN RAILROAD JOURNAL, AND MECHANICS' MAGAZINE.

Published Monthly at 23 Chambers-st New York, at $2 a-year, in advance, or 3 copies for $5. | D. K. MINOR, Editor.

No. 12, Vol. 2. Third Series. | DECEMBER, 1844. | Whole No. 443. Vol. XVII.

THE RAILROAD JOURNAL.

☞ This number closes the volume and the *thirteenth* year since the commencement of its publication.

Of the wonderful improvements made within that period, both in the construction and management of railroads, it is quite unnecessary now to speak except so far as it may be useful by way of illustrating the future. It is enough, to say that the system has grown within that time both in this country and in Europe, from less than *one hundred* miles in either, to *several thousands* in *each* country; and that the onward progress of the system never was as rapid, as certain nor as successful as at the present time.

Believing that a well conducted periodical, devoted mainly to the cause, will promote its success, we announced in our last number that the *Railroad Journal* would, on and after 1st of January next, be issued weekly in its original quarto form of 16 pages.

It seems to us highly necessary that shareholders should become more familiar with their particular roads, as well as with the operation of the system generally, both in this country and in Europe. This can only be done by a more frequent publication of this or some other journal devoted to the subject.

Having been the first to establish a periodical of the kind either on this or the other side of the Atlantic, and entertaining the opinion that railroads are destined with very few exceptions to supersede canals as well for transportation as for travel, and that important improvements are yet to be made both in their construction and management, we are resolved to devote our efforts to the advancement of this important cause, which is doing so much to promote the prosperity, comfort and intelligence of the millions—the mass—*the poor!*

We hold that railroads are doing more than any other institution among us except our schools, towards placing the people on terms of equality, and fortunately their tendency is to level *upward*, instead of downward. They enable the poor man to ride as comfortably as the rich, and what is of the utmost importance to them they save more than the cost in *time.*

Entertaining these views of the value of railroads and of the advantages which may result to them and we hope to ourselves from a well conducted journal devoted mainly to the cause, we do not hesitate to adopt the plan herein indicated, and confidently rely for support on those of our citizens, whose interests are more or less identified with the success of railroads.

BALTIMORE AND OHIO RAILROAD.

In giving the report of this company, as promised in our last, we would draw attention to two important points towards the establishment of which the Baltimore and Ohio company have contributed so largely. These are firstly, the very large amount of business which a railway through a thinly settled country will draw to itself, and secondly, the views presented as to the actual cost of transportation on works with the gradients and curves of the Baltimore and Ohio railway. Both positions are again confirmed by the experience of the Western railroad of Massachusetts.

It seems necessary for us to give the following report for other reasons. We shall be obliged frequently to refer to it during the coming winter in discussing the proper policy to be pursued in this State, and especially in pointing out the causes which have so long delayed the re-commencement of operations on our greatest undertakings.

At a meeting of the stockholders held pursuant to the charter, on the 2nd Monday of October 1844, in the city of Baltimore, the president and directors of the Baltimore and Ohio railroad company submitted the following report and statement of the affairs of the company:

First.—Of the Main Stem.

The statement A shows that the state of the company's affairs on the 30th ultimo; and the revenue and expenses of the *main stem*, for the year ending on the same day, are shown by the statement B.

There is also submitted a tabular statement, marked C, prepared by the engineer of machinery and repairs, which presents in detail the operations of the main stem, and the actual expenses of working that part of the road during the year; together with the amount of receipts, from all sources, during the same period.

These statements show a considerable increase both of travel and trade: and a diminution in the expenses, in proportion to the amount of business: and it is worthy of remark that, although the number of passengers over the entire length of the road, has increased at least thirty-six per cent. upon that of the past year, the aggregate increased cost of transporting them does not exceed five hundred dollars.

It is believed that the economy in the working and management of the road, is as perfect as that of any other similar road in this country or in Europe.

The revenue received from passengers, is greater by $59,712.21, and that from tonnage $22,061.32 than the receipts from the same sources during the preceding year; making together $81,773.53.

The net receipts from the business of the main stem, over and above the expenses, independent of its connection with the Washington branch, amount to the sum of $346,946.03, being nearly five per cent. upon the capital, and one per cent. more than the net earnings of the year ending on the 30th of September, 1843.

The injuries to three of the culverts near Harper's Ferry, alluded to in the last annual report, have been fully repaired, and the work finished in the most substantial manner, at a cost of $1,500 less than the estimate presented in that report.

The board regret that, in the present report, they are called to record an accident to the bridge over the Potomac at Harper's Ferry, by which one of the arches of that structure has been destroyed.

The arch gave way under the weight of a single Engine and tender, after sustaining the entire work of the road for nearly two and a half years, and, only the day previous, eight heavy trains of passengers and burthen, without the slightest indication of defect or weakness in any part.

Providentially, no life was lost, and but slight injury sustained by any of the men who were carried down in the fall; nor was the engine materially damaged.

A delay of a few hours only was occasioned in the passenger travel, and the interruption in the tonnage transportation was less than a week.

The remaining six arches of the bridge, even those contiguous to that which fell, have received no injury from the fall.

A thorough investigation into all the particulars of the accident, has satisfied the board that it was occasioned by the decay of several pieces of timber, comprising an important part of the framing of the arch.

This part of the superstructure, in order to protect it as far as practicable from the weather, had been closely covered by weather boarding and roofing, which rendered it inaccessible to the ordinary inspection constantly made of these structures; and the timber having been in use for two years only, there was no reason to suspect any unsoundness.

No settlement of the frame had previously taken place inconsistent with the soundness and safety of the structure, and it had borne, only the evening previous, the usual trials of its strength; indeed the final fracture took place in a part of the frame so situated, and so surrounded and kept in place, as that there could be no sensible yielding without a total giving away. The decay, therefore, most probably proceeding from an unperceived leak in the tin roof and the spreading of the water between the several pieces of timber composing the straining beam, had been progressing silently and unsuspected, until the strength of the remaining sound wood became insufficient to withstand the strain to which it was subjected.

This accident, it is believed, does not authorize any suspicion of an inherent defect in the principle of construction of this, or any other bridge employed on the line of the road. In the opinion of the skilful engineers, by whom the plan of the bridges was adopted, it is a combination of the most excellent and approved forms of superstructure known to the science of engineering: the principal features being modeled after those of the celebrated bridge over the Rhine at Schaff haausen, which, previously to its destruction by fire, was considered one of the most admirable specimens of the art in the world. The heavy trade of the railroad, and of numerous droves of cattle on that part of it common to the public, which the ruined arch had withstood for more than two years, and the greater evidence of strength offered by some other bridges precisely the same in principle on other parts of the line, for upwards of five years, also inspire great confidence in the plan of these structures; which, from the lesson now learned, may be renderad even more secure in the future.

Immediately after the occurrence of the accident, the weather boarding was removed from all the other structures upon the line of the road, and a minute investigation made into the state and condition of all their parts.

Every precaution will be immediately taken to give additional strength and security to these structures; and nothing will be omitted to prevent a recurrence of an accident.

The board have already determined upon a plan of reconstructing the arch at Harper's Ferry, which will not only ensure more adequate protection of the timber from the effects of the weather, but, at the same time, expose all parts of the structure to a daily and minute investigation of their condition.

The entire loss occasioned by the accident, and the sum required to restore the arch to a condition of even greater strength and security, is estimated not to exceed $7,594.40, being $8,932.92 less than the surplus revenue of the year just ended.

In all other respects the entire line of the road, including the depots and water stations; together with the cars, engines and machinery of every description, are in a state of thorough repair, and adequate, without augmentation, for the accommodation of twelve per cent. more than the business of the past year.

During the year there have been paid to the Messrs. Baring an instalment of $50,000, and interest to the amount of $14,809.72, amounting, with the cost of placing the funds in England, to $71,106.92, and the former being paid in advance produced a saving in interest of $1,100. After these payments the balance due Messrs. Baring, payable in annual instalments of $50,000, is reduced to $200,000.

In the same time there has been paid from the receipts of the year, for an additional engine mentioned in the last annual report; for walling the shafts of the Doe Gully Tunnel, keying up and refitting bridges; for the sideling at Dam No. 6, under the arrangement with the canal company; for improvements at the Cumberland depot, balances for right of way, and various other items arising out of the construction of the road, the sum of $46,747.45.

There have also been paid in the year $29,200 of the debts remaining unpaid, alluded to in the last annual report; leaving of this class unsettled only $11,500, which is yet in litigation.

Besides the foregoing items, there have been applied during the year $38,216.74 to the construction of coal cars for the transportation of coal from the mines to Baltimore, pursuant to the contract with the Maryland and New York iron and coal company, referred to in another part of this report: and which, during the present year, the board propose to reimburse from the proceeds of the coal trade.

After these payments, and the payment of interest on account of the million loan, the net revenue of the year from the main stem, (including the sum of $61,956 received from the Washington road,) amounts to $200,582.18, and with $10,945.14, the surplus of the year 1843, makes an aggregate of revenue on hand from this road, of $211,527.32.

