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THE LEGISLATURE,

OF THE

STATE OF MAINE,

DURING ITS SESSION

A. D. 1837.

REPORT

ON THE

PRELIMINARY SURVEY

OF THE

BELFAST AND QUEBEC RAIL ROAD,

1836.

By S. H. LONG,
Lt. Col. U. S. Topographical Engineers.

ACCOMPANYING THE GOVERNOR'S MESSAGE.

TO

HIS EXCELLENCY

ROBERT P. DUNLAP,

GOVERNOR OF MAINE, AND PRESIDENT

OF THE

BOARD OF INTERNAL IMPROVEMENTS,

AUGUSTA, (Me.)

REPORT.

SIR,—Having completed the survey of the Belfast and
Quebec Rail Road, by an experimental line, extending
from Belfast to the Forks of the Kennebec, and by a Line
of Levels thence to the Canada Line, I have the honor
very briefly and cursorily to submit a series of general
results obtained from the survey, reserving for a future
communication, the various computations that relate to
the amount of excavations, embankments, extent of bridg-
es, causeways, side-walls, &c. &c. and the approximate
cost of road-formation, embracing the items just mention-
ed, and all others pertaining to the construction of a rail-
road on the route surveyed.

I take this opportunity to observe, that the information
just alluded to, is unavoidably withheld for the present,
for want of topographical and other delineations which
are essential to the adoption and introduction of grade
lines on the different portions of the route. Without
these Lines, the declivities of which must be inferred from
a general coincidence with the natural surface, as exhibit-
ed in a sectional or profile delineation, it is not practica-
ble to make any fair exhibit, either of the depths of cut-
tings and fillings on the route, or of the amount of excava-
tions and embankments. Results of this sort can only
be derived from the relative position of the grade lines,
compared with that of the natural surface, at the several
stations made in the survey of the route.

Whenever an opportunity shall have been presented for the preparation of the desired drawings, I shall be prepared to enter upon the various computations for which the survey was intended, and without which, the data obtained, if not entirely useless, will be measurably lost to those concerned.

In describing the route surveyed, we shall treat of it in such separate portions or divisions, as are deemed most convenient for description, and best calculated to afford a clear and concise developement of the features of the country traversed by each. The matter for discussion will be simply the special localities and general character of the route surveyed, the ascents and descents along the line, and the gradations on the same, that are obviously practicable, the elevation of summits and other points of the line, above mean high tide, &c. &c. The order and manner of the discussion will be such as are deemed most conducive to a concise and perspicuous description of each division.

Division, No. I.

This division extends from a point in the town of Belfast, near the lower bridge across Belfast river, to Stevens' Summit in the township of Thorndike, and embraces a distance of seventeen miles and 1169 feet.

From the point of commencement as above, which is at an elevation of twenty-five feet above mean high tide, the route pursues a level, but somewhat serpentine tract along the brow of the river hills of Belfast river one and a half miles, when it crosses this estuary a little below the mouth of Wescott Stream, and pursues its course along the valley of this stream at a uniform elevation, till it reaches a point about two and a quarter miles from the place of beginning. It then enters a more difficult part

of the valley, and ascends at the rate of sixty feet per mile, to a low summit situated between Fowler's and Little Oak Hills, the distance through which, (the ascent is at the rate just mentioned,) being a little more than three miles, and the ground throughout this distance rough and unfavorable.

A substitute for the route above described has been contemplated, and would have been surveyed but for deficiencies in the time and means requisite for the purpose. The substitute alluded to is as follows. Instead of crossing the Belfast river below the mouth of Wescott Stream, the route may proceed upward, on the east side of the river towards the head of tide, cross the estuary on a bridge much shorter than that above contemplated, pass into a broad valley of much more favorable aspect than that of Wescott Stream, and unite with the route above described in the valley of this stream about two miles from its mouth.

The gradations on the proposed substitute, will probably be similar to those on the route surveyed, except that the ascent may be commenced at tide water, and continued through a greater distance, and the distance at a gradation of sixty feet per mile, consequently reduced to about two miles, while the expense of road-formation will no doubt be considerably less than on the route surveyed.

The route then pursues the valley of Wescott Stream four and one third miles farther to Webb's Ledge, the ground being more favorable and the gradations not exceeding thirty feet per mile.

Webb's Ledge must be crossed by a cut in rock fifteen feet deep and nearly three hundred yards long, beyond which the route must be conducted across a bog for a distance of four hundred yards, on a causeway elevated from eight to twelve feet above the surface of the bog.

A ridge joining Stimpson's Hill to the high-lands must next be encountered. The passage of it will require a cut thirty feet deep, on a base about four hundred yards long. On a part of this distance cutting in rock will probably be required. The ascent from Webb's Ledge to Stimpson's Ridge will not exceed the rate of thirty feet per mile.

Having passed this ridge, the route enters the valley of Marsh Stream, and passes over a very uneven surface, hills and valleys alternating with each other, and a succession of deep cuttings and high embankments being unavoidable for the distance of a mile, where it crosses the stream and its immediate valley, on a bridge and embankments of very considerable length, after which it enters and ascends in the valley of Meadow Brook, nearly two miles, the gradations on a distance of nearly four miles from Stimpson's Ridge nowhere exceeding twenty-five feet per mile.

The route then ascends in the same valley about one and a quarter miles farther to a point near Cates', on the road from Jackson to Thorndike, the ascent being at the rate of about sixty feet per mile. The steepness of this acclivity may probably be somewhat reduced, by pursuing a tract a little to the eastward of the route surveyed, by increasing the distance a few hundred yards.

From the road just mentioned, the route proceeds over a waving surface for a short distance, and enters the valley of Jackson Brook, along which it ascends at an average rate not exceeding six feet per mile, for a little more than a mile to Stevens' Summit, the ground for the most part being very favorable.

