EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.
WAR DEPARTMENT.

SYNOPSIS OF A REPORT

OF THE

RECONNAISSANCE OF A RAILROAD ROUTE

FROM PUGET SOUND

VIA

SOUTH PASS TO THE MISSISSIPPI RIVER:

BY

FRED. W. LANDER,
CIVIL ENGINEER.

WASHINGTON, D. C.
1856.

CONTENTS.

LEGISLATIVE AND EXECUTIVE ACTION

IN REFERENCE TO

THIS EXPLORATION AND REPORT.

RESOLUTIONS OF THE LEGISLATIVE ASSEMBLY OF WASHINGTON TERRITORY.

Whereas Frederick W. Lander, esq., civil engineer, of acknowledged reputation and high standing in his profession, has undertaken the examination of a railroad route from Puget Sound, by the valley of the Columbia, to the vicinity of the South or Bridger's Pass of the Rocky mountains, to connect with a railroad to California; and whereas this examination is conducted at the present time, that reliable information regarding the line in question may reach Congress during the present session, and prior to any final action upon the Pacific railroad routes; and whereas it is the opinion of this legislature that the result of this exploration will possess such a reliable scientific and practical character as to entitle it to equal consideration by Congress with those more officially conducted:

Resolved, That, in view of the importance of this exploration, its scientific character, and the value of its results, our delegate in Congress be, and hereby is, instructed to present the report of this examination to the Congress of the United States, and to use his best endeavors to procure its publication as a public document.

And be it further resolved, That our delegate in Congress is instructed to use his efforts to procure such an appropriation as will compensate Mr. Lander for this arduous and perilous service, and repay the necessary expenses incurred by this survey.

Passed both Houses unanimously, March 7, 1854.

Attest: ELWOOD EVANS, *C. Clerk C.*
B. F. KENDALL, *C. Clerk H.*

Resolved by the Legislature of the Territory of Washington, That F. W. Lander, esq., civil engineer, in undertaking the arduous and perilous enterprise, at his own expense, of an exploration and survey of a railroad route, by the valley of the Columbia, through the Rocky mountains—a matter of the highest importance to the interests of this Territory—is entitled to the gratitude of this legislature, and we hereby tender him our thanks and best wishes for the success of his undertaking.

Passed both Houses unanimously, March 7, 1854.

Attest: ELWOOD EVANS, *C. Clerk Council.*
B. F. KENDALL, *C. Clerk House.*

RESOLUTIONS OF THE HOUSE OF REPRESENTATIVES, INTRODUCED BY HON. JAMES A. McDOUGAL, OF CALIFORNIA.

CONGRESS OF THE UNITED STATES,
In the House of Representatives, August 3, 1854.

On motion of Mr. McDOUGAL,

Resolved, That the Secretary of War be requested to procure a report from Mr. F. W. Lander, civil engineer, of a survey of a railroad route from Puget Sound, by Fort Hall and the

Great Salt Lake, to the Mississippi river, and that he cause a copy thereof to be furnished to this House.

Resolved further, That the reports of surveys for a railroad to the Pacific, made under direction of the Secretary of War, also the said report of F. W. Lander, be printed for the use of the House during the recess.

Attest: JNO. W. FORNEY, *Clerk H. R. U. S.*

LETTER OF SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, August 8, 1854.

SIR: In compliance with a resolution of the House of Representatives of the 3d instant, "That the Secretary of War be requested to procure a report from Mr. F. W. Lander, civil engineer, of a survey of a railroad route from Puget Sound, by Fort Hall and the Great Salt Lake, to the Mississippi river, and that he cause a copy thereof to be furnished to this House," I apply to you for the report mentioned therein.

It is proper that I should inform you that there is no fund at my disposal that will enable me to make any remuneration for the document, or for any expense attending the furnishing of it.

Very respectfully, your obedient servant,
JEFF. DAVIS,
Secretary of War.

F. W. LANDER, Esq., *Washington.*

LETTER TRANSMITTED WITH REPORT.

WASHINGTON, *November* 23, 1854.

SIR: Your letter of August 8th, containing a copy of a resolution of the House of Representatives, and applying to me for a report therein mentioned, was duly answered.

I have the honor to submit herewith a report of the result of my late examinations of a railroad route from Puget Sound, via the South Pass, to the Mississippi river, accompanied by introductory remarks deemed necessary for its explanation.

A series of meteorological observations conducted during the reconnaissance are at the service of the Department.

I am, very respectfully, your obedient servant,
F. W. LANDER.

Hon. JEFF. DAVIS,
Secretary of War.

RESOLUTION OF HOUSE OF REPRESENTATIVES, FEBRUARY 14, 1855.

Resolved, That there be printed, for the use of the House, ten thousand copies of the reports of surveys for a railroad to the Pacific, made under the direction of the Secretary of War, embracing the report of F. W. Lander, civil engineer, of a survey of a railroad route from Puget Sound, by Fort Hall and the Great Salt Lake, to the Mississippi river; and the report of J. C. Fremont, of a route for a railroad from the head-waters of the Arkansas river into the State of California, together with the maps and plates accompanying each of said reports, necessary to illustrate them.

Attest: JNO. W. FORNEY, *Clerk H. R. U. S*

INTRODUCTION.

EXPLORATIONS of the wild interior, for the purpose of ascertaining the most economical and practicable route for a railroad to the Pacific, are reconnaissances* rather than surveys. They are engineering studies of *routes*, or belts of country, often of two hundred miles in breadth, of two thousand miles in length, extending from the verge of the eastern border to the Pacific, of which the characteristics are to be known regarding railroad construction.

Routes are not lines; several lines might occupy relative positions on a single route.

The lineal section, rapidly placed by the labors of a single season, and presented as the result of a Pacific railroad exploration, must not always be presumed to be a profile of the preferable or the very best trace for location, existing upon the division examined. From the limited time prescribed for making these examinations, and from the vast extent of country explored, the first line of barometric levels does not always occupy the best position of the route to which applied.

The engineering features of the whole broad division passed over are connected with this base line, and stated in the form of opinions or convictions forced upon the mind of the engineer by former experience of the necessities of location in all varieties of country.

The study of reconnaissance is not, however, confined to single divisions. In its broadest application, it compares routes rather than lines; states their relative merits, and, by a simplified system of hurried field service, restricts the costly and tedious labors of elaborate instrumental survey to the preferable division; and, even upon that division, to a limited section of surface.

Thus, distinct knowledge of extreme, or nearly impracticable obstacles, upon routes involving deep national interests, the existence of which may lead to the abandonment or neglect of important termini, or to the repeated and expensive application of instrumental survey to solve what nature made insurmountable, directs the attention of reconnaissance beyond the narrow limits of sectional location.

And as reconnaissance directs reconnaissance; as the labors of survey are pursued as its results, and are involved and tedious in their deferred conclusions, the developments of the first important service cannot be too speedily continued to their limit when tending to prevent more costly expenditure by anticipating proposed surveys by additional information, which changes their direction.†

In all reconnaissances of location for the selection of the route or the line of a route of a railroad, some requisition to be answered must be present in the mind of the engineer. The interrogation, For what am I here seeking? should be evident to his senses and aid his study.

There are different classes of railroads; different plans of construction.

* *Railroad reconnaissance.*—To look, to view; the study of country with limited use of instruments, to procure information of its characteristics regarding railroad construction.

Report of reconnaissance.—To describe and submit conclusions from inferences drawn.

Railroad survey.—Instrumental examinations, by which surfaces are measured.

Report of survey.—To state by accurate deductions from data gained.

† I shall again refer to this brief definition in giving the reasons why the exploration, of which this report is the result, was conducted at an unfavorable season of the year, by private means, and was endorsed by unanimous resolutions of the legislative assembly of Washington Territory.

In the selection of the route of a railroad to the Pacific, the requisition as to the class of line to be adopted, and the plan of construction to be attempted, is the first and salient feature of the whole question.

This unsolved problem in engineering is dissimilar from that of any road hitherto completed. It is, nevertheless, a problem to which one system of construction is more particularly applicable than any other; the physical obstacles to be overcome are in no degree to be deemed subjects of consideration, as compared with the practical difficulties which conspire to prevent its ready solution.

The opinions of professional parties on this question, which are the result of experience in railroad-building, should meet the direct notice of legislation.

If it can be readily demonstrated that the selection of the class of line which will best solve the present urgent necessities of this nation for rapid and effective means of overland communication restricts the whole question to the selection of a route or routes over which such a class of line or mode of building can alone be attempted, then the choice of these routes should not be made subordinate to any other consideration.

It is not yet particularly known that a wagon-road, a rough, rapidly extended railroad, suited to military and mail transportation, and an elaborately completed, thoroughly equipped Grand Trunk railroad, can each exist in their turn, as called for by the necessities of civilization, and each aid as successive steps towards the consummation of the legitimate object required.

The wagon-road and the rough railroad come within the limits of discussion of constitutional legislation; and if deemed expedient, would progress together. But the Grand Trunk road, if viewed only in legislation as the development of a requisition beyond the reach of constitutional aid, would alone appear as the result of the efforts of private parties to procure remuneration to a patriotic and commendable enterprise by the carrying trade of western commerce.

A review of this whole question is necessary to the purposes of the present report, and as an explanation of the engineering views herewith submitted.

REVIEW OF THE PACIFIC RAILROAD PROJECT.

It is now nearly ten years since the patriotic Whitney first advocated the construction of a railroad to the Pacific. He then asserted that, in working out the grand problem of self-government, this nation occupied a position to command the influx of that commerce of the Indies, which had caused the prosperity of nations to ebb and flow like the waters of the sea over which it had been transported. He visited the principal cities of the Union. He addressed the legislatures of States and the Houses of Congress. He spoke of the development of territory; of the march of a martial people towards the shores of the distant Pacific; of a great highway of nations existing through a line of flourishing settlements; of commerce and agriculture walking hand in hand; of the east and of the west united. He enforced these arguments with the full powers of a commanding intellect, and by the expenditure of his private fortune. But he failed of receiving the support of congressional legislation; and as long lines of railway had never successfully competed with water transportation, private individuals declined this investment without government aid. Whitney went to England. He was received and noticed with honor. He addressed the British Parliament; but he was never able to achieve this grand purpose and glory of his existence. His patriotism and the devotion of his high nature only have their record in the present character of this great project, now fully before the American people, and with which his name must forever remain connected.

But the idea of a Grand Trunk railroad, elaborated from the very outset to the needs of an immense carrying trade, built in sections of one hundred miles, by a system of land grants, and existing, by some act of intuition on the part of its well-wishers, over mountain ranges, mighty rivers, sterile deserts, and regions devoid of wood, building materials, and sources of supply, has never yet been surrendered. When the munificent land grants of Texas, held out as a

bonus to capitalists, led to the creation of a mammoth company, and influenced the voice of the press, this idea of a Grand Trunk road was strenuously urged by eloquent advocates. It appeared in the glorious arguments of Benton. It still lies like an incubus on every effort made by professional parties to divest this national project of those objectionable features which have so long placed it in the light of a chimera and an experiment.

While the whole question has changed in its character, and that feature* which for nearly ten years barely elicited public notice, and failed of gaining the attention of congressional legislation, is no longer the leading, but has become the subordinate requisition of the problem, it is still allowed to weigh upon and embarrass the action of government.

The claim of the Pacific coast to better means of overland communication, unexpectedly made prominent by the discovery of the gold-fields of California, and the corresponding development of the Territories of Utah, Oregon, and Washington, was at once thought a necessity of such character that its solution could not be waived or postponed without vital injury to the best interests of the nation and to those important and isolated communities.