Of this, the board have applied to the purposes of the sinking fund, according to the resolution announced in the annual report of 1842, for the reimbursement of the loan contracted for the construction of the Washington road, the sum of $20,000, and of the balance, they have determined to divide among the stockholders, two dollars and fifty cents upon each share of stock, payable on and after the first day of November next; leaving a surplus of $16,527.32; being $8,932.92 more than the cost estimated to repair the loss occasioned by the accident to the bridge at Harper's Ferry.

While reporting the condition of the main stem, and result of the operations of the year, the board would not discharge their duty if they failed to recall the attention of the stockholders, and especially that of the city authorities, to the onerous expenditure annually incurred by the necessity of introducing passengers and burthen into the city by the employment of horse power, and which must necessarily subtract that sum, whatever it may be, from the amount which might otherwise be divided among the stockholders, and paid into the city treasury. This source of expense, already amounting annually to no less than $18,171.77, must continue to increase in proportion to the augmentation of trade and travel over the road.

Considering the numerous sources of competition with which, in its present unfinished condition, this work so essential to the prosperity of the city, must contend, every motive of sound policy would seem to recommend the utmost possible reduction in the expenses of transportation; and if Baltimore hopes successfully to contend with other rival works, in whatever quarter they may exist, the public authorities will find it necessary to lend all the aid in their power to cheapen the introduction of produce and merchandize into this market.

The necessity of employing horse power through the streets of the city, does not add less than ten cents per ton to transportation of all kinds upon the railroad; of which the obvious effect is not only to drive much of the trade to other channels, but to reduce the net revenue upon that which it may be possible to retain.

The harmless employment of steam power under proper regulations in the streets of other cities, and, by another company, in those of Baltimore, already shows that the privilege may be extended to this company without serious apprehension of damage; and it may be safely affirmed that if the city authorities desire to retain the present amount of trade in flour and other produce; or to enjoy to any considerable extent the advantages of the transportation of coal, this privilege will be indispensable.

In the last annual report, the stockholders were informed that, upon the application of the Chesapeake and Ohio canal company, the board has consented, wish their existing power, and as a part of the general trade, to engage in the transportation of coal from Cumberland to dam No. 6 on the canal, at two cents per ton per mile, to be thence carried by canal to the District of Columbia; and it was at the same time stated that, the company might engage in it at a less charge on the whole or any part of the line.

It will appear in the course of this report, and has already been officially stated to the legislature, that it may do so at little more than half that charge.

The charge of two cents per ton per mile had been previously established as the fixed rate for the transportation of coal, without regard to time, distance or quantity; and the object of the canal company, in proposing the arrangement, was to induce this company to provide the necessary sidelings at dam No. 6, and engage in the transportation, in connection with the canal, at the same rates.

If in the opinion of the canal company a less charge than two cents per ton per mile would have been necessary for the success of the arrangement it desired to make, it would have been practicable to make an arrangement for that purpose; and if the railroad company could have relied upon an amount of trade equal to 50,000 tons per annum, it would have been willing to have increased its machinery for that purpose, according to the growth and requirements of the coal trade.

The canal company proposed the charge of two cents as a rate mutually for the interest of both companies; and, in the opinion of those proposing it, as low as would be necessary to insure the transportation of coal upon the railroad to dam No. 6, in sufficient quantities "to meet the growing demand in the market for that article."

Representing the toll on coal by the canal from dam No. 6 to Georgetown, at half a cent per ton per mile, and the freight at the same, the president of the canal company believed that two cents per ton per mile on the railroad, even during a period of two years, "would enable the dealer to sell his in market at a profit sufficient to encourage the trade."

The means of transportation at these rates being insured, the extent of the demand would, nevertheless, in the opinion of the canal company, be uncertain, and the trade necessarily in some degree, an experiment, only to be determined by circumstances: though from assurances received from parties concerned in the coal fields, the quantity of iron and coal which one company alone would require to be transported the first year, it was thought would amount to from fifty to eighty thousand tons: that "a regular supply being furnished the principal steamboat company on the Hudson would consume about $500,000 worth annually, and that the consumption of the city of New York alone, would not be less than 200,000 tons per annum."

The canal company rightly judged that, if the coal fields of the Allegheny could be developed to such an extent, or even in a far less degree, the arrangement proposed would be mutually advantageous to both companies; and although this company was in no degree misled by these expectations, and were satisfied that many years would elapse before they could be realized even to a moderate extent, they were unwilling to reject an appeal thus made, and decline a business upon terms which, under any circumstances, and without reference either to amount or regularity, would yield a good profit.

The result however has proved that the canal company either greatly overrated the ability of the coal dealers, or the extent of the demand; since from that time to the 30th ultimo inclusive, notwithstanding this company provided a sideling at dam No. 6, costing $2,000,—less than 4,000 tons of coal, and not any iron, has been offered for transportation in the manner contemplated by the arrangement. It may be added that, during the same period, no evidence was afforded that any capital had been obtained for working the mines, or any arrangements made towards the preparation of the necessary transportation of coal from thence to Cumberland; except in the instance of a single company; and by that, arrangements have been made with the railroad company for the transportation annually, for the period of five years, of fifty thousand tons of iron, coal and fire brick, from the mines to Baltimore.

Under such circumstances the board deemed it inexpedient to make any addition to their existing power, or to adopt the improved machinery by which it is now certain the cost of transportation, may be, and in fact has been reduced to little more than half the charge assented to between Cumberland and dam No. 6.

Until the board could be certain of completing the railroad to Cumberland, there was little occasion to investigate its capacity for the transportation of coal; and indeed from the character of the machinery generally in use upon railroads before that period, a general impression prevailed that for heavy articles, the value of which in market bore so small a proportion to their weight as to admit of very low charges, for long distances, these roads would not be a desirable mode of transportation.

For, although a like weight of flour and coal, other things being equal, might be transported at the same charge, it is nevertheless obvious that in consequence of the greater value of a ton of flour than an equal quantity of coals, a rate of charge which might well be paid by the former, would be altogether too high for the latter.

The improvements in railway machinery, however, have been gradually, but constantly, progressive; and in the spring of 1842, when it was certain that in the course of the year the railroad would be completed to Cumberland; anticipating that, from that time they might be required to some extent to engage in the transportation of coal, at least for the consumption of Baltimore, the board directed a thorough investigation by Mr. Knight, chief engineer, into the power of their machinery for the purposes of transportation generally, including that of coals and iron.

For the better understanding of what follows, it may be proper here to state that, the chief, if not the only object for which railways were first introduced, was the transit of heavy merchandize at a moderate rate of speed; and, for many years after their introduction, were exclusively used for the purposes of the great colliery railways in England. As late as the year 1821, the first of the modern or travelling class was authorized in England: and in 1826 the railway between Manchester and Liverpool was chartered. Down to that time the transportation of heavy merchandize was the chief object it professed; and even then it was not determined to employ locomotive power. As late as the year 1829 when it became necessary to determine the nature of the power to be employed, the utmost capacity hoped to be attained in the locomotive was an engine weighing not more than six tons, capable of drawing on a level and straight road, at ten miles an hour, three times its own weight, and to cost less than $3,000. Although at least one eminent engineer in England ventured, at that time, to hazard the speculation that at some future day an improved engine might be constructed with capacity to maintain a speed of twelve, sixteen, eighteen or twenty miles an hour, it was treated in the official reports of commissioners selected to determine the nature of the power, as so extravagant as to prejudice the scheme of employing the use of locomotive power.

Long before the spring of 1842, this speculation had been more than realized.

The genius of American artists also had outstripped the improvements in England; and this company was actually employing upon their road engines weighing fourteen tons, running on eight wheels, of which four were drivers; and capable of drawing on a level and straight road 500 tons, and over grades of eighty-two and a half feet, with curves of one thousand feet radius, not less than eighty tons at a speed of eight miles an hour.

The investigation made by Mr. Knight, under the direction of the board, contemplated the use of this class of engines. So far as it related to coals, it also contemplated a regular trade, which, in his estimate, he charged with a full share of the expenses of maintenance of way, and interest of six per cent. upon the capital. Including these elements, he estimated the cost of the transportation of coals from Cumberland to Baltimore at one cent and a half per ton per mile. Comprehending the same elements, the cost would have been less from Cumberland to dam No. 6.

The report of Mr. Knight was submitted and published in March, 1842; and as early as that period, Ross Winans, an ingenious mechanic of Baltimore, had not only contrived a far more important improvement in the locomotive, but had actually constructed an engine weighing twenty tons, running on eight wheels, all of which are drivers,—and with the weight equally distributed over the whole, so that the bearing upon any one is not greater than upon that of the ordinary machine of ten tons weight,—capable of hauling over a level and straight road, 1100 tons; and over grades of eighty-two and a half feet to the mile, with curvatures of one thousand feet radius, about 170 tons, at a speed of eight miles per hour.