In connexion with this and the succeeding Divisions of the route, I shall introduce a brief tabular exposition of the leading results developed by the survey, in which will

be presented certain localities on the route, the distances
in miles and feet from one locality to another, the aggre-
gate distances on each division, the elevation of each
specified locality above mean high tide, and the grada-
tions in feet per mile, at which a road is practicable. In
the assignment of the gradations, the figures or numbers
by which they are indicated will occasionally be accom-
panied by the letter V, which is intended to show that the
gradations are *variable*, and that the number to which it
is annexed is to be regarded as a limit to the gradations,
and not as an indication of any uniformity of ascent or
descent.

TABULAR EXHIBIT OF DIVISION NO. I.

*Commencing at Belfast, twenty-five feet above Mean High
Tide, and terminating at Stevens' Summit, in Thorn-
dike.*

State-ments No.	Localities on the Route beginning at Belfast.	Distances Surveyed.		Total Distances.		Elevation above Tide.	Gradat'ns per mile.
		M.	Feet.	M.	Feet.	Feet & parts.	Feet.
1	End of Level in valley of Wescott Stream.	2	2023	2	2023	25.000	Level.
2	Point between Fowler's and Little Oak Hill.	3	1100	5	3123	229.732	60
3	Webb's Ledge.	4	1763	9	4886	348.074	30 v.
4	Stimpson's Ridge near Marsh Stream.	–	4897	10	4503	381.177	35
5	Point in valley of Mea-dow Brook.	3	4386	14	3609	414.497	25 v.
6	Do. in road near Cates' Farm.	1	1720	16	0049	488.845	60
7	Stevens' Summit in Thorndike.	1	1120	17	1169	496.952	10 v.

In further explanation of this division, it may be re-
marked that the gradations throughout, with a very few
exceptions of little consequence, are ascending, and that

Stevens' Summit is lower by thirty-three feet, than any other summit to be found in the ridge dividing between the waters of Marsh Stream, and those that fall into Half Moon Stream, and thence by the Sebasticook into the Kennebec River. Todd Summit is higher by the difference above stated, and is accessible on both sides, only by gradations and curvatures more abrupt.

DIVISION, No. II.

This Division commences at Stevens' Summit in Thorndike, and extends to Decker's Summit, in Clinton, embracing a distance of twenty-two miles and 1267 feet.

Having passed over a distance of a little more than half a mile on ground nearly level, the route enters the immediate valley of Gordon's Stream, in which it must descend at the rate of sixty feet per mile, for a distance of about a mile and a half, the valley throughout this distance being narrow and crooked, and the stream rapid. The curvatures however may be limited to a radius of 1000 feet, by much cutting and filling on a part of the distance.

The route then becomes more favorable, and continues so, to a point near Gordon's mill, below which the stream unites with Haskel's Stream, which rises near Todd Summit.

From Gordon's Mill the route proceeds over rough ground, traversing the brows of the river hills, and occasionally crossing the points of ridges, till it descends into the valley of Half Moon Stream, the descent being effected at a minimum rate of sixty feet per mile, on a distance of about one and a quarter miles.

It then passes on rough ground for the distance of something more than a mile, crosses Moulton's Brook, and continues downward at gradations not exceeding twenty-five feet per mile, to Unity village, three and a half miles

from the brook just mentioned. Through most of this distance the ground is very favorable, but in several places the surface is broken by ravines, and much excavation and embankment will be required.

Near Unity village, the route enters upon the flats of Sandy and Twenty-Five-Mile Streams, and passes them with very little interruption, except from three crossings of the streams, for a distance of more than five miles, the trace being nearly straight throughout the distance, and the descent for the most part inconsiderable, although in a few instances it may be advisable to adopt gradations of twenty feet per mile.

The route surveyed leaves the immediate valley of Twenty-Five-Mile Stream, and passes over rough ground for about one and a half miles to the Sebasticook, the minimum rate of descent being forty feet per mile, and a vast deal of cutting and filling being required in order to maintain such a gradation. A substitute for this portion of the route may readily be found by pursuing the valley of the stream downward to the Sebasticook, on which the gradations may very conveniently be limited to twenty feet per mile. The distance on the route substituted will be somewhat greater than that on the route surveyed.

The route surveyed from Unity to the Sebasticook is to be regarded merely as a line of levels carried through swamps and flats, rendered almost impenetrable by the thickets and fallen trees by which they were covered Much careful exploration and the survey of various other experimental lines will be required, before a judicious location can be made. •

The elevation at which it is proposed to cross the Sebasticook, is about twenty feet above its low-water surface. Of the length of the bridge and its embankments,

nothing definitive can yet be stated. It will probably be between 150 and 200 yards.

Having crossed the Sebasticook, the route passes on flats occasionally interrupted by ridges of moderate size, but in general, remarkably free from obstructions, for a distance of nearly four miles, to Twelve-Mile Stream, the inequalities of surface being such as readily to admit of gradations not exceeding twelve feet per mile. The route surveyed passes a little to the northward of Brown's Hill, and strikes the Twelve-Mile Stream about three quarters of a mile from its entrance into the Sebasticook.

From Twelve-Mile Stream the route proceeds on ground less favorable, frequently encountering swells and inter-vening low grounds, which will occasion much cutting and filling in the formation of the road-bed, on most of the distance, viz. two miles and two fifths to Decker's Summit. Of this distance, at least two miles will be·at-tended by a minimum gradation of sixty feet per mile.

The subjoined Table will exhibit more clearly the results developed by the survey; which will no doubt be much ameliorated by the alteration suggested in the foregoing remarks.

It should moreover be observed, in reference to the last column of the Table, that the gradations therein assigned, especially in statement No. 7, are not such as may be readily maintained on the line surveyed, but such as are believed to be entirely practicable, and appropriate on lines that may be substituted in the vicinity of those parts of the route, where a change of locality has been proposed.

TABULAR EXHIBIT OF DIVISION NO. II.

Commencing at Stevens' Summit, 497 feet above Tide, and terminating at Decker's Summit.