For this reason, in the very first discussion of this new and striking feature of the question, many patriotic individuals proposed the extension of a wagon-road. Others, in ignorance of the various classes of railways, advocated the immediate adoption of the grand plan of Whitney. It was urged by the latter that the great plains of the interior were already whitened by the bones of American emigration in the passage of a wagon-road.

The railroad of the isthmus of Panama, extending through an unhealthy climate and over foreign soil, had been projected and carried to its completion by the impulse of American energy. With the aid of government, this project might readily be completed by the enterprise of private individuals over our own territory, and by a route avoiding the fatal fevers of the south. Mails, troops, and munitions of war could be safely and rapidly transported; and the great travelling population of the east and west no longer be exposed to the dangers and inconveniences of the isthmus transit.

But grave questions now came up for consideration. It was open for argument, how far Congress might aid the speculative operations of private parties, save as the most direct step towards the legitimate consummation of a single object in view.

The united sovereignties which jointly possessed the broad domain extending from the east to the Pacific would necessarily act with caution in entering the debatable ground of constitutional rights.

The nation was then laboring under the results of a disastrous depression and derangement of the business relations of the country. This state of things had been produced by an unhealthy mania in railroad speculation, not only unrestricted, but in a measure urged forward by the indiscriminate patronage of local legislation.

The unwieldy operations of companies under the management of interested private parties had not always been guided by the true spirit of patriotism. No argument of mere expediency should affect the action of government. In treating this question, Congress, acting under constitutional limitations, could only continue to insure a perfect union, domestic tranquillity, and common defence; further the general welfare; regulate the land forces; provide for calling forth the militia to repel invasion; promote the progress of science and art; defend California against invasion, and perhaps, by the extension of a post-road, give to her citizens the privileges enjoyed by other sovereign States.

No preference could be given, even by the establishment of a regulation of commerce, to one State over another; and it would require a power of discrimination very difficult of application to decide to which portion of the Union should accrue these supposed wonderful advantages, in the development of a project claiming the aid of a government strictly bound to render exact and equal justice to all.

* The idea of procuring the influx of western commerce to the United States of North America by building a Grand Trunk railroad across the continent.

It is well known that these questions were left to the consideration of Congress. The representatives of a people known to possess more mechanical ingenuity and constructive faculty than any nation of the globe, were called upon by the united voice of the nation to look this subject of overland communication boldly in the face; to view it in its manifold relations; to grapple with its great apparent difficulties; and, if constitutional, to decide *when, where, and in what manner*, it could be best and most speedily accomplished. All sources of information were open to them; and, if a problem and an experiment, it could be met by the full force of that acute American intellect which had done, and will continue to do, so much towards accomplishing the destiny of this wonderful republic.

If it was denied that government had constitutional power to act in the premises, it certainly did not require argument to prove that those distant communities, the unparalleled development of which had been the growth of an epoch in the history of human progress, were an integral portion and a part of the republic; and it was also evident that they were entirely isolated and unprotected. *By the constitution, Congress was compelled to defend California against aggression.* It was well known, in these years of revolutions and of counter-revolutions, that the United States of North America had become an object of suspicion and of dread to older and less progressive nations.

In the event of war with one or more of the great powers of Europe, California could not be defended against aggression by the means then within the command of the general government. Troops, supplies, and munitions of war would be exposed to the dangers and costs of the inadequate modes of transit, of a broken and interrupted water transportation, and to the passage of an unhealthy, and, in that event, probably a hostile foreign territory.

It had ever been the policy of this government to restrict the military operations of the country to a simple and effective character. Her volunteer soldiery had already made the wars of America immortal. Rallying the energetic population of every hill-side and prairie around that gallant and efficient military organization, which would compare in ability and attainment with that of any service of the earth, it was evident that the necessity of the occasion would require the rapid transportation of these suddenly-collected forces to the utmost verge of her remotest border.

In view of the achievements of science and the mechanic arts, and the advanced stage of human progress in the nineteenth century, a military road could no longer be deemed the means of crossing a river or making passage of a hill-side. In reference to the exigencies involved, it was the application of that mode of transit which had in a measure annihilated distance, to a route of two thousand miles in length, from the populous eastern States to California.

It was the definite solution of the requisition of a new, unexpected, and striking necessity, by the use of the best means at the command of the nation.

The demand was immediate. If it was within the power of government to act in the premises at all, then *when* government should act on the question became evident to the weakest observer.

If it was within the power of government to act in the premises at all, then *where* government should carry this project to early consummation grew out of the national requisition of military defence, and those claims which had led to the attention of Congress.

If it was within the power of government to act in the premises at all, then *in what manner* it could be best and most speedily accomplished would be devised by the wisdom of legislation, in order to avoid those misfortunes which, in the development of minor and local railroad projects, had affected the business relations of the country, and had been noticed by a message of the President.

But the project was yet to be placed in a position to become the object of a fostering legislation; an undertaking which, to aid would be national, and to achieve, patriotic.

Unprofessional parties had invariably confounded the domestic and commercial relations of the problem with that distinct and salient constitutional feature which gave Congress power to

act upon it. The question as to whether government could use the iron rail and locomotive engine in the extension of a post-road over two thousand miles of uncivilized country, and that mode of transit which had in a measure annihilated distance, as a means of defending a distant sovereign State against aggression; permitting a proper regulation of the land forces, by rapidly transporting the suddenly-organized forces of her volunteer soldiery to the distant unprotected portions of her domain; whether or not a military road should still be considered that sort of structure which existed at the date of the constitution, or be superseded by the triumph of human ingenuity;—this question had been merged by legislation in an endeavor to answer the anticipations of private individuals, who sought to change a government of general and limited powers into a party speculating with the lands and funds of the people, by aiding an experimental endeavor to procure the influx of western commerce to some single State or section of the Union, perhaps to the detriment of all the rest. This brings the subject to a connexion with my report.

If, from want of professional information, the treatment of this subject has hitherto been reversed in its nature, and the need of the hardy pioneer of civilization has been merged in the claims of the capitalists of the eastern cities, it may readily be placed in a clearer point of view.

A few simple engineering statements will enable the wisdom of Congress to determine how far the power of the constitution will permit government to aid in the furtherance of the operation of private parties towards attaining results desired, and where the restrictions of legislation might be interposed.

I shall endeavor to establish the plain engineering position, that government may act in the premises without risk to first outlay; and if it shall seem expedient to extend a means of communication over our soil to the Pacific possessions, that the use of that mode of transit, perfected by human ingenuity, need not be surrendered on constitutional grounds. I shall also not hesitate to state, most emphatically, that the subordinate or latent feature which has so long given a Pacific railroad project character in the estimation of private parties, and which is not so well entitled to the notice of legislation, is in no degree harassed or restricted, but is in a measure urged forward to earlier consummation by the proper treatment of this undertaking as an engineering problem.

DIFFERENT SYSTEMS OF RAILWAY CONSTRUCTION.

The plan of building a Pacific railroad, which has been so long presented, by extending it in sections of one hundred miles, elaborated from the outset to the full needs of the immense carrying trade of western commerce, and slowly verging towards the wild interior, is that of the English system of construction.* Built on such a plan, by the use of credits, bonds, and mortgages, and by a brokerage over a basis of land grants, it would combine all the disadvantages of both the American and English modes of construction. These are very dissimilar. The English system, adopted in building the first roads of New England, has been modified in America to more expeditious and less costly methods of attaining the results required.

Although the Pacific problem is different from that of any road hitherto completed in civilized regions, it is nevertheless one to which the present American modes of building, *divested of their objectionable features*, are more particularly applicable than any other. It is that of the

* *Grand Trunk, or first-class railroad, English.*—A (practicably) direct route between termini reduced to a close approximation to level gradients, without attempts at deflection to reduce cost. A line of durable and costly works, drained, sodded, and elaborately prepared in road-bed and permanent way for the rapid passage of weighty trains; thoroughly equipped and furnished, of gauge adapted to traffic and connexions.

Grand Trunk, or first-class railroad, American.—A line adjusted to irregularities of surface, between termini, by application of curvature and gradients, regarding obstacles to be overcome and traffic to ensue. A road-bed ditched, sloped, and drained, and made ready for the rail by a cheap ballasting of clear gravel. A superstructure adapted to the passage of weighty trains at paying rates of speed. Works erected in apprehension of a division of traffic with competing lines, as avoiding misdirection of capital and the entailment of high rates of fare. In view of improvements in transportation liable to ensue, and contingencies which inevitably occur, omitting as extravagant and unnecessary many of the operations deemed indispensable to foreign first-class construction.

extension of a road over an uncivilized, and in many instances uninhabitable, country; and the American system is that of the rapid extension of lines, at low cost, over undeveloped and non-paying routes of transit.

The Pacific railroad is to reach a terminus two thousand miles distant, from which a revenue is anticipated; but until this anticipation of revenue is answered, must be restricted, in development, to the simple requirements of military and way transportation.

The American system of building is one by which a line may pass through various stages of elaboration to any class or character required, *even after the connexion of termini has been accomplished;* for it is the great principle of the American "open construction account," that a road should not be placed under the serious liability of maximum equipment for service it may never be called upon to perform; but, if practicable, should be made to reach and develop the sources of future traffic, under the support of a way transportation at paying rates. From the operations of interested and unscrupulous speculators, often occupying the position of railroad directors, and gambling with the funds of stockholders committed to their charge, and *especially in the building of short lines where permanent construction should have been deemed expedient from the outset,* the system of the open construction account has encountered great opposition, and has been unwarrantably assailed by unprofessional parties.

Under the present credit system, (one of the evils of the American mode of building,) from the necessities of brokerage, and premiums, and the gambling liabilities, borne by innocent stockholders, a mere percentage of the amount of margin presented as the cost of roads is devoted by the American constructing-engineer to their actual working. This has been one of the chief reasons why the cost of American roads has so often exceeded their engineering estimates.

Over twenty-five per cent. of the amount now invested in lines of the United States has proved a total loss to the original stockholders. The civil engineers of the country have very generally borne the odium of these liabilities; which is probably the reason why their opinions have such slight weight when brought to the consideration of this national undertaking.*

Yet this project is one to which the application of the American system of expansion will restrict the first liabilities of wear and tear, depreciation and deterioration, risk or loss of outlay, and all questionable expenditures, to the minimum, in the construction of a line which, from the length of route traversed, before connexion can occur with a paying terminus, will not warrant first-class construction and equipment from the outset. It would require a period of twenty years to build such a grand road to the Pacific, on the obsolete system proposed. During this space of time those portions of the road first completed would thrice need renewal as worn out

* We are too apt to confound the achievements of science and art by the first nations of Europe, with the only available methods of accomplishing similar ends in our own country. The great mass of the American people are also too ready to believe that it is from want of some natural gift or cultivation of peculiar qualities that our own countrymen do not erect works bearing favorable comparison with those of older nations.

A few years ago the public press was teeming with accounts of the projection of a Grand Trunk railroad in Canada. A noted English engineer had arrived. A company of English capitalists had been formed. A bridge was to be built across the great valley of the St. Lawrence, rivaling any structure of modern Europe. Some comparisons were made and reflections cast, regarding European and American railways, not wholly complimentary to our own mechanics and engineers. But within a short period it has been made public that the stock of this famous company has become a drug upon the market, and that the business of the grand road affords so slight prospect of paying the interest upon the capital invested, that there is great danger of the total abandonment of the enterprise. Thus the system which had been found to succeed so admirably in the densely populated counties of Great Britain, became totally inapplicable to the needs of a less remunerative route of transit.

I particularly refer to this case, because this Grand Trunk road was extended as the first step towards a Pacific railroad, and because its failure is an example of what may be apprehended by a like incomprehensive treatment of our own Pacific project.

Extract from a speech of Hon. James A. McDougal, delivered in the House of Representatives on the 29th of May, 1854.