With a knowledge of the results of Mr. Knight's investigation and of the further improvements and advantages in railway machinery, it was impossible the board should doubt their ability to engage in the transportation of coals, at rates not only profitable, but sufficiently low, according to any rate of charges then known, to exclude the apprehension of rivalry from other quarters. In this sense only are the observations of the board upon this part of the subject, in their second reply to the house of delegates, when confined to their context, to be appropriately taken.

The capacity of the railway for the transportation of coals was accordingly announced in their annual report of October 1842; and it was at the same time assumed that, when the road should be completed to Cumberland, and thence to the mines, the demand in the market of Baltimore, and other parts of the Union, might, in a short time, require the transportation of 100,000 tons of coal annually.

The board was satisfied that without suitable conveyances from the mines to Cumberland, neither the coal nor iron could be advantageously sent to market from Cumberland, by any channel whatever; and, in the meantime, they deemed it inexpedient to make any preparations to engage in the business. They considered it not less apparent that even after such conveyances should be provided, the trade in coals, would be regulated by the extent of a demand, in a great degree dependent upon the price at which the article could be afforded.

Neither point was free from embarrassment, and the interest of the stockholders required that the subject should be investigated with great care. The grounds upon which a just determination could be made were in some degree speculative. So far as any positive data could be obtained, the consumption of bituminous coal had been gradually and regularly diminishing, and that of the anthracite increasing in a much larger proportion, and, within some years past, with great rapidity. The latter had been advantageously adapted to the manufacture of iron: more extensively to the use of steamboats, locomotive engines, to the purposes of manufactures generally, and for all domestic uses. The consumption of this article had been gradually extending throughout most parts of the Union. From the facilities of delivering it in the market by the Delaware and Hudson work, the Reading railroad and other improvements in Pennsylvania, the price had been gradually diminishing, and the low price at which it was ordinarily selling in the markets of Philadelphia and New York, made it quite plain that the existing demand for coals, for most purposes throughout the country, was fully supplied by it.

It was, therefore, obvious that the introduction of the Cumberland coal, in any considerable quantity, could only be effected by superseding, to nearly an equal extent, the use of the anthracite; and from the preference so long given to the latter, and the adaptation of machinery of all kinds to its use, they believed the degree in which this might be effected for many years at least, exceedingly doubtful; too doubtful, in their opinion, to warrant a large expenditure of capital in preparations for the trade. It was desired rather that the extent of demand should be previously tested by actual experiment.

If any reliance could be placed upon the estimates of the cost of transportation upon canals by the improved Ericsson propellers, it was evident that, with suitable roads from the mines to Cumberland, and the use of the railroad to dam No. 6, even at the rate of two cents per ton per mile, the experiment might be made with nearly the same advantage as when that work should be completed to Cumberland.

In that case, the charge for transportation upon forty-five miles of railroad, at two cents per ton per mile would amount to ninety cents: the tolls one hundred and thirty-four and a third miles of canal at half a cent per ton per mile for the cargo, and two cents per mile for the boat, (assuming the average cargo of boats to be eighty tons) would be seventy-four cents: and if to this should be added thirty-three and a half cents for transportation on one hundred and thirty-four and a half miles of canal, at the rate of forty-six cents for one hundred and eighty-four and a half miles, and thirty-five cents for contingencies and transhipment at Georgetown, making together sixty-eight and a half cents, the entire cost of transportation by this mode, of a ton of coal from Cumberland to Georgetown, including expense of putting it on board a vessel at that place, would not exceeed two dollars thirty-two and a half cents.

If the charge upon the railroad should be placed at one and a third cent per ton per mile, as it might be, the entire cost of coals, according to the assumed cost of the Ericsson propellers, from Cumberland to Georgetown, would be only two dollars two and a half cents per ton.

Without meaning to vouch for the results expected from the application of the Ericsson propellers, no reason was perceived why they might not be used with the same advantage, below as above dam No. 6; and that if a demand for the Cumberland coal could, under any circumstances, be created to any extent, it might not be effected as well in the manner here mentioned, as by any other means.

It appeared to be the plain duty of the board, therefore, to await such developments; and, to engage in the business when it should be demanded by the public, and be profitable to the company.

In the month of January 1844, and previously to the order of the house of delegates of the 24th of that month, the board were officially informed by the president of the Maryland and New York iron and coal company, that having procured the funds requisite to construct a railway from the mines to Cumberland, he was anxious to proceed with the work; if the charge for the transportation of iron and coal from the mines to Baltimore, could be fixed at such rate as would warrant him in adopting the Baltimore and Ohio railroad for the transportation of his products.

The same officer subsequently proposd a contract for that purpose, to continue for five years after the completion of his road; to furnish a freight of coal, pig iron, bar iron, fire brick and castings and other manufactures of iron, (the principal freight being coal) in quantities of one hundred and seventy-five tons per day, for three hundred days in the year. The construction of the railway from the mines to Cumberland, was represented as dependent upon the acceptance of the proposition by the railroad company, upon terms which would be entirely satisfactory.

After the necessary investigation of the subject, the board agreed to furnish cars and moving power, and to transport the freight proposed from the mines to a suitable shipping point at Baltimore, at the rate of one cent and one third of a cent per ton per mile, a distance of one hundred and eighty-eight miles, with an addition of ten cents per ton for transportation through the streets of Baltimore; the cars to be loaded and unloaded at the expense of the Maryland and New York company, and when iron and other articles should be transported in house cars, there should be added for such articles one cent per ton per mile for one hundred and eighty-eight miles.

These terms were accepted by the Maryland and New York company, who proceeded to the construction of the railway, and to make the other requisite preparations to carry it into effect.

This company also is preparing the proper number of the heavy engines, and coal cars; and both parties have mutually agreed that the operations under the contract shall commence on the first day of November next.

The estimates of cost upon which the board felt warranted to enter, into this contract, will be found in the appendix to this report.

In the course of a short time, therefore, any speculation which may in any quarter be indulged of the ability of either party to comply with its engagements, will be at an end: and the adaptation of the railroad to the transportation of coals and iron at the above rates will be subjected to the test of actual experience.

On the 25th of January, and February, 1844, respectively, during the negotiations with the Maryland and New York iron and coal company, and without the prompting or knowledge of the board, two orders passed the house of delegates, requiring the president and directors to report to the house the lowest rate of toll per ton per mile, at which the company would agree to transport coal, iron, etc., from Cumberland to dam No. 6, under a permanent arrangement; and also to report upon various other points comprehended in the orders.

These orders and the several replies of the board to the points embraced in them, dated the first and fifteenth of February, will be found in the appendix to this report; and will afford, it is believed, a satisfactory view of the whole subject.

If by the inquiries contained in the orders, the legislature designed, as it may be presumed they did, to invite or lead the railroad company to lend its assistance to the encouragement or development of the coal trade, the terms upon which the board expressed their willingness to do so must be conceded, in any view of the subject to be just and reasonable.

The rates of charge, stated in the replies, were little more than one half of those that had been previously proposed as quite low enough to develope the trade; and, sufficiently low, in the mode indicated in this report, to enable the dealer to put his coal on board of a vessel at Georgetown, and thence at New York at less cost, it was supposed, than coal from other parts of the Union had been previously delivered at the same city.

Indeed, the rate of charge assented to by the railroad company appeared to be so much lower than had been anticipated, and so much below what had been previously deemed sufficient, as to beget an apprehension of the ability of the company to engage in the trade at such rates.

The other terms presented in the replies of the board cannot be deemed less reasonable. They required only, previous to expending the capital of the stockholders in making preparations for the trade, that communications absolutely indispensable to the transportation of coal to market should be made from the mines to Cumberland; that capital should be provided to work the mines, and that responsible parties should engage to furnish coal in proper quantities, to employ the machinery necessary for its transportation.

These conditions were considered as the appropriate evidence of the existence of a demand to an extent, short of which, no means of transportation would be needed.

The coal and iron of the Allegheny region is not to be developed by a demand dependent upon a precarious and occasional supply. On the contrary, it can only be effected by steady operations, conducted with such capital as will be adequate to maintain a regular trade; and if those concerned in such operations have no confidence in a demand equal to the sale of fifty thousand tons per annum, there can be little inducement for the preparation of extensive conveyances to market. The board at least was unwilling to expend one or two hundred thousand dollars in machinery, not adapted to other purposes, for a branch of transportation dependent upon casualties by which it might be only occasionally employed: and unless they would have been content to rely upon vague expectation, and a precarious trade, it is difficult to imagine any conditions more reasonable than those prescribed.

That the estimates of the cost of transportation are sufficiently liberal, there need be no reasonable doubt.

Founded by the actual experience of the company in their operations, they are little liable to error; and are sustained not only by the engineers by whom they are prepared, but by Mr. Knight, by whom they have been carefully examined, and compared with the elements of his former report.

That they may be fairly understood, these estimates must be considered in reference to the particular trade to which only they are applicable.