Statements No.	Localities on the Route, beginning at Stevens' Summit.	Distances surveyed.		Total Distances.		Elevation above Tide.	Gradations pr mile.
		M.	Feet.	M.	feet.	Ft. & pts.	Feet.
1	Point in valley of Gordon's Stream.	0	3100	0	3100	493.575	Nearly level.
2	Do. Do.	1	3120	2	0940	408.861	60
3	Do. opposite Gordon's Mill.	1	3620	3	4560	351.387	35 v.
4	Do. in valley of Half Moon Stream.	2	0240	5	4800	274.754	60 v.
5	Do. near Unity village.	3	2860	9	2380	194.369	25 v.
6	Do. in valley of Twenty-Five Mile Stream.	5	0675	14	3055	205.839	20 v.
7	Do. near and 20 feet above Sebasticook River.	1	2460	16	0235	145.745	40
8	Do. near Twelve Mile Stream.	3	4272	19	4507	144.980	12 v.
9	Decker's Summit.	2	2040	22	1267	273.127	60 v.

DIVISION No. 3.

From Decker's Summit to Thurston's Summit, embracing a distance of 21 miles 4739 feet.

From Decker's Summit, the route descends a little more than a mile in a broad valley, generally rugged, and in places ledgy, to Morrison's Corner. Much expensive excavation and embankment, 15 to 20 feet deep, will be required in order to maintain the most appropriate gradation, which will be at 60 feet per mile on the distance above stated.

From Morrison's Corner, the route passes on favorable ground $3\frac{2}{5}$ miles to 15 Mile Stream, the gradations being variable, and not exceeding 12 feet per mile.

The passage of 15 Mile Stream, and its valley, will require a bridge 37 feet high and together with its embankments about 300 yards long.

Thence to Mill brook, the distance is about $3\frac{3}{4}$ miles, the ground for the most part flat and favorable, but the route occasionally encounters ascents and descents which

may be measurably avoided by curvatures; or an appropriate elevation for the road may be obtained by cuttings and fillings of 10 to 15 feet deep.

Mill brook must be crossed by a very high bridge which with its embankments will have an extent of several hundred feet.

From Mill brook, to Merrill brook, a distance of a little more than 2 miles including the passage by Herron's hill the crossings of the valleys of several runs and intervening hill points, the route is exceedingly unfavorable, and the road formation will prove very expensive, on account of the heavy excavations and embankments that must be incurred. In regard to this portion of the route, it should be observed, that a judicious location cannot be made without the aid of numerous experimental lines which will be essential to the selection of the most favorable locality for the road.

Thence to a point on Skowhegan Plain $1\frac{3}{5}$ miles farther on the route the surface is quite as unfavorable as that just alluded to; Merrill brook and Wesrunset river must be crossed by a bridge between 80 and 100 feet high connected with causeways or embankments of great length. In addition to these difficulties, others of less magnitude, though of a very formidable character, are to be overcome in surmounting numerous deep and broad ravines.

On this portion of the route, as well as on that just before noticed, additional surveys should be made before a location is attempted.

The object aimed at in the survey of these parts of the route was the practicability of maintaining an elevation nearly coincident with the surface of Skowhegan plain; but the results of the survey have shown that an elevation 30 or 40 feet lower, would suit the ground far bet-

ter, and render the work of construction far less expensive.

Having reached the surface of Skowhegan plain, the route was carried in a direction to ascend in the valley of Cold brook, and pass thence about ¾ of a mile northward of Madison pond, to Thurston's Summit. But the results of the survey have shown that the ascent in the valley of Cold brook for a distance of more than a mile has amounted to about 90 feet per mile, while the distance on the route surveyed evidently exceeds that on the substitute, which we shall now consider.

Instead of taking a direction towards the source of Cold brook the route should proceed across Skowhegan plain, towards the southern extremity of Madison pond, the ground being very favorable, and the gradations not exceeding 20 feet per mile, till we arrive within a mile of the pond.

It must then ascend at the rate of 60 feet per mile, till it arrives at the flats near the margin of the pond, whence it may be carried on the west side, and nearly level, towards the head, or northwesterly extremity of the pond. It then takes a direction about N. N. West and unites with the route surveyed, at the distance of about ¾ of a mile from the pond, having ascended at the rate of 60 feet per mile probably, in this distance. It passes thence on favorable ground, quite to Thurston's Summit, which may be attained at a gradation not exceeding 60 feet per mile, in a distance somewhat less than a mile.

The road-formation on the substituted route will not prove expensive, there being but a very few localities where any considerable excavations or embankments will be required.

2

TABULAR EXHIBIT OF DIVISION NO. III.

*Commencing at Decker's Summit 273,127 feet above Tide
and terminating at Thurston's Summit.*

No. Statements.	Localities on the Route, beginning at Decker's Summit.	Distances surveyed.		Total Distances.		Elevation above Tide.	Gradations pr mile.
		M.	Feet.	M.	Feet.	Ft. & pts.	Feet.
1	Point near Morrison's Corner.	1	0220	1	0220	215.730	60 v.
2	Do. near 15 Mile Stream.	3	2060	4	2280	177.385	12 v.
3	Do. near Merrill Brook.	5	3600	10	0600	222.118	30 v.
4	Do. on Skowhegan Plain.	1	3239	11	3839	220.143	35 v.
5	Thurston's Summit.	10	0900	21	4739	549.996	33

In reference to statement No. 5 of the foregoing Table, which exhibits a difference of elevation when compared with the preceding statement, of nearly 330 feet, and an average gradation of 33 feet per mile, we may safely assume the following rates of ascent as those which will not be exceeded in the distance contemplated in the statement, viz. three miles at 60 feet per mile, and the residue at a variable rate not exceeding 35 feet per mile, much of which will be level or nearly so.

DIVISION NO. 4.

Beginning at Thurston's Summit, and terminating at Bingham ; embracing a distance of 13 miles 2948 feet.