"The line from Halifax, through the British possessions, to the Pacific, is a project contemplated by our northern neighbors, and in it they have the support of heavy English capital."

and decayed. The amount of the cost of this renewal would absolutely construct and equip a road of medium class, with ordinary management reaching the Pacific in ten years, and, if necessary, even in five years. This preliminary road would not make a passage of the same obstacles by reduction of surface, nor adopt so direct a line as a Grand Trunk road; but select a route giving the most rapid results to first outlay, by at once answering the present needs of the nation. It would also accomplish that first step towards the construction of a grand road, which would eventually insure its completion without great loss to its projectors, or, more properly, to the government finding means for extending it.

A doubt exists in the minds of practical individuals whether the traffic of a Grand Trunk overland railroad will ever support its running expenses. Hence, there is an experiment to be tried.

Government is not particularly interested in the question as to whether the commerce of the Pacific seas will pass over this line, when built, or continue to be borne by clipper-ships around the southern extremity of South America. Government is interested in the solution of the problem only so far as the results of the experiment tend towards the extension of a speedily consummated effectual means of overland mail and military transportation.

But while government will hesitate to exercise doubtful constitutional powers, and will practise due economy in the expenditure of the money of the people, it will, when not conflicting with those powers, seek to further all important domestic and commercial relations.

While the idea of a Grand Trunk road must be treated with caution, because, so far as government has constitutional powers to act on the question, the choice merely lies between the use of the iron rail and of the wagon-road, and it can be demonstrated that the use of the iron rail can take place prior to the completion of a grand road; yet, as regards the choice between the use of the iron rail and of the wagon-road, the probability of the future construction of a Grand Trunk Pacific road should be brought into the discussion.

The experiment as to whether the commerce of the west will pass over the American continent by rail-way, even when a rail-way is in operation, cannot be tried by the extension of a wagon-road. But it can be practically tested by the extension of a railroad only suited to the absolute needs of military and way transportation.

Again, should this experiment prove successful, then the Grand Trunk railroad of the present day would be wholly inadequate to the amount of transportation required. The broad uncultivable wastes of the American continent (over any route whatever) are unlike the present railroad routes of civilized regions. They compare with them as the drear expanse of the ocean contrasts with the inland navigable waters of our lakes and rivers. When this sea of space is to be traversed with the certainty of a paying business, with no important way stations, and an enormous through traffic to warrant the running of trains, the locomotive engine will make passage of the level sand wastes of the wild interior at rates of speed which will startle human credulity. And when the same inventive genius which once so readily modified the costly modes of building of older nations to the means and demands of our own new and undeveloped country, is called upon to grasp the broader conclusion, and solve this future necessity of civilization and of progress, then the Pacific railroad will resemble the present Grand Trunk road of populated countries as the new British steam-ship Great Eastern compares with the first-class steamer of the coast. Thus, while the first study of this question should be grounded on a comprehensive desire to answer *at once*, and in the best manner, that which is at present required; yet, in view of the grand prospective contingencies presented, it should also be definitely guided by a full apprehension of that which is liable to occur. The conclusion is, that if government should see fit to construct a railroad, necessarily in connexion with, but in preference to, the extension of a wagon-road, then a railroad suited to military transportation, and to the mere testing of this experiment, is the class of road to be attempted. In this connexion, the assertion of the unprofessional observer, "that it is always cheapest in the end to build a good road first," must have no weight. A road suited to the needs of way and military

transportation is necessarily *a good road*, and, built by the aid of government, should not be accepted if of unstable or insufficient character. It is the choice of route, and nature of surface passed over, which reduces its cost and favors its rapid extension, and which is, in reality, the chief argument for its use in preference to the wagon-road.

But I will close this argument by asserting that no road of permanent works and substantial class *can be built* across the continent with only the use of a wagon-road as a vehicle of transportation. The appliances of civilization, and the materials of construction, must be placed contiguous to the works by progression of settlements, or by the prior extension of a pioneer or preliminary railroad. But although permanent works may be erected by awaiting the tardy progression of settlements through the fertile border country, they cannot thus be raised in the far interior. Long sections of all routes are there devoid of wood, stone, and every variety of building materials. Broad divisions are not susceptible of development by settlements, and can never become provision-producing districts. From the distance to be passed over, and the amount and speed of transportation required, labor can neither be supplied nor supported.

Weighty materials cannot be moved over the hundreds of miles from where, existing in natural deposits, they must be furnished to sections deficient. Mules, oxen, and horses fail, break down, and die by scores, in making passage of those distant, sterile, and arid plains. The use of the iron rail and locomotive engine is that means of transit perfected by human ingenuity to the best practicable result for the moving of weighty materials at high rates of speed and at low cost. In fact, it cannot be denied that it fully transcends all other modes of land locomotion.

These very routes, where domestic animals can hardly be made of use, and where the supplies of human subsistence cannot be procured, can be readily developed by railway, by laying a rough superstructure on the natural surface of the earth, and thus the very best means of transportation can be supplied.

The whole pecuniary question regarding the treatment of this project of a railroad to the Pacific resolves itself into the expenditure of the least amount of cash capital without reasonable prospect of remunerative return. The engineering question resolves itself into the obtaining of some rapid and effective means of transportation along the route of the grand road, *that it may be constructed at all.* The first relation is, the distance to be passed over before connexion can occur with a paying terminus; and the second, the stupendous nature of the nearly insurmountable obstacles and practical difficulties which will serve to postpone the completion of any road of first-class character. Both presentations of the subject are wholly subordinate to the great and immediate need of the Pacific coast, to the healthy overland military and mail transportation, which is the single constitutional requirement in the premises. This is a requisition which cannot be waived or postponed. A wagon-road will not answer it, and a permanent railroad cannot be legislated towards the Pacific by the will of its well-wishers, under incomprehensive views of the difficulties attending its extension.

Therefore, with a full sense of the importance of such an opinion, and a definite knowledge of at least two of the great routes across the American continent, I propose the extension of a rough American railway, of weighty superstructure, but of medium equipment, from *the extreme western border of eastern civilization* to the Pacific, as the exponent of that practical experience of the railroad-builders of America, which, if never officially called to the treatment of this public question, has shown such admirable results in the extension of lines through thinly populated regions, even when harassed by the unscrupulous management of speculative parties. I present it as a simple proportioning of means to the end required; and as a restriction of the undue expenditure of the money of the people in the solution of a national problem.

For, (returning to the first point of this argument,) if, by the constitution, Congress is compelled to defend California against aggression, and regarding the settled policy of this government, forts and standing armies are not deemed the preferable means of military defence; if, as is stated by the first military talent of the nation, California *cannot* be practically defended by the means at present within the disposal of government; if a wagon-road is unsuited to the rapid

transportation of weighty supplies, forces, and munitions of war; if the construction of a Grand Trunk railway is a ponderous and dangerous experiment, and its eventual completion beyond the limits of reasonable anticipation; if the iron rail and locomotive engine may be made of immediate use, and solve this necessity by the mere adoption of a route of transit over which it can be profitably extended; then the building of this railroad to the Pacific, applicable to the exigencies involved, the amount of transportation required, and the remuneration which will ensue, is a legitimate and warrantable undertaking, because no other will answer the purposes of the case proposed. It is the extension of a railroad of the least cost in the first outlay, because built through an uncivilized country, over an undeveloped route, and as subject to the contingency of total loss to its projectors if elaborated beyond the stringent needs of the mere requirements of necessity, before reaching the distant terminus from which a revenue is anticipated—the extension of a railroad to solve the correctness of this anticipation of revenue, and, under the nature of an experiment, to test its value; but, beyond all these minor requisitions, the extension of such a railroad as the comprehension of other and more important national considerations will alone warrant constructing. It is, in like manner, the adoption of a route which, from the nature of the surface passed over, and from the avoidance of great obstacles, will lead to the immediate consummation of the project.

If the use of the rail prior to the actual completion of the road, by the mere selection of a route over which it can be extended by light grading, seem to the unprofessional observer impracticable and absurd, to the experienced railroad-builder, who has seen the working locomotive and material train made the grand vehicle of transportation over unfinished lines and upon every variety of surface, this mode of transit will at once sustain its important character in relation to the peculiar necessities of the present case.

The road would consist of a T-rail, of sixty pounds to the lineal yard, spiked to a wooden cross-tie, and adjusted to a ditched and drained surface. But, as it progressed, it would be liable to modification by those improvements which inevitably occur, and which, in view of the constructive faculty of this nation, should not be lost sight of in preliminary arrangements.

Over portions of that broad central division of the continent, reaching from the Missouri river to the Pacific, the mountainous, broken, and undulating country bears a very small proportion to the extent of elevated plateaux, either level or of slight inclination to the horizon. These elevated plateaux offer substrata of sand or gravel, easily excavated, slightly affected by the action of frost, and, by nominal reduction of surface, affording a road-bed of perfect drainage, and of superior quality for the preservation of superstructure and machine, and also favoring those simple manual operations deemed sufficient to keep American railway lines in working order. A railroad line passing over such a surface would as far transcend all means of transportation by plank or wagon-roads as is possible to conceive. It would admit a speed of twenty miles per hour, with loaded trains, over the greater portion of its distance, and at least the passage of loaded trains over all portions of its distance.

It would appear as a direct exemplification of capital reserved. *The whole amount of its cost would have been expended in the mere needs of transportation for the purpose of building the proposed Grand Trunk road.* Attempted without its aid, the construction of the Grand Trunk road may be regarded a chimera; and even if eventually completed, the depreciation and renewal of its superstructure and rolling stock, the loss of interest on dormant capital, and the disastrous results attending its consummation, would thrice exceed the entire cost of a preliminary road.

The mere development of territory would remunerate the cost of constructing a road, only attempting in every stage of its completion a character or medium adapted to the simplest requirements of necessity; while no such minor sources of revenue would warrant the construction of a first-class line or road assuming an elaborated character from the outset.

ROUTES.

For a Pacific railroad, the term *route* will cover the extreme breadth of country to which side examinations may reasonably extend, or to which any claim of location may carry a line by detour. The term *route* in these remarks must not be confounded with the word *line*. The route of a line is (strictly) *defined by survey*. The route to which the location of a line is referrible is described by reconnaissance.

Two of the grand routes across the American continent are peculiarly adapted to the ready and rapid extension of a rough preliminary railroad. One of these routes passes south of the Sierra Nevada mountain range, and in the vicinity of the Mexican frontier. The other is that of the present emigrant road of the South Pass to California, Utah, and Oregon. Both of these routes are of flat plateau surface, and gravel substrata. Over one of them, the passage of trains would be obstructed during winter by the snow of the great plains; over the other, a northern population would be decimated during the summer by the fevers of the Gulf. Over one of them, the frosts of the northern winter would, during half the year, prevent the speedy progression of the works of construction; over the other, the miasmas of a southern summer would prove fatal to the health of the Celtic laborer. Over the northern route, pure water can be delivered from abundant sources of supply, at sufficient height above the rail, to be furnished at low cost for the use of locomotives; over the southern, it must be procured by more expensive methods, from fountains difficult of access and limited in quantity. The northern route is longer than the southern, but, of central position, it can be more readily defended in the time of war. Contiguous to provision and labor-producing States, it can be more cheaply constructed, and, when built, will command and unite important and conflicting public and private interests. Long sections of both routes are destitute of timber, which can only be supplied by the use of the iron rail. Both of them differ from all other routes across the continents. Both are better suited to the speedy extension of an effective means of military transportation by railway than any others. Both are especially worthy the attention of government in the selection of the route of a road for the purposes of military defence; but neither of them would so readily attract the notice of speculators in land grants, nor is either particularly adapted to the development of great agricultural interests.