They suppose a distinct branch of transportation separate from, and wholly independent of the general trade and traffic of the road; and therefore not properly chargeable with the existing and fixed expenses incident to the general miscellaneous business; which would be the same without the trade in coals.

They also include only that degree of wear and tear due to this particular operation.

The estimates suppose also: First—the use of the heavy improved engines, possessing double the capacity of those assumed in the former report of Mr. Knight. Second—a cheaper and lighter description of cars, by which the useful load in proportion to the weight of the car is considerably increased; and Third—a larger amount, and greater regularity in the trade.

Conforming the data embraced in the report of Mr. Knight of 1842 to these elements, the present estimates will be shown to be abundantly sufficient. They have also received the approbation of respectable scientific journals throughout the Union, and are found to be even more liberal than those comprehending the actual cost of similar transportation upon other roads in the United States.

All estimates of the actual cost of transportation upon English railways, of which we have any accurate knowledge in detail, are of a date so remote as to embrace only the earlier description of locomotive power; possessing from a third to a fifth of the capacity of that proposed to be employed upon the Baltimore and Ohio railroad in the transportation of coals: and contemplate the use of a description of cars weighing one ton and three-tenths, and with a capacity to carry two tons and six-tenths of coal.

Conforming the actual cost, according to the experience in England, and the description of machinery there employed, to the improved engines and cars to be used by this company, it will be foud to correspond with the present estimates, and to verify them in every particular. By the most recent authority of the best approved authors of England, it has been confidently stated that coals may be transported upon English railways at half penny per ton per mile: which is not only about the same as the cost assumed in the estimates of this company, but, when taken in connection with the more expensive operations of English railways, would warrant even a less estimate in the United States, than that now given.

The board have it in their power to state also, that, subsequent to the date of the estimates submitted to the house of delegates, a further improvement has been made in the construction of the coal cars, by which a greater reduction in the cost of transportation is effected.

The estimates submitted to the house of delegates adopted a car of a wood frame, costing three hundred and eighty dollars, weighing three tons and carrying seven tons of coal. In the improved car, subsequently invented and now adopted, sheet iron, in a cylindrical form, is substituted for wood, costing three hundred and forty dollars, weighing two and a half tons and carrying seven tons of coal.

In the appendix to this report the board subjoined a revised estimate of cost founded upon this improvement, and including interest of six per cent. upon the capital employed in the machinery; by which it satisfactorily appears that coal may be transported from the mines to dam No. 6, at a cost less than one cent per ton per mile; and to Baltimore at a cost of one cent and half a mill per ton per mile.

It is thus shown that the statement of the capacity of the railroad submitted by the board in their reply to the legislature of the 15th of February 1844, is in all respects confirmed, and may be fully relied upon.

The board desire again to repeat that whether it may be expedient to engage to any extent in the transportation of coal at the rates now estimated, must depend upon contingencies not at present to be foreseen. They have at no time particularly desired to engage in it; and would always regard it as quite subordinate to the paramount duty of pressing forward their work to the Ohio river; leaving the general trade in coals and iron from the Allegheny region, to others more ambitious of monopolizing it. So long, however, as the railroad may be arrested at Cumberland, the transportation of these articles must unavoidably form a natural and legitimate object of attention; and during this time, if those concerned in supplying the demand, looking to the advantages of speed and uniformity of working at all seasons, find it advantageous to resort to the railroad, neither the interest of the stockholders nor a due regard to the trade of Baltimore would permit the board to decline the business.

Second.—Of the Washington Road.

The affairs of the Washington road are shewn by the statements D and E.

These statements show an improvement not less gratifying in the trade and travel and in the operations of the road, and also in the expenses of working the road in proportion to the business, that has been already stated in those of the main stem.

The net earnings for the year ending on the 30th ultimo, are $104,519.-33, being upwards of six per cent.; which added to the surplus of the preceding year amounting to $6,275.86 make an aggregate of $110,795.19, or six and five-eighths per cent. upon the capital of the road. Of this sum the board have decided to divide among the stockholders six dollars per share, payable on and after the first day of November next; reserving a surplus of $11,795.19.

The board deem it proper on this occasion to announce their purpose in future of dividing among the stockholders the net earnings of this road semi-annually, without reference to the operations of the main stem.

The sum paid to the State for the six months from the 1st of July, 1843, to the 1st of January, 1844, being one-fifth of the gross receipts from passengers, amounted to $18,189.19, and from the 1st of January, 1844, to the 1st of July, 1844, to $22,851.10, making together $41,040.29.

It will be observed that if to this sum of $41,040.29 be added the sum of $33,000, the amount of dividend to be received by the State from the Washington road, $12,500, the dividend from the main stem, and $1,269,60 regularly remitted to London as the interest on £5,250, the amount of the sterling bonds sold on account of the State's subscription of $3,000,000, it will be seen, that during the year, the State has received the aggregate sum of $86,809.89 being nearly nine per cent. upon the actual investment in both roads.

The railway, the passenger and burthen cars and depots and water stat tions are in good condition; and a comparative statement of the operations upon the road during the past and preceding year, is here appended, marked **F.**

In the last annual report the board adverted to the rivalry between the inland route south of Washington, by the railroad through Richmond and Petersburg, of which the Washington railroad forms an important connection, and the bay line from Baltimore to Norfolk, and thence by the Portsmouth and Roanoke railroad: and they stated the desire of the parties interested in the southern railroads, that this company should co-operate with them in such reduction in the fare upon the Washington road as might be necessary to bring a greater amount of travel to the inland route.

The board also acquainted the stockholders with the provisions of their charter, forbidding any reduction in the charge upon the Washington road with the consent of the legislature, or, in the recess, of the Governor of the State: and which also prevents the railraad company from applying to the legislature for such consent, without conferring upon that body a dangerous control over the chartered privileges of the company.

During the last session an application was made to the legislature by other parties to consent to a reduction in the charge; and the railroad company itself was desirous that the discretion vested in the Governor to be exercised by him in proper contingencies in the recess, should also he extended to the board of directors, in order that it might be exercised when a proper occasion should arise with a better knowledge of the circumstances than the Governor in most cases could possess.

It is very obvious that at the time of granting the charter, although it established for general purposes a maximum and minimum charge, the legislature itself foresaw that contingencies might arise in which it would be expedient and necessary, temporarily at least, to reduce the charge; and accordingly on this ground they authorized the Governor to act in the recess. Experience has shown that the necessity thus contemplated was not overrated by the legislature; but it has also shown that the discretion they provided for the emergency, has proved altogether inadequate; and under these circumstances it appeared to the board, not less for the interest of the State than for the public and the stockholders, that a similar discretion should be vested in the board, who with a familiar knowledge of the subject, might act in this respect under the same responsibility as that under which all their other duties are performed.

By any existing law, the board have the unlimited power to reduce the charge upon all passengers going and returning between the two cities of Baltimore and Washington, or between any intermediate points on the same day: and no objection was perceived to such enlargement of the power as might be found to increase the travel upon the road, and to augment the revenue of the company.

It pleased the legislature, however, not only to withold such discretion from the board of directors, but to adjourn without giving any consent upon their own part to a reduction in the charge; and it is the opinion of the board that in consequence of this failure on the part of the legislature, many passengers between Baltimore and Washington, and Baltimore and points south of Washington, and also a considerable number who were desirous of attending public celebrations of various kinds, have been prevented from using the railroad, to the serious injury of the interest of the State and of the company.

After the adjournment of the legislatures, measures were taken by parties more immediately interested in the success of some of the southern railroad companies, to establish an opposition between Baltimore and Washington, which has already diverted a considerable number of passengers from the Washington road.

On the 15th of June last, two lines of stages commenced running for the conveyance of passengers between Baltimore and Washington and intermediate places. On the 25th of August, another line was added, and since that day three lines have been running in each direction daily, by which passengers are conveyed from one city to the other, and taken up and set down at any place in either, at the charge of one dollar and fifty cents each.

By the annual report of the Richmond, Fredericksburg and Potomac railroad company, dated 27th May last, it would appear that these lines have been established under the auspices of that company.

In that report it is stated:

"Large as this increase is the board of directors have no doubt it would have been materially larger, but for the high charges on the southern travel, imposed by the State of Maryland, and the Baltimore and Ohio railroad company on the Baltimore and Washington railroad.

"The excessive rate charged on the through travel on this work, has tended to retain on the bay, and to throw into coasting vessels, or divert over the Baltimore and Ohio railroad to the Ohio river, a considerable amount of travel which would otherwise have been secured to the line of railroad and steamboat communication through Virginia.

"The presidents of the Virginia railroad companies having for years remonstrated with the directors of the Baltimore and Ohio railroad company, and lately appealed to the governor and legislature of Maryland unsuccessfully, on the unfairness of exacting an undue proportion of the charge which could be judiciously made on through passengers, the attention of the board of directors has lately been directed to other means of preventing for the future the injury which has hitherto resulted to them from this cause, and they are sanguine, that by means of an efficient line of stages, which will be placed about the 15th proximo, on the Baltimore und Washington turnpike, and which in connection with the railroad and steamboat companies will convey passengers between Baltimore and Richmond, and points south of Richmond, at much lower rates than heretofore, they will be able to recover a large portion of the travel which has hitherto been diverted from their route by the charge on the Baltimore and Washington railroad.