From Thurston's Summit, which divides the waters of the Wesrunset from those that run northwardly into Michael Stream, the route descends into an extensive tract of flat and hard land, called Bear Swamp, the gradations through a distance of about one mile from the summit, being at the rate of 60 feet per mile. It then pursues a very favorable track, descending at a variable rate not exceeding 35 feet per mile, for a distance of $2\frac{2}{5}$ miles, when it approaches the base of Williams' hill in Solon.

In its farther progress towards Solon plain, a surface far more rugged and broken must be traversed. The route first winds along the slopes of the hill for the distance of nearly a mile, the hill sides being rather favorable for this purpose. It then crosses a succession of ravines and hill points protruding between them, in which cuttings and fillings 20 or 30 feet deep, and of various distances on the line of the route, will be required.

It then crosses the deep and broad ravine of Michael Stream, at which a bridge, together with causeways or embankments, 70 or 80 feet high in the deepest part of the ravine and many hundred yards long, will be essential as a means of conducting the road across this difficult pass.

In reference to the position of the route situated between Williams' hill and Solon plain, it should be remarked that our time and means would admit of the survey of a single line only, whereas the selection of the most favorable locality on ground so diversified and intricate, should depend on a series of lines carefully run, with a view to the adoption of such a system of gradations as would be most conducive to economy of construction, without enhancing too much the cost of transportation. Such is the object that ought to be kept in view in determining upon a location for the road through all difficult passes, and it is confidently believed, that the attainment of this object, in the case now before us, is entirely compatible with the assignment of gradations not exceeding 35 feet per mile.

We shall of course regard the route as practicable from Bear Swamp to Solon plain, by adopting ascents and descents wherever they may be found expedient, at a rate of 35 feet per mile.

Having attained the surface of Solon plain in the manner above intimated, the route traverses the plain at an elevation of between 100 and 120 feet above the surface of Kennebec river, passing a little in rear of Solon village, crossing Fall brook about $\frac{1}{4}$ of a mile from its mouth, and proceeding in a direction to strike upon the slopes of the river hills about a mile above the village. The distance across the Solon plain, by the route surveyed, is a little more than two miles, through which the ground is favorable in all respects, except at the crossing of Fall brook, where a bridge and embankments of considerable length, but of moderate height, will be required.

The passage along the slopes of the river hills above Solon village, will be rendered somewhat difficult, for a distance of nearly a mile, by reason of the deep cuttings and fillings that will be required, in passing several deep ravines and the hill points that are presented between them.

Thence to the end of this division, embracing a distance of nearly six miles, the route passes a part of the way on the slopes of the river hills, which are deeply indented by ravines, but for the greater part of this distance, the surface is more even and the cuttings and fillings such as might be ordinarily expected in the passage over a rolling surface. The gradations may be limited to 30 feet per mile, except on the last two miles, on which 35 feet per mile would be a more appropriate limit.

The following Table will show more explicitly the character of this Division with respect to distances, gradations, &c. The substitution of another line on portions of this division will not materially affect the character of the route with respect to its length, and deviations from a level.

TABULAR EXHIBIT OF DIVISION NO. IV.

Commencing at Thurston's Summit 550 feet above Tide, and terminating at Bingham.

Statements. No.	Localities on the Route, beginning at Thurston's Summit.	Distances surveyed.		Total Distances.		Elevation above Tide.	Gradations pr. mile.
		M.	Feet.	M.	Feet.	Ft. & pts.	Feet.
1	Point in Bear Swamp.	1	0020	1	0020	476.615	60
2	Do. near Williams' Hill.	2	2040	3	2060	428.373	35 v.
3	Do. on Solon Plain.	1	3720	5	0500	399.175	35 v.
4	Do. near Mrs. Maynard's.	4	2295	9	2795	438.266	25 v.
5	Do. about 4 miles below Bingham Village.	1	1193	10	3988	407.246	30 ʙ.
6	Flats near Bingham, 1 mile below Village.	2	4240	13	2948	342.860	35

DIVISION, No. 5.

The Division commences on the Flats of the Kennebec about a mile below Bingham village, and extends upward in the immediate valley, to the Forks, embracing a distance of 24 miles and 57 feet.

The route passes for about 1¼ miles on very favorable ground, being a portion of the beautiful plain on which the village of Bingham is situated, and crosses Austin stream and its valley, at which a bridge and embankments 12 to 15 feet high and 125 yards long will be required.

The additional remarks we have to offer in reference to this division will be of a more general bearing, and are to be regarded as applicable to the route generally, in its progress from Austin Stream to the Forks of the Kennebec river.

From Bingham the route ascends along the valley of the river alternately passing on the slopes of the river hills at or near their bases and on flats of greater or less extent, situated between the hills and the river. In a few places it passes in the rear of insulated ridges denominated horse-backs, which are generally of a sandy or

gravelly structure, while the ground in the rear presents an even aspect like that of other intervale lands.

The object in passing occasionally in the rear of these ridges, is not merely to shorten the distance on the route, but to avoid the steep and unstable slopes on the river sides which are often too abrupt for the formation of a road-bed without the aid of expensive river walls.

The most serious difficulties to be encountered in the road-formation on this division, are the side walls that will be required for sustaining the road-bed in places where the river hills present abrupt slopes, the bases of which are coincident with the margin of the river. Places of this sort are of frequent occurrence, and occupy an aggregate distance of about six miles, or about one fourth part of the division. The height to which the walls must be raised in order to place the road beyond the reach of freshets, need not in any place exceed 12 feet. In general this elevation will vary from 5 to 10 feet. This part of the work however will not prove very expensive, stone suitable for its construction being very abundant and convenient.

Another difficulty far less considerable will be occasioned by the passage of numerous sloughs and inlets, at which bridges and causeways will be required.

With these exceptions, the road-formation may be effected at a very moderate expense, the ground being easy of excavation, and no great amount of cutting or filling being required.