As the salient requisition, which gives government constitutional power to act in the premises, is that of military defence, and the leading feature of that requisition is early communication, the first step towards the solution of this intricate problem of overland communication is narrowed down to the choice of one or both of these routes; the subordinate or latent characteristics which subsequently come forward in the domestic relations, of development of inland territory, and of procuring the influx of western commerce, not being confounded with, but in every respect kept distinct from, the peculiar and striking national feature which first won the attention, and is now strenuously urged as entitling this undertaking to the full notice of legislation.

The most southern of these routes being beyond the field of the present report, I bring this whole view of the engineering merits of the question as giving great character to a forked road, which, reaching by a main stem from the central border of eastern civilization to the Mormon settlements, would there permit of the connexion of a short branch line to Puget Sound, and of the extension of a main trunk to California.

This road, as first extended, would represent the word *line*, as *delineated*, or placed by the requirements of location, by the trace of actual survey, for preliminary service. But, as eventually elaborated, it can only be described, at the present time, by the report of reconnaissance, as within the limits of all future claims of location by the word *route*. The rough road, built for the purpose of military transportation, must be placed, by engineering study, over a surface adapted to rapid extension, and be adjusted with great care at water crossings, summits of

country, and all positions of a character to postpone early consummation. But it may, nevertheless, become the means of constructing a grand line, not necessarily contiguous to it, as the term would be applied in civilized regions; for, reaching by any line of approach, the vicinity of the plains and rim of the Great Basin, where occur sources of supply of iron, coal, building materials, and way-stations of population, a preliminary road would become the carrying line for developing and transporting these resources.

To once more state this question. It is probable that Col. John Charles Fremont (not particularly a railroad-builder) is better qualified than any other individual to name the relative merits of the several lines of central routes, regarding agricultural development, from having compared them in the field. The direct line from St. Louis to San Francisco—which is located too far south to admit of ready connexion by a branch with Puget Sound and the important northwestern coast—is described by that distinguished explorer as possessing such characteristics. It has attracted national notice as a grand central Pacific line. Its adoption has been advocated by one of the oldest statesmen of America. And these desultory remarks are for the purpose of explaining that the combined extension of a wagon-road and preliminary railroad over the present emigrant trail of the South Pass, would in no degree prevent, but would, in fact, absolutely further the completion of a grand highway of commerce and of nations over the direct line named, which, central in reference to commercial and domestic relations, is not central as regards the combined claims of California, Oregon, Washington, and Utah, or of the entire Pacific coast, for military defence; and under the contingencies of rapid railroad construction, could not conscientiously be selected for such a purpose by legislation.

This view of the question should also practically refer to all routes of such undulating and broken surface as to postpone *early* communication, if adopted.

A military railroad should extend over plateau surface, from the mere fact that a railroad is not a line of fortifications, but a structure peculiarly pregnable to the most insignificant means of attack; and, when built over substrata of sand or gravel, the line of communication can be renewed, when broken, at a few hours' notice.

The energy of the American people has never yet failed to develop border country by railway. Legislation has seldom hesitated to aid the construction of roads, even in advance of the needs of civilization. But (summing up the statements of this paper) if nature has debarred any section of the continent those facilities of surface or position which warrant the attempt at rapid railroad extension, in answering this grand necessity of the earliest practicable consummation of overland transportation, then the requirements of a whole nation should not be made subservient to such merely local claims to attention.

If local roads can only tardily progress over a rich agricultural, but broken surface—a surface of excavation and embankment, of masonry and bridging, of practicable construction but of deferred communication—while the less costly preliminary line might be speedily extended toward the mountains, then the claims of the hardy pioneer of civilization, of the citizen of California, Utah, Oregon, and Washington, should not be deemed subordinate to the prayer of the wealthy capitalist of the eastern city. If legislation is to furnish the means of solving this problem of overland communication, the rights of the poorest herdsman of the Pacific are as much entitled to notice as those of the eastern speculator in land-grants.

THE CONSTRUCTION OF THAT FIRST SECTION OF A PACIFIC RAILROAD CONTIGUOUS TO THE STATES, THE INITIATIVE OR PRELIMINARY STEP TOWARD THE EARLIEST PRACTICABLE CONSUMMATION OF THE WHOLE UNDERTAKING.

During the many long discussions which have taken place on the subject of a railroad to the Pacific, it seems to have been forgotten, or to have entirely escaped notice, that all great railroad lines are built in sections, and that, although this road is one of two thousand (2,000) miles in length, yet but a single mile need be built at the outset.

The argument that the difficulty of selecting a route prevents such a conclusion need not be entertained, if the route is chosen on the constitutional grounds of the cheapest and earliest consummation of the military defence of the Pacific possessions by overland railways.

If the whole question of the construction of a permanent road to the Pacific resolves itself into the prior construction of a railroad to the Pacific of less elaborated character, so too the construction of a preliminary railroad to the Pacific resolves itself into the building of the first mile of the very first section of the best route for that road adjacent to the border settlements.

The first section of the main stem of the forked route of the emigrant road does not, however, commence at the first unfinished portion of the Pacific railroads (so called) of Iowa or Missouri. The two hundred and fifty miles of severe undulating surface extending between these lines of rail, now tending west, and Missouri river, is of a character to prevent early completion; and the people of the Pacific coast and the present claims of the nation will not permit awaiting the three, four, or five years it will require to bring these roads to Missouri river.

Neither can it commence at Fort Kearney, which is the proper point of intersection of all eastern lines. This point is as far inland toward the west, and wagon-roads will not furnish the cheap and rapid transportation required for weighty materials of construction.

From the peculiarity of surface offered—a surface graded and ballasted by the act of nature—the first section of the pioneer railroad of the emigrant plateau route must be supposed to commence on Missouri river, near the mouth of the Platte.

As the navigation of the Missouri, as high as this point, is ample for the transportation of rails, equipment, and furnishing, the road—finding its own means of rapid extension—would reach the mountains, over the flat sandy surface offered, at about the same period of time that the local roads of Iowa and Missouri were completed, to become its connecting links with eastern lines—say in three, four, or five years.

The line (of five hundred (500) miles length) would traverse the edge of a range of low sand-hills, skirting a broad and fertile river valley, which reaches, without a break in surface, from the mouth of the Platte to the first broken country of the great grazing section of the Black Hills (so called).

Under the present system of legislation—the aiding of the extension of railroads by speculations based on the augmentation of the price of government lands to the actual settler—reasons might be offered why Congress can assist in the construction of this road of five hundred (500) miles on far more equitable grounds than have hitherto led to the multiplication of rivaling and competing roads across the border.

The fact that this line *would* become the first section of a Pacific railroad, and the needs of California, Utah, Oregon, and Washington find a place in a discussion which has hitherto been devoted to those of Texas, Arkansas, Missouri, Iowa, and Minnesota, or the wealthy capitalists of eastern cities, is probably the cause why this line could not thus be aided.

The following domestic relations entitle it to notice, without reference to the fact that it would become a section of the Pacific railroad, viz:

While other divisions of the public domain are favored by navigable waters, by which the appliances of civilization may be transported, the narrow belt of fertile soil which this line traverses can only be laid open to the pioneer by the passage of a railroad. Like many of the richest regions of the west, the country is sparsely wooded; and during the growth of wood, (by keeping out the prairie fires,) fuel and building timber cannot be transported for the use of settlers by the insufficient means of a wagon-road.

The needs of better means of transportation than this route now affords have become so great, that it has been proposed to secure them for the benefit of the Mormon settlements, by building a canal from the head-waters of Yellow Stone river toward Utah, and by a detour of over three thousand (3,000) miles of river and canal navigation.

The construction of the road would shorten by five hundred (500) miles the distance now travelled by the overland emigration, and prevent the great loss to the nation in domestic stock

which yearly occurs; and the value of which, thus saved, would pay the interest on the whole cost of building it.

To secure the advantages of becoming the sources of supply to emigration, settlements would grow up at the mountain terminus of the line. These settlements would become some of the most important of the nation. They would soon furnish those supplies to transportation which, in event of war, would make the defence of the Pacific coast a practicable measure, by the farther overland passage of trains by a wagon-road. The citizens of a narrow State would defend and support their railroad. The border population, thus placed five hundred (500) miles nearer the Pacific, would soon reach the outlying farms of the Mormons. Intercourse would take place with that singular people, and the weight of public opinion tend toward solving an intricate problem in the science of self-government.

All these results can be obtained by the construction of a railroad at lower cost than any line now in operation in America, of equal length.

The road is on the grand approach to both the Bridger's Pass and the South Pass of the Rocky mountains. It is the main trunk of the whole great overland travel going west of those mountains. It is most advantageously situated, regarding the connexion of eastern lines. At a point near Fort Kearney, at the head of Big Island of the Platte, roads from Lake Superior, from the pine districts of Minnesota, from Lake Michigan, at Chicago from the central roads of Indiana, from St. Louis and the South, can favorably intersect with it on equal terms.

These roads can there drain the traffic it has developed, and their trains make passage over it to the mountain terminus and the interior. The road would become, in its artificial relations to Kansas, Nebraska, and Utah, what the great rivers of our country have been in their natural advantages to the country east of the Mississippi; or, as all navigation ceases at the Missouri, a deficiency of nature would be supplied by the triumphs of human ingenuity; therefore, the general government might reasonably afford to aid the construction of this first section of a great railroad line in its passage towards the Pacific, where, full of important connexions, like the branches of a river, its arms extending upon either side, it would develop not only the narrow region which it traverses, but the resources of distant localities, and become to the western portion of the American continent what the Ohio and Mississippi have been to the eastern.

THE CREDIT SYSTEM OF CONSTRUCTION.

In the course of these remarks, I have repeatedly referred to the credit system of construction.

The construction of the pioneer or preliminary, rather than the permanent Grand Trunk road, will restrict the evils of this system to the minimum; and a mode in which the road might be built would, in a measure, prevent their occurrence. Without presuming to suggest to the attention of legislation the evils which, in my own belief, will inevitably follow the literal overworking of the land-grant system of construction, when the stock market becomes flooded with the scrip of unfinished roads, I will refer to the credit system as connected with the subject of a railroad to the Pacific.

Returning to the legitimate discussion of this question, I shall endeavor to maintain the position, that even the construction of the first section of a Pacific railroad should not be made to labor under the liabilities of the land-grant and credit system of building.

The conduct of the preliminary step in a series of experiments which shall test a great national project, and, in a measure, define its character, should be simple, effective, and guided by judicious deductions from former experience.

The railroads of the United States are *actually constructed* by building contractors, under the direction of civil engineers. These building contractors take the works from other contractors, who are great stock operators, and are often even directors of the company they bargain with. The companies are generally formed in the following manner:

A very small amount of stock—say 30, 40, or 50 per cent. of that required—is raised by local parties along the route of the line. These parties (farmers, mechanics, merchants, and land-holders) thus form the basis for the schemes and management of the operator, who takes the residue of the stock. Both company and operator are now at the mercy of the agents of the great capitalists of the country. By holding such amounts of stock, the operator in many instances controls the directors' board, or even changes it at his will, by the votes of proxy. When, by capital raised, borrowed, and furnished, the road is partly or wholly graded, it is then mortgaged or bonded for iron and equipment. The running of trains now takes place, and the road, still in an incomplete state, is turned over to the company. About this period of time the able operator decides whether to dispose of or retain his interest in the line.

A few years ago, when many of the lines of the country were first opened for travel, this plan of building occupied a very high place in public estimation; but, since these roads have begun to wear, and the costs of renewal, of closing the open construction account, and of running trains at non-paying rates have opened the eyes of stockholders, it has, in a measure, fallen into disrepute.

Very few of the roads of the country will now more than pay the interest on their bonds, the original stock subscription or basis being in most instances totally absorbed.