"Should their expectations in this respect be realized they will be enabled to protect themselves against the competition of other routes, at the same time that they will prevent the reduction in their charge, (which will be confined to passengers taking the stage line,) from benefitting the Baltimore and Washington railroad, and thereby tending to keep up the excessive charge which has hitherto been levied on through travel on that work.

"Should the legislature of Virginia co-operate, as the board of directors can scarcely doubt they will, by refusing a right of way, or any other privileges to the Baltimore and Ohio railroad company, until they shall have redressed the grievance of which the State of Virginia, and the Virginia railroad companies have so much reason to complain—the board of directors entertain no doubt it will be ere long corrected."

It is understood from other sources, although not official, that the Richmond, Fredericksburg and Potomac railroad company, has contracted to pay the stage proprietors two dollars and fifty cents upon each through passenger carried by the stages between Washington and Baltimore, in either direction, in connection with the lines south of Washington; and has also stipulated to pay the stage proprietors five thousand dollars, if the stages are withdrawn from the route at the company's instance.

From these documents it is obvious that the stages have been established in competition with the railroad, for the avowed purpose of coercing, not the railroad company, for it has no power to act in the premises, but, the authorities of Maryland to engage in a rivalry between different works in another State; in behalf of enterprises comparatively of recent origin, and undertaken with a full knowledge of the declared policy of the State, and of the positive provisions of the law which it is now sought to change.

It is not to be denied that the Washington road is a Baltimore enterprize, designed to connect that city with the metropolis of the Union, and to be supported by the travel to the seat of the federal government from the north, east and west, and from Maryland and her capitol.

As a thoroughfare of southern travel, at the date of the charter, the work was scarcely thought of, for at that time none of the present Virginia railways, forming its southern extension, were projected: and at this day, nearly fourteen years after the origin of the work, the local or Washington travel is the primary, and the through or southern travel the secondary, in the most ample sense of the terms.

It is evident from the report already quoted, that it is no part of the object of the southern companies to reduce the charge upon the Washington railroad, in favor of the public generally: on the contrary, they expressly propose that the reduction should be made in favor of "through passengers" only, or those travelling in connection with the southern lines; and that, this object being attained, they would be content with even a higher charge upon passengers travelling between Washington and Baltimore or intermediate points: a system which, it is understood, the Fredericksburg, Richmond and Potomac company has adopted upon its own road.

If the terms of the contract already referred to, be correctly reported, in the prosecution of their designs and as indispensable to their success, "the Richmond, Fredericksburg and Potomac company" does not in fact derive any greater proportion of the charge for passengers passing over their line, than if conveyed by the railroad, at the established charge; but, on the contrary, consents to sacrifice, or give to the owners of the stages a bonus of one dollar upon each passenger carried in the stages, in connection with the southern lines; and also to incur a penalty of five thousand dollars whenever it may determine to discontinue the compulsory means at present employed.

Independently of this sacrifice, it may be well expected that the southern company will ultimately suffer greater injury from these proceedings, than can now be foreseen.

It is not unreasonable to suppose that the substitution, in connection with its route of forty miles of stages, instead of an easy and comfortable railroad, will increase the advantages already complained of in favor of the bay rival: and the consequences most to be apprehended from this novel scheme will be the diversion of a greater amount of travel from the inland to the bay route, and of the local travel between the cities of Washington and Baltimore from the railroad to the stages; such in fact, it is believed, is the result up to this time.

It is obvious, however, that whether the passengers be diverted to the bay line or to the stages, the injurious effect upon the business of the Washington railroad, will be the same.

The number of passengers conveyed by the lines of stages the entire distance between Baltimore and Washington in both directions, from the 15th of June to the 30th of September inclusive, was 3419, and in addition 889 passengers with through tickets to and from points south of Washington, making an aggregate of 4308.

During the same period the number of passengers transported in the trains from Baltimore to Washington at the established rates of the road was 5676, and from Washington to Baltimore 7486, and in addition 2742 passengers with through tickets to and from points south of Washington.

On the 8th of July last, pursuant to the authority conferred by the 7th section of the act of 1836, ch. 261, the board of directors of this company reduced the charge to passengers on the railroad between the cities of Washington and Baltimore, going and returning the same day, to the sum of two dollars and fifty cents for the round trip; and at the meeting on the 4th of September, they established the same rate of charge for similar travel from all intermediate points.

Within this period the number of passengers transported over the railroad with tickets for the round trip, at the reduced rates, has amounted to 2322.

It will be obvious, however, from an examination of the facts and statements now communicated that, unless the stages be withdrawn altogether a reduction of the railroad charges upon "through passengers" only, or those to and from points south of Washington, according to the views of the southern companies, would not prevent the competition, but that it would be necessary to reduce the charge at the same time upon all passengers, passing over the railroad.

By two several communications from the president of the company, dated the 4th of September, and the 4th instant, the governor was made acquainted in detail with all the facts herein stated, and to which, up to this time, no answer has been received.

By these communications the duty of the board has been fully discharged; since having no power of themselves to act further in the premises, the subject, in the recess of the legislature, can only be submitted to the governor to be dealt with as he may deem most expedient.

To the Editor of the American Railroad Journal and Mechanics' Magazine.

Sir:—Although I am not the proprietor of a single share of any railroad, canal or steamboat company, I am not an indifferent observer of the improvement and prosperity of these several institutions of wealth and in dustry; and to the fullest extent they can be made subservient to the public welfare, I wish them a hearty *God-speed.* And as a particularly satisfactory indication of their growing interest in the public mind, I have noticed the proposal you make to enlarge the pages and contents of your Journal, a work which I esteem as among the most honorable and useful to the present and coming generations, that emanate from our national press.

As I have not the entire series of your Journal, (as I hope by and by to possess,) I may be mistaken in the impression, that neither in its pages, nor elsewhere, does there exist anything like a comprehensive table of the statistics of the different railroads in our country, such as would be almost in-valuable to the engineer, the broker, the political essayist, and to the statesman, in both State and National legislatures. At the patent office in Washington I was both astonished and ashamed of the niggardly provision which exists even in the library of that great national department not merely of government, but of national inventive genius. A few only of the latest parts of your Journal are to be found there, and scarcely an *entire* series of any other scientific and statistical publication of our country! For one, I trust another session of congress will not expire, without placing an entire series of your Journal and a complete one of every other practical periodical connected with the arts and public improvements, whether published in our own country or in Europe, upon the book shelves of the patent office.

But in respect to your Journal, I think another suggestion is due It is a publication that is *sui generis* in this country, devoted exclusively to the great spirit and the great works of enterprize and internal improvements in our land; and it ought to be in the hand of every agent, engineer, contractor and director upon these works. If any man in responsible trust connected with any of our roads is not your patron I should esteem him too far behind the age, or too decidedly wanting in spirit and ambition in his pursuit, to merit his station. The public safety—the whole travelling public are interested in the wide diffusion of practical and professional knowledge respecting railroads and especially the diffusion of it among all persons officially connected with their care and management. It carries in it both the preventives and the remedies of accidents and cheapens though silently and unseen, the whole system of transportation, while it elevates the standard of employment and gives new character to the entire business of the operative.

But I have elaborated into an article what I only started to make into a congratulatory letter. Whoever begins to think on the utility of your Journal, cannot well avoid wishing it in the hands of every man connected with the construction and management of railroads, steamboats and canals in our country. Such at least is the sincere feeling of your friend and obedient servant and constant reader, Francis O. J. Smith.

Forest House, *Westbrook Me., Nov.* 18, 1844.

Report of the directors of the New York and Erie railroad company to the stockholders, 17th October, 1844.

The directors of the N. Y. and E. railroad company believing that they have as far as has been in their power, carried into execution the views set forth in their acceptance of office, feel themselves called on, as well in reference to the manner in which they have fulfilled the trust reposed in them as to the results which have attended their measures, to submit at the close of their term of office a brief summary of their proceedings.

It will be recollected by the stockholders, that the critical situation of the company, prior to the election of 1843, had induced them to place the control of that election in the hands of a few gentlemen possessing the confidence alike of the community and the stockholders. It was represented that the main object of the measure was to ascertain whether the embarrassments of the company could be so far relieved as to enable an entirely new direction to submit again to the city and country, the question of the completion of the New York and Erie railroad freed if possible from all other considerations than those of the value of work done, probable cost of completion, the degree of its importance to the city and country, and the facts which would determine the extent of its pecuniary returns.

The consideration that a work of such vast importance and promise, might through their instrumentality be again placed in a position to be successfully prosecuted to completion, induced the individuals subsequently elected directors to consent to aid in the proposed effort to carry these views into execution.