In prosecuting the survey, the line was carried upward on the east side of the river, quite to the Forks. Subsequent examinations, together with the results developed by the surveys on the line between the Forks and the Boundary Summit, have contributed to show the propriety of crossing the Kennebec river at a point about one mile

below the Forks, and near the head of Williams'
Intervale.

At the place of crossing here contemplated, facilities
for this purpose, which are seldom to be met with on the
river, are presented. An Island is situated in this part of
the river between which, and the east shore, is a narrow
channel, through which a small portion of the river passes.
By crossing this channel on a bridge 15 or 20 feet
high, we reach the surface of the Island, and the route
may then be deflected in a manner to cross the remaining
portion of the river to the best advantage; after which it
may cross Brown's Intervale, and take the direction most
suitable for ascending in the valley of Dead river.

With respect to the gradations on this Division they
may be limited to 12 or 15 feet per mile, without much
inconvenience. The average descent of the river, on
equal portions of this Division is very nearly as follows:
From Bingham upward 6 miles, 6 feet per mile; thence
6 miles further, 8 feet per mile; thence 6 miles further,
10 feet, and thence to the Forks 12 feet per mile. No
curvatures of a radius less than 1000 feet will be required
on this Division.

TABULAR EXHIBIT OF DIVISION NO. V.

*Commencing at Bingham Flats 343 feet above Tide, and
terminating at the Forks of Kennebec river.*

State-ments No.	Localities on the Route, beginning at Bingham Flats.	Distances surveyed.		Total Distances.		Elevation above Tide.	Grada-tions per M.
		M.	Feet.	M.	Feet	Ft. & pts.	Feet.
1	Point on N. Bank of Austin Stream.	1	1820	1	1820	357.398	12 v.
2	Do. near Baker's house.	1	4112	3	0652	361.712	10 v.
3	Do. near Hunnewell's house.	5	3180	8	3832	412.964	10 v.
4	Do. near I. Spaulding's house.	6	4120	15	2670	492.515	12 v.
5	Do. near Williams' house.	7	0537	22	3209	558.553	12 v.
6	Forks of Kennebec River.	1	2128	24	0057	583.163	12 v.

We shall now exhibit a series of results derived from the survey of the Line of Levels, which was run from the Forks of the Kennebec to the Canada Line, for the purpose' of ascertaining certain features of the country which were too rugged and deformed to be comprehended in any other way, as also for the purpose of determining with precision, under what circumstances, and with what deviations from a level, a route might prove practicable, on ground deemed most favorable for its reception, by those best acquainted with the country.

The line alluded to, and surveyed as above, crosses the East branch of the Kennebec River, immediately above the mouth of Dead River, ascends in the valley of the latter, and on its north side to the mouth of Salmon Stream, and thence in the valley of this stream in a direction for Atwood's Camp. It thence passes into the valley of Cold Stream, and continues to ascend to Cold Stream summit, from which it descends to Parlin Pond. From Parlin Pond it ascends in the valley of Boyce's Brook, crosses Churchill's summit and descends by the valley of Churchill's Stream, to Moose River, a little above Attian Pond.— Thence it proceeds northwardly along the east sides of Attian and Wood Ponds, crosses Moose River near Holden's and ascends in the valley of Sandy Stream, to the Beaver Dam summit. From this summit the line descends into the valley of one of the head branches of Penobscot River, crosses the branch, and ascends in the ravine of one of its tributaries, to the Boundary Summit.

The distances, elevations, average gradations, &c. along the line surveyed, so far as they have been deemed necessary to an exposition of its general features, are presented in the following Table, from which it will appear, that the aggregate distance from the Forks to the Canada line, on the route surveyed, is nearly 47 miles. Of this distance

it will also appear, that about 14½ miles are attended by gradations of 90 feet per mile ; nearly 4 miles by gradations of 60 feet per mile ; 4¾ miles by gradations of 140 feet per mile ; 10½ miles by a slight deviation from a level, and the residue amounting to more than 12½ miles by gradations exceeding 100 feet per mile.

TABULAR EXHIBIT OF RESULTS ON THE LINE OF LEVELS.

Commencing at the Forks of the Kennebec River 583,163 *feet above Tide, and terminating at the Boundary Summit.*

State-ments.	Localities on the Route, beginning at the Forks of Kennebec River.	Distances Surveyed.		Total Distances.		Elevation above tide.	Grada-tions per mile.
No.		M.	Feet.	M.	Feet.	Feet & parts.	Feet.
1	Cold Stream Summit.	13	1060	13	1060	1696.669	90 v.
2	Parlin Pond.	1	2420	14	3480	1610.217	90 v.
3	Churchill's Summit.	3	4960	18	3160	1817.390	60 v.
4	Point on Moose River, above Attian Pond.	4	3680	23	1560	1182.828	140
5	Point at Moose River bridge near Holden's.	6	5020	30	1300	1174.741	10 v.
6	Point in valley of Sandy Stream.	4	1189	34	1189	1210.829	10 v.
7	Beaver Dam Summit.	6	4520	41	1729	1957.653	109
8	Point in valley of a branch of Penobscot R.	2	3540	43	5269	1655.869	116
9	Boundary Summit on Canada Line.	2	4840	46	4829	1964.034	109

Hence it appears that the distance from the Forks to Moose River at the head of Attian Pond is 23 miles 1560 feet. It also appears, that 14 miles 3480 feet of this distance are attended by gradations of 90 feet per mile ; that 3 miles 4960 feet are attended by gradations of 60 feet per mile ; and 4 miles 3680 feet, by gradations of 140 feet per mile. Of the residue of the line of levels we shall have occasion to treat hereafter.

In view of a route rendered thus formidable by reason of ascents and descents so abrupt, and extending through

distances so great, it became very desirable to find a substitute more favorable in some other locacity. Enquiries and examinations were accordingly made with a view to this object, and resulted in the discovery of a route by the valleys of Dead River and Spencer Stream, longer than that above designated, by about 8 miles, but virtually shorter, on a fair equation of distances, due allowance being made for the difficulty of overcoming ascents, by more than 20 miles.