But it is, nevertheless, undoubtedly true, that the farmers, mechanics, and land-owners, who took the initiative and lost their original stock, are actually reimbursed by advantages gained. All sections traversed have been augmented in value, and, in the majority of cases, (always excepting the crises of monetary liabilities,) the country generally benefited.

By the land-grant system of credit construction, after small outlay, the lands donated by government become the basis of a borrowed capital, which is devoted to the extension of the road; the security given to government being the preliminary construction of a portion of the road. It is not necessary for me to describe a system so recently within the treatment of legislation.

As applied to a Pacific railroad, its results would appear in the creation of a greater and more powerful monopoly than has ever yet affected the business relations of this nation. The placing of the rapid extension of this national road under the necessity of public appreciation, affecting and affected by the monetary transactions of the country, would tend to produce those crises in the stock-market, to which the pecuniary affairs of this enterprising people have always been so peculiarly liable. But, without referring to these disasters, it is plain that if, during the progress of this road, public appreciation is once lost, all credit will be withheld, and a clear, simple, readily-defined engineering problem will appear in the light of a false, visionary, and chimerical speculation.

The cause of the adoption of the old credit system of construction was from absolute poverty of means; the reason of the continuation of the great monopoly of the land-grant system is because its evils are not yet sufficiently developed to be perfectly understood; but why either plan of building should be applied to retard the construction of a Pacific railroad, I am at a loss to learn.

If there is any power of the constitution by which government *can* aid this undertaking, on the grounds of military defence, neither poverty of means, nor any plea of expediency, conspires to place the project in a chimerical point of view, and no such course should be adopted to further the needs and desires of speculation.

Dismissing the idea of the Grand Trunk road, which is an experiment, the subject of inquiry is, whether the pioneer or preliminary railroad shall be used for military defence in lieu of the wagon-road. To still further divest the project of chimerical features, a surface or route is sought where, by proper management, the use of the rail can take place without material cost in grading. The selection of such a route reduces deterioration without paying business to the minimum, and enables government to procure an approximate estimate of cost. Or, more plainly, over either of the plateau routes of the continent a railroad can reach the Pacific in seven years. A road in common use needs renewal in superstructure and rolling-stock in seven

years;* but the pioneer road having, within this period of time, reached the supposed paying business of the western terminus, a general through traffic would begin to balance wear and depreciation.

Government is amply able to construct the road by cash payments. The need of the nation is immediate. To place the undertaking under the liabilities of borrowing, and to subject it to the fluctuations of public estimation, is to retard it. To retard it when once commenced, is, in a measure, to defeat it, or, at least, to indefinitely augment its cost. To create a moneyed monopoly, which will undoubtedly harass the stock-market, by an unrestricted paper issue, is to infringe upon the legitimate currency of the country, and has not hitherto been thought constitutional. We may, therefore, most certainly affirm that the land-grant system should be applied to the Pacific railroad undertaking with great caution. As the very intricate and peculiar questions of loss of outlay by deterioration, and by working without revenue over a route of extreme length and novel character, may not yet be perfectly understood, I will once more allow myself to repeat conclusions offered.

I distinctly state that *if* routes exist across the American continent over which communication can ensue with a Pacific terminus in seven years, government should take no action to delay the communication beyond that period, but should aid the construction of roads over these routes only by cash payments.

But as there are many other routes across the continent, which are fully practicable, but, by passage of undulating surface, need excavation and embankment, bridge and culvert masonry, ballasting and drainage, before the rail can be made of use, and as these tedious operations (without reference to tunnels and mountain sections) will postpone communication, however attempted, government need not necessarily feel compelled to aid the construction of such lines by the direct application of cash capital.

Hesitating to bear the risk of private experiments to procure the influx of western commerce over these lines, Congress might with reason sufficiently endow them against loss of running trains through undeveloped country, and against cost of renewal during their twenty years' progression toward the Pacific.

This aid, however, should only be bestowed in sections; for, in the present instance, it is entirely out of place to endeavor to anticipate those contingencies of the future, which are in the course of solution by experiment, and which, within ten years, or less, will be completely solved by the completion of the more rapidly extended preliminary line.

Having now placed this subject in every point of view of which I believe it capable, I will again refer to the construction of the first section of the preliminary road on the constitutional grounds of military defence.

HOW THE CASH SYSTEM OF CONSTRUCTION MIGHT BE APPLIED.

As this road is to be aided on the grounds of military defence, it is in some measure a government work.

To favor the proper dispositions on Missouri river and along the route required for the purposes and supplies of military defence, it should be built under the direction or with the cooperation of military engineers. To secure the efficient management and able practical knowledge of private parties, it should be forwarded by contract.

The line of location of the route should be *placed*, from Missouri river to the mountains,

* This is a broad conclusion. T-rails of 70 pounds the lineal yard have been known to wear in two years. I have seen, in my own experience, the edge or chair-rail and the lightest class of U-rail wear ten years without need of renewal. The weight of the engine, the inclination of gradients, the nature of earth passed over, the care given to keeping line and level in "surfacing up," (technical terms,) the rates of speed, and the number of trains run, all affect this estimate, which is approximate and not in excess

by military engineers, to the furtherance of rapid extension, and not for the purposes of private border speculations by contractors.

Iron rails and equipment should be deposited, by the water transportation of the Missouri river, at some point best favoring the most direct approach to the main Platte valley by light grading. This point should be selected by government engineers during preliminary arrangements; and the sources of supply of building and working materials should then be retained, from location of private parties, for the use of the road.

The first section of five hundred (500) miles should be placed under contract requiring its completion within three (3) years from date.

The expense of grading the road will be merely nominal, and is not sufficient security for advances by government. To require a very large deposit in money, might embarrass the operations of the active parties (the *real* railroad builders and mechanics) who should be called upon to construct this work by contract.

From the favorable nature of the surface passed over, iron rails are necessary to the purposes of construction at the outset. As of high cost, and not liable to depreciation in value below a certain estimate, railroad iron should be regarded as equivalent to a deposit in bullion, and be accepted in lieu of moneyed security, or security by grading.

A laid superstructure, capable of sustaining the tread of a first-class locomotive engine at a speed of twenty (20) miles per hour, should be provided with simple working equipment, turnouts, and watering stations, before any payment is made to contractors.

From the point on Missouri river to Fort Kearney, near Big Island of the Platte, the road might properly consist of the common T-rail, of 60 pounds per lineal yard, spiked to a wooden cross-tie, and extended over a ditched and drained road-bed of the clear gravel of the section.

From this point of intersection of all eastern lines, (see sketch,) near Big island, a different class of structure might be attempted, at the option of the engineer. Just beyond this point, the great untimbered section, reaching toward the Rocky mountains, would be entered by the line.

Government might make payments of $10,000 per mile for the first and for each succeeding one hundred (100) miles of road completed, if expedited to the satisfaction of the directing engineers. On reaching the western terminus of the first section of five hundred (500) miles, government to pay to private parties such sum as shall have been agreed upon by a first contract, based on proposals issued, and thereon concluded with responsible bidders; government to reserve the right of cancelling the contract and taking possession of the road during progress of the work, upon equitable grounds, or upon failure of contractor to perform obligations.

Such a road sold at public auction would always guaranty first outlay. When completed (the first section) it would become the outlet and carrying line for the building of a Pacific railroad over any central route.

It would, therefore, be readily accepted by private parties in lieu of further cash payments (beyond the first $10,000) by government. But, from its important position, this road should continue to be within the general control of legislation.

As extended over the route of emigration, the building party could afford to keep up, beyond mere working supply and material trains, a medium equipment for common service; and government would not be called upon as a donating power to bestow immense land-grants on speculating individuals, to guard them against loss by running trains and depreciation of way over a non-paying route.

Government could make all payments by issuing scrip in applicable sums. Certificates to bear interest, and be payable within a limited number of years.

Public lands sold to actual settlers along the line would, in the meantime, take up all scrip issued by government. The sale of these lands should not become a governmental speculation. They should be furnished to the pioneer at the very lowest rates, and the settlement of the route traversed be promoted by every practicable method.

Sections of this narrow strip of valuable territory should be reserved for the growth of timber for the use of the road.

The company building this road, and encountering the risk of testing this first step of an experiment, should be admitted to the single legitimate speculation of having donation and pre-emption fee of a limited quantity of land at station-grounds, but not to interfere with actual settlers.

All speculations *should be brought to the best engineering line for the road. The road should not be carried from its proper engineering position to further any speculation whatever.*

In the present instance, the engineering line is that which will best favor the most rapid extension of the iron rail to the mountains. The summit-ridge between the mouth of the Kansas and the Platte is an obstacle to be encountered by a junction line, but not by the preliminary road.

The favorable features presented in the above plan would be in the competition of the ablest actual railroad-builders in the nation to construct this road under the scientific direction of individuals educated and trained at the expense of government for the service of military defence.

In event of war, this country will rely on her system of railroads for defence. By the revolutions of human progress, the Pacific railroad is especially an arm of national defence.

The military engineers of the country should have practice in this new branch of service; and as government is to furnish a portion of the means for extending this road, the scientific department to which is intrusted the erection of military works should not be debarred from participation in its construction.

The practical energy of the civil engineers of the nation will at once turn toward the consideration of this project, and appear among contracting parties; and the basis of the plan of construction offered, however modified, will serve to blend these important branches of an eminent profession in the solution of a national undertaking.

CONCLUSION OF INTRODUCTORY REMARKS.

Making no excuses for the many repetitions and the desultory character of these introductory remarks, which I have conceived necessary for placing this subject where it may be treated as a practical and scientific problem, I will now apologize for having sometimes been betrayed into a style of more earnestness than should properly appear in the statement of an engineering question.

Having devoted time, health, and pecuniary means, for over three years, to the furtherance of this great object, it requires the discretion of a caution not always within the powers of self-denial to apply to it only the defined terms of lucid demonstration.

Here, on this soil, the great masses of the people, once "hewers of wood and drawers of water" to lords and emperors, are erecting an empire of grandeur, the more comprehensive from being grounded on the broad basis of popular rights.

They are making deeper foot-prints on the path of civilization than any nation of the globe.

They are true to their own destiny, to the claims of human progress, and to the example they have become to the toiling white men of the earth.

They are inspired by the first sounds of approaching danger, and they have seen the necessities of an occasion.

They have beheld the surface of the Pacific whitened by a commerce which takes its departure from the rude cob-wharves of a city risen from the sea.

They are true to the claims of that far-off, moving, and practical population which is a part of their union, and from which they are divided by sterile deserts and snowy mountains.

They know that, by the simple triumphs of human ingenuity, these obstacles may be spanned by a Pacific railroad.

They are bound to that distant population by every impulse of generosity and by every tie of the heart. The wealth of the single isolated and unprotected State, brought home to them by the husbands, the fathers, and the brothers of virtue, has permeated every hamlet of every hill-side of America.

They feel that, in these years of tearing down and building up, this undertaking need not be postponed or confounded with the obsolete traditions of the achievements of the past. Standing so sturdily upon the present, and gazing into the future, they have long ceased to cling too steadfastly to the tottering remnants of the past.

Of energies too vast to be always within the control of legislative restriction, they have never yet failed to respect the government which they have of themselves created.

To the representatives of such a people, no plea of temporary expediency, no mere anticipation of the advantages to accrue by the extension of the Pacific railroad, will justify the slightest infringement of a single provision of the instrument whereby so heroic a mortal destiny has been achieved as the present welfare of this republic. And where the views submitted for the elucidation of this report have reached the style of argument, it has been from the desire to make the engineering difficulties of this question, as affected by constitutional requirements, definitely and perfectly understood.

Any competent engineer of even ten years' practice in railroad-building, would have offered the same conclusions.

I have the honor of assuming that, if a statement were required from the scientific department to which the conduct of the Pacific railroad explorations was confided, it will not be found seriously to conflict with the conclusions herewith submitted.