For a statement of the manner in which the board undertook their responsible and difficult duties, and of the measures which were adopted to effect the ends in view, the stockholders are referred to the report addressed to the public and published Feb. 8th, 1843, a copy of which has probably reached every stockholder.

The board then refer to the failure of their various appeals to the public and to a new plan suggested which met with rather more favor.

The paper prepared on this occasion is annexed to this report. Its main features were, that 200 persons should undertake to furnish the capital required of $6,000,000, on condition that priority of dividend at 7 per cent. per annum, be secured to the holders of the new stock, and that 14 per cent. per annum should be the interest to be paid by the State, in case the State should elect to purchase the road on its completion.

A larger amount has been subscribed on this basis, than on any other, but the subscription has not reached a sum that will justify the hope that by its means the capital can be raised.

It is with extreme pain that the board find themselves under the necessity of presenting this discouraging statement, but they feel that without it, no proper estimate can be formed of their proceedings, nor a correct idea be given of the present situation of the company.

Disappointed in the result of their measures for obtaining capital by private subscription to the stock of the company, the attention of the board was next directed to the resources supposed to be placed at their command, by the act of 1843. By that act the right to issue bonds to the amount of $3,000,000, was to be waived for that object. By means of the bonds so authorized, it was proposed to raise $500,000 for the purpose of extending the road to Port Jarvis, a distance of about 20 miles from the present termination. It was ascertained that the money could probably be raised in the manner proposed, if the act would make the security offered good. That the character of the security might be satisfactorily established the question was submitted to legal counsel, from whom the opinion was received that the waiver of the State lien was made dependent on the completion of the road in seven years from the date of the act, and that so far as that event was uncertain, there would be a corresponding risk to the bond holders. In view of this opinion, it was evident that the bonds could not be sold, and the measure was therefore abandoned.

The stockholders will learn from what has been herein stated, that the board under existing circumstances referring especially to the lien which the State has on the entire property of the company, have no resource on which they can rely as the means of insuring the construction of the road, and complying with the stipulations of the act to the completion of certain portions in assigned periods. Attention is called to this position, that if it be found to be correct, those who are hereafter intrusted with the management of the interests of the company, may at an early day take the measures which it renders necessary.

The board are of opinion, that unless the State will agree so to amend the act, as to allow the property of the company to be pledged as security for the expenditure of new capital on the extension of the road from place to place as circumstances permit, there is little reason to believe that any efficient measures can be taken at present for the extension and ultimate completion of the road.

On reviewing the measures of which a brief summary has now been presented, the board are aware, that views may be entertained by some of the earnest friends of the road which are entirely opposed to the position taken by the board, that the work should not be resumed on private subscription, unless the means of its completion were fully provided. They are aware that it may be contended that with a subscription of one or two millions the road could have been so far carried forward, that its completion would have been secured, almost as soon as by a full subscription at this time.

It has been already stated that the board believe that a sum sufficiently large to make it judicious to commence the work at all could not have been obtained on the principle alluded to.

The board would now add that their confidence that remunerating dividends would be paid to persons subscribing to the stock, rested solely on the completion of the railroad to lake Erie, and that therefore they could not consistently with their view of responsibility to subscribers to the stock, ask for their subscriptions on a principle that left that event in great uncertainty. The contingency may not be very great, and by some may even be considered small, but it has been deemed by the board of sufficient magnitude to involve a responsibility which they do not feel themselves called on to assume.

The board are gratified on being able to report on the present financial position of the company, and the amount of business done on the road, in highly encouraging language. The report of February presented the situation of the affairs of the company at the time the present directors came into office. The property of the company was in the hands of assignees, and so entirely without resources did the directors find the company, that the funds required to meet the ordinary office expenses, and to carry into effect the measures proposed to remove the embarrassments under which the company was lying prostrate, were only obtained through gratuitous subscriptions of a few friends of the road. The amount so obtained and which has enabled the board so materialy to improve the financial condition of the company, it has given the board great satisfaction to be able to state that they are now in a condition to repay, with thanks in the name of the company, for the aid so timely rendered.

The measures which are described in the report of February, 1843, as being in progress, have since that time been continued and mainly with the success anticipated.

The embarrassments growing out of the indebtedness have at times threatened the interruption of the operations on the road, without the aid of which the claims against the company would be of but little value. But the representatives of the officers of the company have been successful in effecting arrangements which the interests of the company and the creditors equally required.

On the 2d April, 1844, the board of directors adopted a resolution calling for an instalment to be paid on or before the 20th May last, of five dollars a share on all stock of the company, whereon payment already made did not exceed fifteen dollars per share, under the penalty of forfeiture of said stock, and of all previous payments thereon, as provided in the charter of the company. In default of compliance with such call, 4,290 shares were forfeited, upon which payments had been made of $48,296.90.

In the report of Feb. 1844, the net revenue of the 50 miles in use was stated at $46,000, and that sum was taken as the basis of calculation in deducing an estimate of the probable revenue of the entire road from the actual returns of the road in operation.

Since the publication of the report, such has been the increase of business, that, with a very inadequate equipment of cars and engines, the net earnings of the year ending Sept. 30, 1844, has exceeded $58,000, being 25 per cent. more than the sum stated above.

The following have been the net earnings for the last three years, and will be seen to present a very encouraging rate of increase.

Net earnings of the railroad for the year ending Sept. 30th 1842,	$31,224
" " " " 1843,	43,815
" " " " 1844,	58,678

It may be proper to add that the charges for freight and passengers on the New York and Erie railroad, are less than other railroads in the country, probably without exception.

The members of the present board came into office possessing a very limited knowledge of the merits of the project, of connecting the city of New York with lake Erie by a railroad. Their duties subsequently, have made them better acquainted with the grounds on which it is maintained that its completion will be attended by results in the highest degree important to the city and country. The board would again record what on several occasions they have already expressed, their full confidence in the soundness of such views.

This report is signed by Horatio Allen, president, James Brown, vice president, and D. A. Cushman, C. M. Leupp, F. W. Edmonds, S. Brown, Theodore Dehon, P. Spofford, Anson G. Phelps, Matthew Morgan, John C. Green, A. S. Diven, Wm. Maxwell, Elijah Risley, directors.

At the annual election held on the 23d of October, 1844, the following gentlemen were elected directors for the ensuing year, viz: George Griswold, Jacob Little, John C. Green, James Harper, Eleazor Lord, Paul Spofford, Stewart C. Marsh, Henry L. Pierson, Henry Shelden, C. M. Leupp, J. W. Alsop, Silas Brown, Robert L. Crooke, (and Sidney Brooks, who has since declined) of this city, and D. S. Dickinson of Broome County, A. S. Diven of Allegany and Elijah Risley of Chatauque. At an early meeting of the board, the following address was ordered.

Address.—It may be expected that this board should express to the public their views of the undertaking, the progress of which is the object of their appointment.

Happily the merits of this undertaking are universally acknowledged. The lapse of time has but rendered them more evident and unquestionable: and the importance, not to say the necessity of the work to this metropolis, has come to be very generally felt. But in common with many other public works, including those of this State, its progress has been suspended, and the plans and measures heretofore proposed for obtaining funds for its completion have failed of success.

There is, nevertheless, in the community, not only a prevalent feeling in favor of this work, but a belief that it may be, ought to be and will be completed—that further delay is neither necessary nor expedient—and that a practicable plan for its resumption and accomplishment may be proposed, and would be promptly supported.

Much of the doubt and discouragement which has heretofore prevailed has arisen from want of information on the part of those who were favorably disposed towards it; but more, by far, from the opposition and misrepresentations of parties interested to defeat it, and from individuals who were disappointed of success in their private schemes. The object of this opposition was to destroy confidence and defeat the undertaking. It proceeded from hostility to the work itself, which was viewed as in conflict with certain local interests, and as prospectively in rivalship with the more northern route to the lakes, which had been rendered populous and powerful by a munificent outlay of the public funds.

The effect of the misrepresentations so long and so industriously propagated, aided as they were by the embarrassments attending and following the suspension of the work, has been to induce extensively an impression that there must be some great difficulty, some formidable obstacle, deeply seated in the scheme itself, or in the manner in which its affairs have been conducted. The failure of the company to obtain the means necessary to a resumption of the work, appears to have strengthened this injurious and unfounded impression. Some elucidation of this subject seems therefore to be called for on the present occasion.

The hostile misrepresentations referred to, had respect chiefly to the prices paid by the company for labor and materials; which were alledged to be exhorbitantly high. Confidence was in this manner impaired and a door opened to every species of injurious imputation.

The facility with which misrepresentation and prejudice on this subject were propagated, was greatly augmented by the disastrous state of the times, and by the madness which seized the minds of a portion of the people, who from being the friends and promoters, proclaimed themselves to be opposed to the construction of public works, whether by corporations or by legislative authority, and seemed to exult in the suspension and ruin of every such undertaking.