Hence the substitute was deemed far preferable to the route surveyed, and would have received due attention in the prosecutions of the surveys, but for the near exhaustion of the funds appropriated, before it could be known that another route might be advantageously substituted. In this emergency, all that could be done, was to ascertain by actual measurement the height of the summit, which must be crossed on the substituted route, in order that a fair comparison might be made between the aggregate ascents and descents of the two routes. This was done, and the result has been taken into the estimate of comparative distances just given.

We now return to the Forks of the Kennebec, and proceed on the route by the valley of Dead River, Spencer Stream, &c. to Attian Pond, and thence by the valley of Sandy Stream, &c. to the Canada line.

Division No. 6.

Commencing at the Forks, ascending in the valley of Dead River, and in that of Spencer Stream, and its easterly branch, to the Spencer summit and embracing a distance computed at 30 miles.

Having crossed the Kennebec River about a mile below the confluence of its easterly branch with Dead River, the route enters the valley of the latter, and ascends along the

slopes of its hills on the south side, for a distance of 5 or 6 miles, perhaps more, where it may cross to the north side or continue on the south side, according to the comparative facilities presented on each.

It should be remarked in this place that my personal examinations extended but about 6 miles upward in the valley of Dead River, which according to the concurrent testimony of several persons well acquainted with the character of Dead River from its mouth to Spencer Stream, embraces the most rugged, and difficult part of its valley, so far as the contemplated route has any connexion with it. Through most of the distance examined as above the valley of the river is very narrow, bounded on both sides by steep hills of great height, and presents in all respects a very ruggid aspect. Yet on the south side of the river particularly, the hill slopes are such as will without much difficulty admit of the passage of a road upon them, in a direction sufficiently free from curvatures though pretty constantly serpentine, with flexures of 1500 or 2000 feet radius. On the distance through which I examined, I witnessed but a single cliff, and that of no great extent, through which cutting in rock would be required, in the formation of the road bed. There are no doubt many places where side walls would be necessary.

The hill slopes are presented on the south side, extending downward quite to the margin of the river, and will admit of a route, ascending uniformly from the mouth of the river upward as far as my examination were carried. The gradations on this part of the route may be limited to an average of 35 feet per mile.

With respect to the valley of Dead River above the point to which my examinations were made, no doubt is entertained, that it is even more favorable for a Rail Road than that already described. This opinion is strengthen-

ed, not only by the testimony of others as before intimat
ed, but by the fact that there is less fall in the river, and
of course a less rapidity of current between that point
and the mouth of Spencer Stream.

From the information obtained, it is impracticable to
form an opinion as to the comparative facilities for a
passage on the north or south side of the river, or indeed
in reference to the number of crossings that may be advis-
able. It may be confidently stated however, that the river
is so shoal, and its bed so invariably rocky, that there is
no difficulty in finding good and substantial bridge sites,
while the flexures of the valley are such as to afford con-
veniences for crossing sufficiently direct, at almost every
turn of the river.

The distance from the Forks, to the mouth of Spencer
Stream has been measured on the ice, and is said to be
14 miles.

The gradations on the last eight miles of the distance
to the mouth of Spencer Stream, may be limited at 35
feet per mile, though on a part of the distance they will
probably be somewhat less.

The route then ascends in the valley of Spencer Stream,
6 miles to Lower Spencer pond, the ground being repre-
sented as more favorable, and the ascent less considerable
than on Dead river. We shall accordingly assume 30 feet
per mile as the limit of the gradations.

In reference to the assignment of gradations as above,
it may be observed that the aggregate height of the Spen-
cer Summit above the Forks is $653\frac{1}{2}$ feet. Now, if we al-
low the ascent in Dead River to be 35 feet per mile, we
shall have for the aggregate ascent in Dead river 14 X 35
=490 feet, and for the aggregate ascent in Spencer
Stream 6 × 30=180 feet, and the sum of these two ascents,
viz. 490 + 180=670 feet, which is considerably greater

than the entire difference between the elevation at the Forks and the elevation of Spencer Summit. Hence it may be fairly inferred that the gradations assumed as above are excessive rather than defective.

From the foot of Lower Spencer pond, the route proceeds by easy gradations to within about a mile of the Summit, where an ascent of 30 or 40 feet per mile may be required. The following Table will exhibit more clearly, the main conclusions derived from our inquiries and surveys.

TABULAR EXHIBIT OF DIVISION NO. VI.

Commencing at the Forks 583,163 feet above Tide, ascending in the valleys of Dead river and Spencer Stream, and terminating at Spencer Summit, the distances being assumed, but the elevation of the Summit determined by actual admeasurement.

Statements No.	Locations on the Route, beginning at the Forks.	Distances surveyed.		Total Distances.		Elevation above Tide.	Gradations per M.
		M.	Feet.	M.	Feet.	Ft. & pts.	Feet.
1	Mouth of Spencer Stream measured on the ice.	14	——	14	——	——	35 v.
2	Foot of Spencer Pond by supposition.	6	——	20	——	——	30 v.
3	Head of Do. by supposition.	6	——	26	——	——	12 v.
4	Spencer Summit by supposition.	4	——	30	——	1236,814	30 v.

DIVISION No. 7.

This division commences at the Spencer Summit and extends to the Boundary Summit, embracing a distance of 25 miles and 3269 feet.

At Spencer Summit, a cut 15 or 20 feet deep and 150 or 200 yards long, will probably be advisable, in order to reduce the elevation at this place, and render the gradations more easy on both sides of the summit.

From this summit the route descends on sloping ground,

3

for a distance of about 2 miles to a point near the Jamb on Moose river, at gradations not exceeding 30 or 35 feet per mile.