CIRCUMSTANCES UNDER WHICH THIS RECONNAISSANCE WAS CONDUCTED.

The present reconnaissance was pursued as the result of the reconnaissance of the northern frontier Pacific railroad route, which extends from St. Paul, Minnesota, to Puget Sound. The extreme difficulties of that route gradually led to the necessity of seeking other location by detour, and eventually to the exploration of the present line.

This report may, therefore, be considered as offering a general recapitulation of the features of country between latitude 49 north and the Salt Lake City, and between the southernmost point of Lake Michigan and Puget Sound, regarding railway location *as affected by the peculiar character of the project of a railroad to the Pacific.*

The difficult nature of the western mountainous country traversed by the northern route had, in a measure, destroyed its character before reaching the Cascade Mountain range of the Pacific coast. It became necessary either to tunnel that mountain range at an almost impracticable pass, to procure passage to the ocean, or to surrender the line of direction, and to deflect so far towards the south as to pass through the great valley of the Columbia river. This detour south, which involved an increased distance of 140 miles, was at once decided to be the preferable line.

The valley of the Columbia was of remarkable nature; the waters of the interior had there perforated the great chain of the Sierra Nevada and Cascade Mountain range, and flowed to the ocean over the nearly level bed of a navigable stream. No engineer of practice in railway construction could fail to be impressed with the strength of the line. It was the only natural pass to the ocean from the great interior of the American continent. Danger from snow, a most formidable enemy to encounter upon the steep grades and in the deep cuttings of a mountain route, was wholly avoided. A navigable stream afforded means of transportation for weighty material. The work of construction could take place from the Pacific as well as from the Atlantic side of the continent. Large forces of laborers could be employed along the whole length of an open route, and speedily grade and perfect the road. And when the study of the question of detour reached the consideration of the merits of a rival route, then this great pass and valley became exponents in a discussion which destroyed all claims of the extreme northern frontier line to further attention. It occupied a position to command and unite the grandest interests, and to place such weight upon the scale of public opinion (fixed on the merits of all the national routes to the Pacific) as evidently to do much toward ruling the selection. Railroads from the southern waters of Lake Michigan were already in construction west, as the continuation of the great ramification of the net-work of iron which had so aided and developed the resources of the northern and middle States. All the important interests of those sections, and the capital invested in those lines, concentrated and fixed their united strength upon a route to the Pacific through a *healthy* country, practicable of solution as a problem, in the questions of construction which arose in the application of labor and the transportation of supplies. It was evident that the wealth and mineral resources of California first drew public attention to the question of a railway across the American continent. This project, aided so long by the labors of Whitney and his associates, received little encouragement until the immense trade of the gold regions, and the important interests therewith connected, added their strength to its development. Therefore, if but one road were constructed to the Pacific, it would seek the bay of San Francisco as a terminus.

But coeval with the growth of California had been that of the northwestern Territories. The great harbors of the Pacific were San Francisco and Puget Sound, of which the latter was the superior. There were seven hundred miles of coast between them. With a railroad from the east to San Francisco, it was evident that a short period of years would require the extension of a line up the coast to Puget Sound. But this was a local contingency; and how far preferable in first location was a road, the main trunk of which, extending from the mouth of the Platte toward the Salt Lake City, would there meet two great lines—one from the bay of San Francisco, the other by the valley of the Columbia from Puget Sound—resolving (by the mere choice of a location of the railroad to San Francisco) the extension of a road from the east to Puget Sound, to the mere completion of a branch road of eight hundred miles. In reviewing this matter, it will be seen, then, that the first step in the premises was an attempt to preserve the character of the northern line, already seriously affected by the severe nature of the rocky and mountainous country it had traversed, by a deflection south to the great valley of Columbia river, to avoid the necessity of tunnelling the Cascade mountains at a nearly impracticable pass. But the second step involved in the connexion was to waive all claims of the extreme northern route to notice, until a distinct route between Puget Sound and the southernmost waters of Lake Michigan was examined, that a comparison between the two routes, or broad divisions, might be instituted; and in the meantime to distinctly state to the nation that the primary object of the extreme northern exploration, which was the finding of a facile and favorable railroad route of minimum distance between eastern navigable waters and Puget Sound, had in a measure failed, having been surrendered to procure location. This was the plainest and most definite view of the question.

The superior and distinctive feature of an extreme northern route to the Pacific was the apparent short distance between the navigable waters of Lake Superior and Puget Sound. This distinctive feature was seriously modified by the fact that the harbors of Lake Superior were frozen or obstructed by ice during a large portion of the year; and that during that period a railway terminating so far to the north would debouche directly into foreign or Canadian roads, and being, therefore, more particularly the requirement of a foreign than a national interest, might more properly exist as developed by the investment of foreign rather than of American capital. This presumption was guarded against by the connexion of the northern route with the Mississippi river at St. Paul, Minnesota, and by direct connexion with railroads already constructed through central American territory at the southernmost point of Lake Michigan.

But the distinctive feature of the extreme northern route to Puget Sound, which was the shortest distance between termini, having been surrendered to procure location, the distance between the southern shore of Lake Michigan and the western terminus appeared no greater upon the southern than upon the northern route to Puget Sound.

It would not, then, be a warrantable procedure to extend a railway over the extreme northern route to Puget Sound, and so near an exposed frontier, unless it offered superior facilities for developing national territory, or for ready railway construction. But a line passing along the frontier was not in a position to develop national territory; and regarding railway construction, "nearly impracticable" obstacles had already directed examinations further south.

The last presentation of the problem was the engineering feature, and to this requisition the examination of the new route from Puget Sound to Lake Michigan was distinctly referred. In the development of this engineering requirement, the opportunity of a connexion with the great northern or central route to California was disclosed.

When the latter consideration came into the study, it concluded argument upon the subject, since it reduced the completion of a railroad to Puget Sound to the mere construction of a spur line from the vicinity of the South Pass to Puget Sound.

It will be seen, then, that the whole question had changed in its character, and, no longer presenting a certain paramount claim to notice, became affected by interests, in no degree subordinate, as engineering and national considerations were brought to bear upon it. The subject

of a railroad to Puget Sound no longer lay under the contingency of a terminus upon Lake Superior, or the distinctive claim of the shortest distance between termini, but became distinctly referrible to the location of a road to California—a proper view of the prospective development of the northwestern Territories tending to place the national route to California in a position to afford a favorable connexion to a branch railroad to Puget Sound; and the engineering requisition being reduced to finding a practicable line by which this important result might be accomplished.

But this information was needed at once—"prior to any final action of Congress on the Pacific railroad question," and without the delay of communicating with the East, or organizing a costly expedition; because, *should* a decision occur upon the Pacific railway question previous to such information being offered, the difficulties existing upon the extreme northern route would evidently defeat that project; and, should a railroad to California be placed too far south to favor a branch connexion, have a fatal effect upon the interests of the important northwestern Territories.

It therefore became necessary for some professional party to attempt this examination, without regard to preliminary formalities, and with sufficient faith in the good sense of the community to justify the reasonable expenditure required.

The whole experience of my professional life had been to demonstrate that the comparison of great divisions of country, regarding railway location, did not involve the costly equipment of ponderous expeditions, but really referred to the amount of information gained; and that the extension of a line of odometer distances and astronomical stations in the vicinity of a proposed Pacific railway route, although a highly important, was by no means an absolutely necessary procedure to obtain the features of the country regarding facilities for construction; that the general tendency or direction of a route might be preserved by minor observations, by the aid of which could likewise be pursued the important labor of reconnaissance.

It was also deeply impressed upon my mind, that the only result of the northern exploration in the examination of the entire western division,* extending from the Rocky mountains to Columbia river, had been a mere demonstration of what was needed in the premises; and although a ponderous and costly expedition had passed through that mountainous country, this result might be traced to the labors of a few small parties.

A like result (regarding only the railway question) could readily be secured, prior to the next session of Congress, upon the southern route.

Therefore, (under a unanimous vote of both branches of the legislature of Washington Territory,) I commenced an examination of the route by the Southern Pass on the 18th of March, 1854.

The party organized for conducting the exploration was very small. Three of the men accompanying me had already crossed the mountains with the northern expedition; two of these were soon disabled, and left at the agency of the Upper Umatilla river, during the first reconnaissance of the Blue Mountain range. Saddle horses were procured of the very first class, some of which were lightly packed with the mere necessaries of subsistence. Spare horses were driven loose, and reserved for side examinations. It was proposed to cover a wide extent of country by side-work; to limit the observations to mere railway statistics, and to leave the more elaborate delineations of surface to future survey, should the route prove highly practicable.

As the reconnaissance was conducted early in the season, when the soil was heavy with recent rains, and the weather severe in the mountain passes, and as the party passed directly through a hostile Indian country, its success must be attributed, in the one instance, to the manner in which the men were mounted and the number of spare horses provided; in the other, to the

* This has no reference to the labors of the coast division.

use of Indian presents, and to the habit of constantly seeking the hospitality of the Indian camps.

All examinations of reconnaissance upon the more northern exploration to Puget Sound had been connected with a base line, the position of which may hereafter be determined by instrumental observations. Those of which the present report is the result, were connected with the line of the great emigrant trail to Oregon and California, and with positions defined by topographical surveys.

A series of meteorological observations were conducted from Columbia river to the mouth of the Port Neuf river, (establishing the relative height of mountain passes and great planes of surface of the branch line,) but they were necessarily discontinued at the Port Neuf, from the breakage of the barometer with which they had been conducted. Near that point connexion is made with the observations taken by Fremont, which extend to Missouri river. I have already referred to the mere relative value of the barometric profile, as furnishing a lineal section with which side examinations can be connected. I am indebted to the patriotism of Dr. John Evans, geologist of Oregon and Washington Territories, for the furnishing of the instrument to which I allude, which, at the time of my departure, was the only barometer to be procured on the northwest coast.

I am also under obligations to the same able and scientific explorer for reliable information of the great valley of Snake river, north of the Blue Mountain range—information which proved of great service to me in expediting the progress of the reconnaissance.

REPORT.

Referring to the accompanying sketch for a delineation of the lines described, I will now report on the salient character of that portion of the important forked route to which I have repeatedly referred, which extends from Puget Sound to the plains of the Great Basin, and in a more general manner on the succeeding sections of the route between the plains of the Great Basin and the Mississippi river.

It will be readily understood that that portion of the route between Puget Sound and the plains of the Great Basin is the northern fork or branch of any central railroad to California.

In describing the lines of this first portion of the route, I will term the belt of country extending from Puget Sound to Fort Boisé (see sketch) the first division; and that extending from Fort Boisé, through Snake River valley, to the plains of the Great Basin, the second division.

From Seattle, on Puget Sound, to a point near the Dalles of Columbia river, all lines are common to both the northern (that of the 47th and 49th parallels) and the southern (that of the present report) routes to Puget Sound. From that point to the approaches of the Blue Mountain range on the river line (see sketch) to the Pass of the Walla-Walla, undulating grades of thirty-five (35) feet to the mile may be adopted to save work. The actual approach must be made at fifty (50) feet. In the continuation of the river line north of the Blue mountains, the approaches can be adjusted at forty (40) feet per mile, and some difference of grade be adopted to save work.

By the line from the vicinity of the Dalles, skirting the high country south (to avoid river bridges and severe cuttings of low summits near the Columbia) by detour and by "side-hill approach," the first rise from the river valley will probably require grades of not less than fifty (50) feet per mile. All work in the vicinity of the valley of the Columbia is of costly character; but on reaching the surface of the plateau, at the base of the Blue mountains, grades of thirty-five feet may be adopted. All these details of location will be studied in future survey, and the line chosen which shall seem best applicable to the summit of the pass and its approaches.