Successive legislatures, however, understanding the state of facts in regard to the proceedings of this company, far better than the public did, have passed laws of the most favorable character at nearly every session for the last twelve years; not indeed without the boldest exhibition on the part of some, of the hostility which has been referred to, but generally, nevertheless, by strong majorities. In short, the undertaking and its managers, appear to have had the confidence of the stockholders, of a majority of the legislature, and of that portion of the public generally, who desired the completion of the work.

It therefore seems to the board to be due to the character of the undertaking, to say, emphatically, to those who may be disposed to promote it, that the difficulty in the case is not internal—that it results not from anything in the actual condition or proceedings of the company, but from hostile misrepresentations and false impressions to which it has been subjected. Were this difficulty of a nature to be overcome by testimony, by the results of impartial investigation, or by the opinions of disinterested or candid men, enough would seem to have been done in that way to effect the object; or on the contrary, enough to show conclusively, that while the ruin of the undertaking continues to be considered possible, opposition to it and to all attempts to resume and carry it forward, is to be looked for from the same source and for the same purpose as heretofore. It can be encountered and surmounted, not by timidity, inaction, and delay, but only by earnest and successful action on some feasible plan.

If therefore the city needs and desires the completion of this work, a timely and resolute effort to sustain and provide for it is imperatively called for; and to such effort, with a right apprehension of the case, and a practicable plan, there is no obstacle, but every encouragement. The public need no further evidence to show that the undertaking is well founded, that its execution is of the highest importance to this city, or that it will, when completed, yield satisfactory returns to its proprietors. The city and the whole country are satisfied in these respects. It remains only to propose and prosecute a plan, which those who desire its completion will not deem impracticable. There is nothing in its condition, its history or its prospects to discourage or impair the value of new subscriptions to the stock. On the contrary if stock in such a work could in any case be deemed desirable or unobjectionable to the citizens of this city, new subscriptions to this are recommended by two unusual and valuable considerations: namely, first that the time necessary for completing the road is brief, compared with that which would be required, were the work now to be originally commenced; and second, that by the law of April 1843, the company are entitled to the State loan of three millions as a bonus, or a return of the monies paid by them, with legal interest, on condition of their accomplishing the construction of a single track of the road within seven years from the passage of that law.

It should be known, however, that by this law, two years only were allowed for the company to resume the work. The period thus limited, will expire in the month of April next, and all the benefits of the law will then be forfeited should the company fail to obtain funds and resume the work before that date.

In the same most encouraging and valuable act of the legislature, provision was made expressly, to supersede the necessity of any very formidable amount of new subscriptions to the capital stock. The company was authorized to issue bonds for three millions of dollars, being half the amount required to complete the work, which were constituted a lien upon the road, in preference to that of the State.

With respect to that law, no renewal of its provisions can be hoped for, should the company fail within the time limited, to avail itself of its advantages, by obtaining funds and resuming the work. Least of all, is any modification of the law for the purpose of authorizing an issue of the whole or a portion of such bonds, as the sole reliance for the means of extending any section of the road, reasonably or with any confidence to be looked for, while no provision is made by new subscriptions for carrying out the entire undertaking. The object and intention of the legislature was to aid, encourage and secure the completion of the entire work. So far as the benefit of the law was intended as a boon to the southern tier of counties, it was intended for all of them; and in so far as the legislature designed in this way to benefit this city, they undoubtedly had in view the entire work, as a thoroughfare of commerce with the lakes and regions of the west. And if with the extraordinary advantages of this law, in a period of commercial prosperity like the present, the means of going on with the work in such a manner as to justify confidence of early and entire success cannot be attained, what rational consideration can be urged to justify any further public patronage? If the importance and the merits of the work will not draw to it the requisite support, who can persuade himself that there is any ground of hope in the future. If with its acknowledged merits and importance it fails of support from this city, who can bring himself to believe that any further encouragement of it would be conceded by the legislature, or could with any propriety be solicited.

It is known and felt by the friends of this work in every successive legislature, that its benefits are to centre and be realized chiefly in this metropolis, the interests of which in that behalf were so carefully guarded in the charter, by the provisions which confine it within the limits of the State, and contemplate its approaching on the east side of the Hudson, and traversing the whole length of the city. They are also aware, that as yet the city has not been heavily taxed for its construction, the city subscribers having paid less than $400,000; a sum believed to be considerably inferior to that annually saved to the inhabitants, by the reduction in price of a single article of daily consumption, in consequence of the new supplies thrown upon the market from the counties through which the road is in operation—while the inhabitants of the counties on the route have paid an aggregate approaching $1,200,000.

The actual outlay upon this work, including the value of donations for roadway and other purposes, may be reasonably estimated at five millions of dollars: consisting of stock of the company somewhat less than one and a half millions; debts, chiefly settled by obligations at five years, about six hundred thousand dollars; and three millions furnished by the State.

The donations of land furnished for the roadway, depots, stations, and other purposes, are deemed to exceed in value the loss incurred on the sale of State stock, and the damages to unfinished work, consequent on suspension and delay.

Those best acquainted with the subject, with the amount of labor and materials employed, and the prices paid, deem the work to be well worth all that it has cost; and are of opinion, that were it now to be commenced, taking into view the unavoidable loss of time required in such a case, a greater amount or value of results could not be accomplished for a less sum.

Much more than half of the work necessary to prepare the entire line of the road for the rails, has been performed. The work is well done. No part of it requires to be altered. The plan of the work is in no respect inferior to that of any similar undertaking, and is believed to be susceptible of no material improvement. The track is six feet in width, in which respect it is deemed to be more advantageous for so important a thoroughfare, than the narrower tracks on other roads.

Fifty-three miles of the road on the eastern division are in prosperous and profitable operation. On the Delaware, east of Deposit, between 30 and 40 miles are graded. Between Binghamton and the lake, 150 miles are prepared for the superstructure, some of which is laid. The timber for the superstructure is provided for about 250 miles. At the western termination the rails are laid on about ten miles.

To complete the entire line of the road $6,000,000 is deemed necessary and sufficient. Towards this sum, the bonds legally authorized are an eligible and safe reliance for 3,000,000. From a variety of considerations it is believed to be quite safe to rely upon the interior counties for further aid to the amount of 1,000,000. So that to insure the immediate progress and early accomplishment of the entire work a subscription of $2,000,000 only is required. With such a subscription the board would have no hesitation in proceeding with the work in the confidence that no further call upon the citizens of this city will be necessary.

Believing this to be the smallest amount that would give the stockholders sufficient confidence of success to render their subscriptions safe as an investment, and that subscriptions to this amount will be deemed impracticable or out of proportion for this city, it is proposed to give notice in due form within a few days, comprising substantially the following conditions, viz:

1. That books of subscription to the capital stock will be opened for $2,000,000; the option being reserved by the board of accepting such further subscriptions as may be made prior to the 1st day of April, 1845.

2. That if 2,000,000, and no further sums should be subscribed by that date, the board will rely for subscriptions for 1,000,000 in the interior counties, so as to make an aggregate of 3,000,000, which, with the like amount of bonds, as authorized by the legislature, is deemed sufficient to complete the road from the Hudson to the lake in such time and manner as to secure all the benefits of the law of April, 1843.

3. That an instalment of $5 per share be called at the pleasure of the board after the 1st day of January, 1845, and that subsequent instalments be restricted to $20 per share in 1845; $30 in 1846: and $45 in 1847.

4. That as an equitable, and under existing circumstances, an expedient measure, interest at the rate of six per cent. per annum be allowed on all the instalments on the stock which shall be subscribed, from the dates of the respectiee payments until the whole line of the road from the Hudson to lake Erie shall be put in operation; and that the same be liquidated and paid yearly on the 1st day of January.

This address is signed Eleazer Lord, president, and dated 31st Oct., 1844.

It will be remarked that the late board do not regard the bonds as offering a reasonable security; Mr. Lord, on the contrary, pronounces them "an eligible and safe reliance." Their value depends on the probability of the completion of a single track to lake Erie within four years from this time; a contingency involving "a responsibility which they (the late board) do not feel themselves called on to assume."

The above extracts will, however, sufficiently explain the tone of the two reports. They differ essentially, we might even say they have few points of resemblance, and we are bound to confess that the change is not for the better. For example, what is the use of declaring war against "the more northern route to the lakes," and exciting the hostility of the central counties from Albany to Buffalo, and of the counties on the eastern bank of the Hudson? We have never heard it hinted that the appeal of the late board to the public last spring, failed from any opposition created by the friends of "the more northern route to the lakes," and we doubt whether any such influence will be exerted against the present address, notwithstanding its—as we believe—unfair, and certainly unfortunate insinuations. It is less wounding to our self-love to ascribe our failures to the machinations of rivals, real or supposed, than to our own incapacity. The present board, that is the *acting* portion of the directors, have long controlled the management of the New York and Erie railroad, and we would venture to suggest the bare possibility that *some* part of their present difficulties may be owing to the circumstance that their past course has not been quite as satisfactory to the public, and especially to the *stockholders*, as it appears to have been to themselves. In our enlarged sheet we will endeavor to state clearly and fairly the obstacles which the New York and Erie railroad has to surmount. We will also notice certain injurious impressions entertained by large portions of the community, which we shall be happy to aid in removing.