It continues thence on sloping ground quite favorable for its reception, and of a character to admit of almost any desirable elevation for the road, quite to Moose river bridge, at the outlet of Wood pond, the distance being 7 miles, and the gradations not exceeding 12 feet per mile. In the distance just mentioned, the route passes on the east sides of Attian and Wood ponds.

From Moose river, the route ascends in the valley of Sandy Stream about $4\frac{1}{2}$ miles. The valley is crooked and varies in width from 100 feet to 2 or 3 hundred yards, and is bounded by high sandy bluffs, the bases of which are washed alternately on both sides of the stream which meanders in serpentine folds through the valley, and must no doubt be crossed frequently by the route. The gradations on this distance may be limited to 20 feet per mile.

The further progress of the route upward in the valley of Sandy Stream will be rendered very difficult on account of the great ascent which must be overcome in order to arrive at Beaver Dam Summit, which is no doubt lower than any other summit that can be found in the high-lands dividing between the waters of Moose river and those of the Penobscot. The distance from the point in the valley of Sandy river where that portion of the route last described has its termination, to the Beaver Dam Summit, is 6 miles 4520 feet, and the ascent in this distance is nearly 747 feet, which gives for the average ascent per mile on this distance, about 109 feet. The question now arises, whether the ascent may be more conveniently and economically overcome, by means of

Inclined planes and Stationary power, or by means of an ascending gradation of 109 feet per mile, extending through a distance of nearly 7 miles.

In the absence of experimental data from which we may draw conclusions entirely safe and satisfactory, and for want of surveys sufficiently minute and diversified to show the practicability of a uniformly ascending gradation, we shall regard the difficulties on this very unfavorable portion of the route, as more easily surmounted by Inclined planes, and Stationary power, than by any other mode of transit.

The amount of elevation to be overcome in the way just suggested we shall assume at 621 feet. This elevation is equal to the altitude of a plane $1\frac{1}{2}$ miles long, inclined in an angle of $4\frac{1}{2}$ degrees with the horizon.— Hence the whole of this elevation may be overcome, either by two Inclines, each $\frac{3}{4}$ mile long, or by three Inclines, each $\frac{1}{2}$ mile long, the angle of inclination in both cases being the same, viz. $4\frac{1}{2}$ degrees.

Having deducted the amount of the lifts by means of the Inclines, viz. 621 feet, from the aggregate elevation on this portion of the route, viz. 747 feet, we have remaining 126 feet to be overcome in a distance of about $5\frac{1}{3}$ miles, which gives for the average gradation on this distance a little less than 25 feet per mile. Hence the gradations on this sub-division of the route will be as follows, viz. 5 miles 1880 feet, at 25 feet per mile, and one mile 2640 feet, at an inclination of $4\frac{1}{2}$ degrees.

With respect to the practicability of surmounting the difficulties above considered, in the manner just explained, nothing decisive can be stated till additional surveys shall have been made, those already executed having been intended merely as a means of ascertaining the general features of the route, with a view to the adoption of a

system of gradations for the regulation of subsequent surveys on this sub-division. Yet so far as the information gathered from persons who professed a knowledge of the country, and so far as a careful observance of its general aspect, screened as it was from the view by a dense growth of trees and bushes, will enable us to judge, there is very little doubt that the mode of transit above proposed is practicable on favorable terms.

The remaining portion of this division, extends from Beaver Dam to the Boundary Summit. The route surveyed descends in the valley of a small run, to the main westerly source or branch of Penobscot river, which is here an inconsiderable stream, crosses the branch, and ascends along one of its tributaries to the summit on the boundary line between Maine and Canada. It crosses the branch at a point less elevated by at least 40 feet than that at which it would be most advisable to cross it, and about half a mile farther down the stream. This difference of elevation may be readily obtained by crossing the stream near, or perhaps a little above Hilton's house, where the route may conveniently pass upon hill slopes without materially increasing the distance.

The gradations on the route surveyed, will not admit of a limit less than 100 feet per mile, whereas those on the route proposed as a substitute will be very considerably less, and need not exceed 90 feet per mile.

The following table will show the distances on the several portions of the route constituting this division, and the average gradations corresponding to each, as deduced from the survey.

TABULAR EXHIBIT OF DIVISION NO. VII.

Commencing at Spencer Summit 1236.814 feet above Tide,
and terminating at the Boundary Summit.

State- ments. No.	Locations on the Route, beginning at Spencer Summit.	Distances surveyed.		Total Distances.		Elevation above Tide.	Grada- tions per M
		M.	Feet.	M.	Feet.	Ft. & pts.	Feet.
1	Point near Jamb on Moose Riv- er by supposition.	2	——	2	——	1182.828	30
2	Do. at Moose River Bridge near Holden's.	6	5020	8	5020	1174.741	12 v.
3	Do. in valley of Sandy Stream.	4	1189	13	0929	1210.329	20 v.
4	Beaver Dam Summit.	6	4520	20	0169	1957.653	109
5	Point in valley of branch of Pe- nobscot River.	2	3540	22	3709	1655.869	90
6	Boundary Summit.	2	4840	25	3269	1964.034	90

Having described in succession the several Divisions into which it has been found convenient to divide the route, we shall conclude the description with a brief synopsis, setting forth the locality of each Division, the distances under different gradations contained in each; the length of each Division, and the aggregate distance on each, from Belfast.

TABULAR SYNOPSIS OF THE ROUTE.

From Belfast to the Canada Line.