From the summit of the first Blue Mountain range, the whole country toward the south is distinctly visible. The connecting spur between the Blue mountains and the great Cascade range, near the source of the Des Chuttes or Fall river, appears perforated by the headwaters of that river, and presents a low depression in their vicinity. The line of detour to which I have last referred, (see sketch,) rising by the valley of the small stream near the Dalles, and skirting the mountain base, would develop some of the richest country in Upper Oregon, and, through the pass of the headwaters of the Des Chuttes, could make connexion with a route to California, by a descent to the plains of the Great Basin in a due southerly direction. The last-named route is not within the province of the present report. A line of such direct southern tendency should preferably pass west of the Cascades, and through Willamette valley and the gold regions of the coast.

A descent east from the pass of the Walla-Walla can be made by skirting the valley of the Grande Ronde river toward the south, and thence crossing the summit between the Grande Ronde and Powder rivers, by a system of curvature approach—the change of direction from a tangent of at least one thousand (1,000) feet—and the curvature of mile radii. The descent toward the waters of Powder river can be made by skirting the broken country south, (or nearer

the headwaters of that river,) which is the apparent location for a Grand Trunk road, assuming the most direct line between termini.

After crossing the summit between Grande Ronde and Powder rivers, the route can either skirt the base of the same hilly country toward the south, and which extends in an easterly direction to the valley of the Burnt river, or pass down the valley of Powder river to the Snake. Either location is practicable—the former the most direct, and the latter the least severe. The character of grade and curvature is favorable upon both, although continued rock-cuttings will occur near Burnt river upon the former, or southern line.

Both routes are designated upon the sketch.

The former, or southern route, can still skirt the mountain base, and, crossing Malheur river, six miles from its confluence with the Snake, preserve an easterly direction toward Fort Boisé and the broad valley of the Snake. The northern can keep the valley of the Snake, and by side-cutting gain a road-bed through this valley, which, in the immediate vicinity, does not offer so favorable facilities for railway construction as exist a few miles farther east. Either of these routes, hereafter assumed as a grand location line, will need care in adjustment, the engineering problem resolving itself into the "keeping up" of grade, or making facile descent from the pass at the head of the Walla-Walla, by skirting the Grande Ronde valley, and thence by skirting the broken and mountainous country south, avoiding too sudden and abrupt descents and ascents of the various water-drains of this mountainous country flowing toward the great valley of the Snake, and which occur in the crossings of the Powder, Burnt, and Malheur rivers.

Fifty miles of country, extending west from Burnt river, is severe, but of a nature which reducing the character of the line, by adjusting either steep gradients or sharp curvatures, cannot obviate. Fifty per cent. of the work is rock-cutting at short haul, spurs of ledges which cannot be avoided, but with no bad summit section. The work is so placed, that large forces of laborers could be applied to it. At prices of excavation in New York and the eastern States, this 50 miles of line could be readily reduced to gradients of 40 feet per mile, and a road-bed of 35 feet, (which admits of a first-class line, with double track of wide gauge, properly ballasted and drained,) at $100,000 per mile. This is the severe ledge section of the line east of Columbia valley, and extending to the Great Basin. The summit section of the Walla-Walla will undoubtedly prove deep ledge-cutting, and may require tunnelling, but its approaches are of 80 per cent. earth.

From the valley of Burnt river to Fort Boisé no great difficulties of location or construction will occur.

The route, by detour through Snake-river valley, would possess features of a decidedly more favorable character, as traversing a gravel surface. In reaching the country in the vicinity of the Powder river, the route north of the Blue Mountains would occupy common position with the most northerly of the lines upon the sketch, or continue down the valley of the Snake. Side-cutting would occur in the latter instance for a distance of twenty (20) miles, or would be avoided by forming a road-bed of the débris of the neighboring basaltic ledges, which are near the mouth of the Burnt river, and jut down upon the line. For the purpose of keeping a road elevated in approaching the higher plateau west of Fort Boisé, the line should encounter the ledge-cutting. This would render the road more expensive at the particular section, but would reduce cost in advance. No deep rock-cutting should occur upon a preliminary railroad. The line could be temporarily adjusted to make passage of this unfavorable point for first transportation to the interior, and, when the obstacle is reduced, the main route supersede the preliminary one.

The description of the second division of the route from Puget Sound to the plains of the Great Basin may be briefly summed up, as the extension of a line over a broad gravel surface, at merely nominal cost of grading, all questions of location being readily solved. The connexion between the southern plateau of Snake river and the valley of Bear river was obtained

by passing up the valley of the western fork of the Pannack river, and over prairie surface of clear gravel formation, to the waters of a small stream seeking an outlet in the Roseaux, or southern Malade, a tributary of Bear river. Three very practicable passes were examined in this vicinity; and of these, that to which I have first alluded is the superior. The character of the country, as ascertained by an examination of both the northern and southern bases of the northern rim of the Great Basin, admits the practicable passage of railway lines between Snake river and the Great Basin at numerous low passes dividing this range north and south. The topographical sketches of country in this vicinity, taken by the late survey of the Salt Lake basin, are very characteristic, and define its features with great fidelity. Passage can be readily made north and south, but is not so facile at angles to that direction. The lines are designated on the sketch. The technical description of the first division was entered into as affording information to future survey, and is of slight interest to unprofessional parties.

BLUE MOUNTAIN RANGE, AS CONNECTED WITH ABOVE DESCRIPTION OF LINES.

My exploration of the Blue Mountain range was first directed toward the headwaters of John Day's river (so called); and the approaches proving of more serious character than first anticipated, I was then led to confine myself to approaches of more practicable nature near the headwaters of the central fork of the Umatilla. To the latter pass, which is termed that of the Young Chief's Trail, I gave a very thorough and careful examination, from the result of which I am compelled to pronounce it impracticable for a *Pacific* railroad.

By barometric approximation, the summit of the Blue Mountains (the Young Chief's Trail) is 4,650 feet above the sea. Railway summit at head of lowest swamp, 4,393 feet above the sea; by the character of the "approaches" involving twelve (12) miles tunnelling, and continual water-drift.

When such obstacles (encountered at a distance from civilized communities) can be avoided by reasonable detour, no claim of direction should style them practicable in comparison.

This result affords no grounds for a judgment against the pass of the Walla-Walla, delineated on the sketch, which has been known for years as a low passage of the Blue Mountain range.

It is situated at the head of the numerous branches of the Walla-Walla river, and in the vicinity of the remarkable valley of the Grande Ronde.

It should be made the line of passage of these mountains by a main road, but I have proposed the extreme northern passage of the great valley of the Snake for a preliminary railway.

IN REFERENCE TO THE SELECTION OF A TERMINUS AT PUGET SOUND—FIRST SECTION OF LINE.

In recapitulation, I shall state the merits of these divisions regarding construction, dividing the first division into three distinct sections.

In reference to the choice of a terminus on Puget Sound, I will quote the language of Captain George B. McClellan, chief in charge of the western division of the northern exploration, a military engineer of practice and ability, whose opinion on the selection of a great harbor on an isolated coast, needing thorough protection by the erection of suitable fortifications, is entitled to more consideration than any which I could myself offer as a civilian. The opinion of Governor Stevens concurs with that of Captain McClellan; and the experience of both gentlemen in their peculiar branch of service places the selection beyond a question.

Captain McClellan states: "I have mentioned Seattle as the proper terminus for the road, whether it crosses the mountains by the main Yakima, or by the Columbia-river Pass. This place is situated on Elliot bay, and is by far superior to any harbor on the eastern shore of Puget Sound."

"Seattle is the nearest to the straits of Fuca. It is easily entered with any of the prevailing

winds; is secure from heavy seas, and has a most excellent holding-ground of blue clay, and a good depth of water—thirty fathoms. The banks are suitable for a town; the deep water comes so near the shore that but very short wharves will be required. Semi-bituminous coal can be found within fourteen (14) miles by water. The harbor can be defended by permanent fortifications."

From Seattle to Vancouver, a distance of one hundred and sixty-five (165) miles, (round numbers,) twenty-five (25) per cent. of all grading will consist of high prairie plains of light soil—embankments built by side-work in easy gravel shovelling. Fifty (50) per cent. of work, extended plateaux of heavily timbered country; low, wet surface; deep, black soil; embankments built by long haul, with gravel trains. Twenty-five (25) per cent. of work, undulating surface of equalized cut and fill; fifty (50) per cent. of the latter is ledge excavation at short haul; no deep cuttings; no gradients of over forty (40) feet per mile; curvatures of mile radii, readily located; minimum amount of masonry; stone suitable for rubble-work at Puget Sound. Brick clay reported in abundance, but not seen by engineer. More than average facilities for railway construction at reasonable cost.

FROM VANCOUVER TO THE DALLES OF THE COLUMBIA, A DISTANCE OF NINETY (90) MILES.

Not less than fifty (50) miles of heavy embankments exposed to the action of water in the great freshets of Columbia river; to be formed by borrowing, in the broken débris of basaltic ledges, a material abundant throughout the river valley; the weightier blocks to be placed at their natural slope upon the face of the embankment; forty (40) miles of equalized side-cuttings and embankments; the excavations averaging 70 per cent. of ledge. No gradient exceeding 15 feet per mile, unless at the discretion of the engineer. Curves of 2,000 feet radius, and a reverse within 200 feet of tangent point from intermediate straight line; or a tunnel of 700 feet at the mountainous point, termed Cape Horn, but avoided by preliminary road. Maximum amount of rough masonry: first-class bridge-masonry at a crossing of the Columbia, 1,200 feet in length; stone suitable for rubble-work, if combined with brick-work, may be procured in vicinity of line. Brick clay occurs in abundance in vicinity. A fine variety of mountain pine, suitable for all timber structure and tressel-work in vicinity of line. First step in grading, the construction of the road around the falls or cascades of the Columbia, to connect water transportation. The whole section of 90 miles to be assailed during first labors of grading, that supplies and material may be transported to the divisions of the interior. A severe and costly section, requiring the experience of first-class engineering faculty for proper reduction at reasonable outlay.

FROM THE DALLES OF THE COLUMBIA TO SNAKE RIVER, NEAR FORT BOISÉ—GENERAL APPROXIMATION OF FACILITIES FOR RAILWAY CONSTRUCTION OVER WHOLE DIVISION.

Fifty (50) per cent. fair gravel-work; equalized excavation and embankment, at reasonable average haul; 30 per cent. of ledge in side-cutting. Summit sections, 30 per cent. hard material; (loose rock and hard pan;) 20 per cent. of all gradients 50 feet per mile; room for reasonable adjustment of curvatures of 2,000 feet to one mile radius; abundance of first-class timber for all structures to vicinity of Powder river; brick clay in quantity near Powder river; abundance of boulders, affording suitable material for all minor masonry in vicinity of Grande Ronde and Powder rivers; granite in quantity near Burnt river; brick clay near Malheur river; at mouth of Malheur river fine granite suitable for masonry; near Fort Boisé excellent material for masonry in various localities; some timber, with facilities for boating or rafting, upon the great tributaries of the Snake river.

The western portion of this section affords fair opportunity for railway construction at reasonable cost. The problems of construction readily solved, experience in location being mainly required to give the line its best position over such broken, undulating country. Should the

line pass to Fort Boisé, by detour towards the north, through the valley of Snake river, gradients would be materially reduced, and this broken country, in a measure, avoided.

From Fort Boisé to the valley of Bear river, the route is of nearly uniform character. The line would traverse a high gravel or sand plateau, requiring mere nominal grading to prepare it for the rail. A few spurs of the hilly country towards the south extend toward Snake river, and can be encountered by the line, and reduced at low cost, or readily avoided. The changes in level are very gradual, and occur in broad terraces of many miles in extent, gradually rising toward the eastern mountains.