We take a different view of the work from either the present or the late board. We place its claims on higher ground than they do, and shall take an early opportunity of developing our views, which we shall endeavor to do in such a manner as to enable those opposed to us fully to understand our position, and, if in error, to point out where we are wrong. We have uniformly and untiringly advocated the cause of this great work, as our columns for the last ten years will abundantly show. We have even permitted our zeal to influence us so far as to pass by without animadversion proceedings which we did not approve of. This we shall do no more, convinced as we are that the cause of railways is forwarded as much by the exposure of abuses as by giving publicity to improvements. While keeping a watchful eye on the latter as usual, we shall at the same time try to steer clear of the censure conveyed in the motto of the Edinburgh Review. In justice to ourselves we may be permitted to observe that a monthly journal is scarcely a proper organ for such discussions, but with a weekly sheet we shall again and again refer to the New York and Erie railroad, and we hope not without effect.

The proof sheets having failed to reach the author there are numerous errors in the "explanation" of the Tables of Excavation and Embankment, but fortunately the tables themselves are correct. We regret this the more as we had taken great pains to follow the manuscript, which was unfortunately incorrect, and the proofs having failed to reach their destination and of course, not hearing of them, we supposed that all was right.

Page 162 line one from bottom, for $(D-d)_2 \frac{mL}{6}$, read $(D-d)^2 \frac{mL}{6}$.

Page 164 line six from top, for the areas $a\,i\,E$, read the areas $a\,l\,E$. The d at the end of this line and the h at the beginning of the next line ought to be together on the same line.

Page 165, if the latter part of table XXII is left out 200 on line four from top should be changed to 182. E at the end of line seventeen and E′ at beginning of line eighteen should be together. The same remark applies to A′ L′ at the end of line twenty-seven and E′ at beginning of line twenty-eight. Line thirty for $\frac{T P x^3}{3 M M}$, read $\frac{T P x^8}{3 M M'}$.

Page 166 line fourteen, for F, read (F).

" 169 line nineteen, for $2\,b^2\,y$, read $2\,b\,y^2$.

" 170 line twelve, for 109·529, read 109·259. Line fifteen, for 120·731, read 120·371.

Page 198 line twenty-eight, for $\frac{7+100}{7\times33}$, read $\frac{7\times100}{7+3}$.

Page 199 the working of example 7 should be as follows:

Depth in feet.	H + H' in feet.	C. ys. from table xxii.	H — H' in feet.	C. ys. from table xiv.
0·0				
2·0	22·0	1792	2·0	1
3·6	25·6	2427	1·6	0
8·9	32·5	3912	5·3	9
12·4	41·3	6317	3·5	4
14·0	46·4	7974	1·6	1
9·0	43·0	6848	5·0	8
6·0	35·0	4537	3·0	3
4·2	30·2	3378	1·8	1
2·1	26·3	2562	2·1	1
0·0	22·1	1809	2·1	1
		4)41,556		29
		10,389		
		29		
		10,418		

Now $\frac{B}{2m} = 10$, the correspondig number table xxii is 370,

$$\text{And } \frac{370 \times L (= 1000)}{100} = 3700$$

10418

6718

Hence $6718 \times m (= 2) = 13{,}436$ cubic yards is the total content of the excavation.

Page 200 line eleven, multiplied by ·0473, should be placed opposite to 3740, and the inverted commas opposite to 3740 should be omitted.

853
149
6

The same remark applies to the second method of working this example. All the examples are carried out in detail to show the whole operation and the multiplications being performed by the contracted method the figures of the multipliers are ranged in inverted order under the multiplicand.

The number 6046 at bottom of page 200 should be placed over the multiplier 3820 at the top of page 201 and the "c. yds." and inverted commas opposite to 3820 should be omitted.

1209
484
18

Page 201 line thirty-one, place $\frac{1}{12}(Y + y)$, etc. = ·2783, opposite to 3872 in the line above.

Page 202 line thirty, the figures 2214, should be 2214·2 and should also be moved one place to the left and so should the figures under it also. Line thirty-three, multiplied by $\frac{1}{12}(Y \times y)$, etc. = ·0197, should be opposite to 7910 in the line above.

Page 203 lines two and three, for $(A' - a)$, read $(A - a')$. Line th teen, place multiplied by etc. = ·0047, opposite 7400 in the line above. Line eighteen, place multiplied by etc. = 0197, opposite 7910 in the line above. Line thirty-one, for $(P - p')$, read $(P' - p')$.

Page 204 line one from bottom, omit "by formula ( )."

Page 205 line twenty-one, place $A \times \frac{L}{3} = \frac{1501}{3}$ etc. = 0175, opposite to 5710 in line above.

Page 207 line thirteen, for "on H," read or H.

TO CORRESPONDENTS.

We acknowledge the receipt of sundry papers on the late explosion of the locomotive Richmond, and shall endeavor to lay before our readers in our next a general review of the facts in this remarkable occurrence. The valuable papers of the United States engineers we have alluded to elsewhere. The report of the Madison and Indianapolis railroad is received and will be noticed in our next. An elaborate paper on the "Repeal of the duty on railroad iron," by Mr. Casey, will most likely appear in our January number. The views of the writer differ from ours, and we confess that they are more in accordance with the popular voice, especially in the mining region in Pennsylvania. A review of the objections to a railroad in Broadway, by Alba Kimball, in which the writer goes at length into the various advantages which would result, and the comparative ease with which the obstacles may be overcome. We shall gladly insert any information from "J. C." as to the performances of his iron steamer, and the merits of the new propeller, which is said to exceed Ericsson's in speed, and with a saving in fuel.

ITEMS.

The subscription to the new stock of the New York and Erie railroad goes on well. Nearly all the papers are out in favor of it, and the time is very favorable, as well on account of the abundance of capital as the early closing of the canal, which brings the merits of railways home to the community.

A temporary track has been laid through the Long Island tunnel, but the revetment walls of the approaches are not completed. Bitter complaints are made of the mode in which the company have conducted the work.

The rates of freight during the winter on the railways from Albany to Buffalo are fixed at 3, 4, and 5 cents, per ton per mile, besides what the companies pay the State, 1 and 2 cents per ton per mile, according to the nature of the freight. From New York to Albany, via. the Housatonic railroad, the rates are 7, 9, and 12 dollars per ton of 2000 lbs.

The use of the Drummond light on railways has been suggested to us as likely to be useful in many cases.

The "canallers" at Montreal are very troublesome, and occasionally shoot the citizens within a few miles of that city, with perfect impunity. These occurrences cause public works to be viewed with dread by those in the vicinity, and are deeply to be regretted. But, after all, their conduct well matches that of the board of works, and never was the old adage, "like master like man," more thoroughly verified.

Our Canadian neighbors are waking up on the subject of railroads, and we shall gladly do all in our power to lead them to the construction of works destined to serve the country, and not to fill the pockets of political adventurers.

We beg to acknowledge the receipt of the first and second numbers of "Papers on Practical Engineering," from Col. Totten, chief engineer of the United States. The second of these has appeared in the *Journal*, and the first we shall have occasion to refer to hereafter. The style in which these papers are published leaves nothing to be desired, and we trust they will follow each other more rapidly than they have hitherto done. We would suggest that simple and clear statements of work done would be more useful than ambitious papers, aiming to become regular treatises, a fault into which young engineers are apt to fall, and to whom we would point out No. 2, by Col. Thayer, as a model.

TO DIRECTORS, ENGINEERS AND SUPERINTENDENTS OF RAILROADS AND CANALS.

It is our intention to give in the *enlarged Journal* a table of American railways in the manner of the English railway journals. We therefore earnestly request from our readers a statement of the length, cost, gross income, net income, dividends and value of stock and such information as may be necessary to give a correct view of the present state of the several railways and canals with which they may be acquainted. For example, it is important to know whether the road or canal is finished, if the profits go to pay interest on bonds, to extend the work, to renew the track, etc. Without these explanations many works would be placed in a very wrong light and would appear to bo worthless, when, in fact, they were just emerging from their difficulties and about taking their permanent stand among the roads paying regular dividends. This information is demanded alike for themselves as well as for the cause of railways generally. Many gentlemen may also be acquainted with the particulars of roads little known, and may be pleased to give the details of such along with those of the roads or canals with which they are more immediately connected.

But, in *all* cases, we hope to receive the length, cost to this time and gross income of 1843 and 1844 to November or to the end of the year, approximately the amount as nearly as practicable. Regular returns of weekly receipts, as now published by many companies, are very desirable and aid powerfully in drawing the attention of the public to the large amounts received by these works even in the most unpromising situations. It is our intention to publish such a table and we hope to include many roads who now make only annual reports.

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