Divi- sions. No.	Locality at the end of each Division.	Distances under different Gradations.								Length of each Division.		Aggregate Distances.	
		0 to 35 ft. per mile.		35 to 60 ft. per mile.		60 to 90 ft. per mile.		I. Planes 4 1-2°					
		M.	Ft.	M.	Ft.	M.	Ft.	M.	Ft.	M.	Ft.	M.	Ft.
1	Stevens' Summit.	12	3629	4	2820	–	——	–	——	17	1169	17	1169
2	Deckers' Summit.	15	3967	6	2580	–	——	–	——	22	1267	39	2436
3	Thurston's Summit.	17	4519	4	0220	–	——	–	——	21	4739	61	1895
4	Bingham.	12	2928	1	0020	–	——	–	——	13	2948	74	4838
5	Forks of Kennebec.	24	0057	–	——	–	——	–	——	24	0057	98	4900
6	Spencer's Summit.	30	0000	–	——	–	——	–	——	30	0000	128	4900
7	Boundary Summit.	17	0169	–	——	7	0460	1	2640	25	3269	154	2889
	Totals.	129	4709	16	0360	7	0460	1	2640	154	2889	154	2889

Hence it will be perceived that the aggregate distance on the route deemed most feasible from Belfast to the Canada Line is 154 miles 2889 feet, of which 129 miles 4709 feet, are attended by gradations varying from a level to 35 feet per mile ; 16 miles 360 feet by gradations not exceeding 60 feet per mile ; 7 miles 460 feet by gradations not exceeding 90 feet per mile, and 1 mile 2640 feet by inclinations of $4\frac{1}{2}$ degrees.

All information relative to the amounts of excavations and embankments—the extent of bridges, culverts, causeways, &c. &c.—also, any estimate of the cost of road-formation as predicated on such information must unavoidably be withheld, till an opportunity shall have been presented for the execution of the various delineations from which the desired intelligence can be derived.

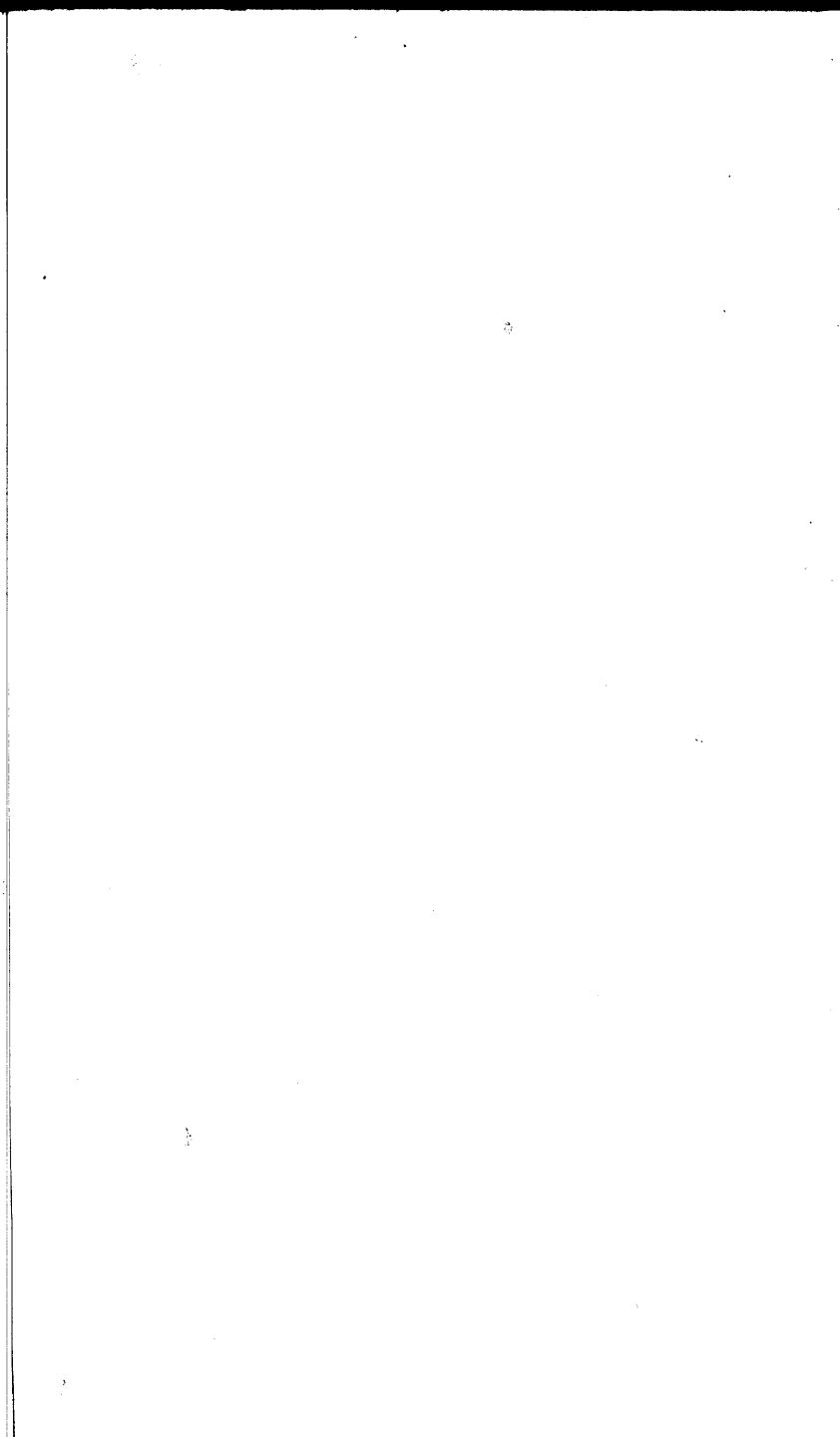I have the honor to be, sir,

very respectfully, your obt. servt.

S. H. LONG, *Lt. Col. U. S. Top. Eng.*

To his Excellency,

ROBERT P. DUNLAP,

Governor of Maine, and

Pres't of the Brd. of Intl. Improv't.

STATE OF MAINE.

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Ordered, That 1000 copies of the Documents accompanying the Governor's Message be printed for the use of the Legislature.

Sent down for concurrence.

J. C. TALBOT, *President.*

HOUSE OF REPRESENTATIVES, }
January 9, 1837.   }

Read, and 1000 copies ordered to be printed in concurrence.

H. HAMLIN, *Speaker.*