Brick clay occurs in quantity upon Katherine creek, (so-called.) The scarcity of wood in the vicinity would prevent its use; but the extension of a preliminary road over the broad surface of these level plateaux would transport all necessary material to any section required, at low cost. Sufficient timber exists in the vicinity of the line (a species of mountain fir upon the hilly country south, and stunted cedars upon all low summits) to allow the ready extension of a line of rail, by the laying of a cross-tie and rail upon the level surface.

This section preserves its character in approaching the summit of the dividing range between the waters of the Snake river and the Great Basin. The approach is very easy, and the summit itself is an elevated gravel plain. By gradually approaching along the mountain side—the position of which allows the adjustment of the line by regular curvature—this summit can undoubtedly be accomplished by a cutting of thirty (30) feet in gravel, and gradients not exceeding fifty (50) feet per mile. A preliminary line could be extended over it, without more excavation than necessary for the adjustment of the superstructure. The descent to the plains of the Great Basin is more difficult than the rise from the valley of Snake river. It may be readily accomplished, however, at low cost.

The whole country is open. From surrounding summits, the inclination towards the Pass and entire line of approach is distinctly visible. The route is remarkably favorable for railway location and construction. The chief difficulty to be apprehended, is from the scarcity of timber, both in the immediate vicinity of the Salt Lake, and over the whole section extending to Fort Boisé. This difficulty must be obviated by the use of a preliminary road; for the construction of which, suitable stone for masonry is found on the northern rim of the Great Basin. Timber occurs in average quantity in the mountains north of Snake river; for all the purposes of a preliminary line, it can be obtained in the vicinity of the route.

From the need of the construction of a preliminary road to complete any railroad to the Pacific within a reasonable time, I shall therefore state that this second division of the route, or section extending from Fort Boisé to Bear-river valley, or to the plains of the Great Basin, presents extraordinary facilities for the construction of a railroad at minimum cost; and that in the comparison of the engineering features of the lines from Puget Sound, in an easterly direction, to Bear river, upon this southern, with an equal distance upon the northern route, the advantage is immeasurably in favor of the southern line.

It may be reasonably affirmed, from this result of reconnaissance, that the extension of a railroad line from the Great Salt Lake City to Puget Sound, or from the route of a railroad from California to Puget Sound, is eminently practicable. The character of Columbia-river valley is severe; but it should be borne in mind that it is a pass or passage of the Sierra Nevada or Cascade mountains, and is therefore merely to be weighed in comparison with other passes, as incurred by all other lines. It is common to both the northern and southern routes to Puget Sound. It is the most severe section upon the southern, but by no means the worst section upon the extreme northern route.

I may observe, in this connexion, that the Grand Pass of the Yakima river, or the Snoqualmie Pass, to which so much attention has been given upon the northern exploration, is in far better direction in extending the southern than as a continuation of the northern route to Puget Sound. By a glance at the sketch, it will be observed as occupying a direct line from the Walla-Walla to that terminus.

Should future instrumental survey demonstrate the section to be more practicable than is now anticipated, it will be a source of pride and gratification with me to withdraw any expressions of opinion I have offered on the subject, and to claim the location thus developed as giving still greater character to the southern route to Puget Sound. It must necessarily appear, however, that during the excavation of the deep-rock cuttings and long tunnel of this summit, communication should be extended to the interior; and I should most emphatically advise the development of the Columbia valley, by cheap railway facilities, to afford such communication. The cheap or rough railway to be extended to the interior by detour from direction north of the Blue mountains, and through the Snake-river valley, to the extensive plateaux east of those mountains—solving the problem of construction at low cost, and existing for the period of years required to construct the more direct route of the Walla-Walla and Powder rivers, as a full solution of the Pacific railway problem.

CONNEXION OF BRANCH ROUTES, AS ABOVE DESCRIBED, WITH THE VARIOUS CENTRAL ROUTES TO CALIFORNIA.

Connexion can alone occur with the straight route of the 38th and 39th parallels from St. Louis to California, (that advocated by Colonel Benton,) by extending the branch line from Puget Sound along the eastern shore of the Great Salt lake, and by the line of the Mormon settlements to the vicinity of Little Utah valley—an entire distance, in round numbers, of 1,200 miles from Puget Sound.

Should the Pacific line reach California through the Bridger's Pass, the connexion of the branch road could take place on the plains of the Great Basin near Salt Lake City, by a route of 1,050 miles from Puget Sound.

But should the line to California adopt the route of the South Pass, a line might be adopted which would afford opportunity for the connexion of the branch road to Puget Sound by a route of 875 miles. In the latter instance, the Pacific project would be restricted to reasonable limits, and to the least cost in first outlay which will afford results desired.

My estimate of the cost of a branch line will be confined to the intermediate length of line of 1,050 miles.

ESTIMATES OF COST.

All approximated estimates of cost upon the route from Puget Sound, *via* the South Pass, to the Mississippi river, must necessarily be confined to the branch road from Puget Sound to the plains of the Great Basin—the continuation of the reconnaissance toward the Missouri not being of a character to admit of more than a very general statement of the features of the section passed over. This general study of the route is, however, fully sufficient to demonstrate its merits regarding facility of construction as a railroad line, as compared with the more northern route. The material of excavation, readiness of reaching mountain sections, character of surface, &c., &c., will appear in a general comparison herewith given.

No estimate of the cost of a Pacific railroad can be deemed reliable, from the remarkable contingencies which must inevitably occur during the consummation of the project, and serve to defeat what may at present appear quite warrantable conclusions on the nature of the question and the cost of the road.

I resolve the whole question of the construction of a railroad to the Pacific, in present estimates, to the mere extension of a railroad to the Pacific, of unelaborated character and of medium equipment; *not in broken, or temporary working sections,* but actually making connexion between eastern lines of similar gauge, and eastern water transportation, and a Pacific terminus. The connexion with terminus, and the passage of trains, without breaking bulk, along the whole line of the road, giving greater character to the conviction I have so often directly expressed,

that the construction of a preliminary line will lead to the most effective solution of the question in its manifold relations.

When contiguous to settlements, and under due prospect of remuneration from way business, this line need not necessarily be confined to a preliminary character; over no section encountered in the passage of the continent, necessarily confined to any peculiar character or class, save as under attendant liabilities; and, while always subject to the principle of expansion, or of elaboration, as circumstances shall direct, still never surrendering the obvious necessity of the earliest practicable connexion of termini.

Should the passage of the great obstacles to railway transit—by the channels perforated through them by the act of nature, in the flowage of the waters of the interior to the ocean—be prevented for a few weeks by the freshets of the mountains, it is still assumed, in this estimate, that the use of the rail eleven (11) months of the year, during the long period while these obstacles are being overcome by the means of transportation thus afforded to supplies, laborers, and all needed appliances, will still prove a remarkable desideratum in the early consummation of the project.

Although in a detailed estimate of the cost of the northern route to Puget Sound, I submitted, by direction of Gov. Stevens, what my experience in railway construction then led me to believe would prove a close approximation to the cost of a Grand Trunk line to the Pacific, of the class of the present day, subsequent experience of the late crises in a railway mania of the country has demonstrated to me the fallacy of submitting any estimate of eventual costs of a Grand Trunk line of two thousand (2,000) miles, extending through an uncivilized country, and fully elaborated, equipped, and furnished—when built under a system of competition, hazardous speculation, inadequate application of cash capital, and as affected by discursive attempts at the construction of several Grand Trunk lines.

But a road of rough class, admitting the passage of weighty trains, and reaching the Puget Sound terminus by practicable detour, can be completed from *the waters of Missouri river to Seattle, on Puget Sound, for fifty millions* ($50,000,000)* *of dollars* in cash capital, actually expended on the construction and equipment of the road.

The following estimate for the branch road of one thousand and fifty (1,050) miles embraces a larger sum per mile, from the better class of line proposed over certain portions of the route—as probably required by adequate way business, and as more economically accomplished if attempted at the outset:

From Seattle to Vancouver, on the lower Columbia, a distance of one hundred and sixty-five (165) miles, facilities existing for cheap construction, a preliminary line of better class than would be attempted in the far interior, with a rail of sixty (60) lbs. per yard, or structure of corresponding strength, and reasonable reduction of surface, erection of rough masonry, &c., at the present prices of the Pacific coast	$4,125,000
From Vancouver to the Dalles, a distance of ninety (90) miles, and including a passage of the Great Cascade mountain chain—a line of rail of sixty (60) lbs. per yard, secured by mechanical appliances, and admitting the passage of a locomotive engine and train without breaking bulk—the temporary road-bed of ledge debris covered with water, and unserviceable during the freshets of the Columbia.	3,150,000
From the Dalles to the plateau surface at northern base of Blue mountains, including bridge of Columbia, and approach to upper plateau surface from lower level of Columbia valley, one hundred and fifty (150) miles	4,500,000
Passage of Snake-river valley plateau and cañons, a distance, in round numbers, of two hundred (200) miles, some portions of line unserviceable during the spring	

* With all contingencies; depreciation, workage, management, inadequate appropriations in broken sums, credits, &c., say $75,000,000.

freshets of Snake river, involving some preparation of rough surface to use best route of descent to Boisé, but with long stretches of level gravel plains..... $6,000,000

From Fort Boisé to the Great Basin, including passage of the Pannack, by practicable detour—say five hundred (500) miles, over gravel plateau..... 9,000,000

For general approximation, say eleven hundred (1,100) miles of road from Seattle, on Puget Sound, to the plains of the Great Basin..... 26,775,000

As connected with a railroad line to California, by the South Pass and valleys of the Snake and Pannack rivers, the branch road would be subject to a reduction, in cost, of about four millions of dollars.

In the above estimates an addition of fifty (50) miles, at average cost, has been made for contingencies and probable deflections in locating a preliminary road.

CONTINUATION OF RECONNAISSANCE TO MISSOURI RIVER.

The route just described is, as heretofore stated, the northern branch of a forked route, the main stem of which extends from the plains of the Great Basin to Missouri river. The southern fork of this route, and the main trunk or stem, is termed, in the reports of the Pacific explorations, the route of the 42d parallel. Two of the lines of the route of the 42d parallel respectively extend—the one through the South, the other through the Bridger's Pass of the Rocky mountains. I consider the choice between, or selection from, these two lines, the most important and interesting of the many engineering details connected with the adoption of the line of a central railroad to California. This is especially the case, if the selection is to be guided by a determination to reduce the whole question of a railroad to the Pacific to the construction of such a sort of military railroad as shall reach the Pacific coast within seven (7) years.

The statements of the Introduction to this Synopsis will now have their weight, and simplify the final engineering presumption of that paper—that Congress should hesitate to do more, at the present time, than aid the construction of those first sections of the Pacific railroad lines contiguous to the States; aiding the first sections of routes of undulating surfaces, with reference to the needs of civilization and way-transportation, if deemed constitutional, by land-grants; but aiding the two lines of plateau surface, extending over broad plains, with a view of the earliest practicable connexion of termini.

The following reasons are offered for arriving at such definite conclusions in reference to the route of the 42d parallel:

The first section of this route is the line of approach to both the South and Bridger's Passes of the Rocky mountains.

The examinations of these passes have been confined to reconnaissances, and have not yet been verified by survey.

By reference to the sketch, it will be seen that a dotted line is carried from the South Pass, in a northwesterly direction, to the head-waters of the Snake. This line (so far as examined) extends over a broad gravel plateau; a flat sand-plain, interspersed with swamps and ponds of brackish water. The South Pass is nothing but an extended plain, slightly broken towards the south into an undulating country. It is the first break down of the Great Wind River mountains at the north, among which is a summit of over 12,000 feet above the sea. In this plain, and among these ponds and swamps, head the waters of the tributaries of the Grand Colorado, the Snake, and the Platte. The engineering rule—in seeking location over broad belts of surface between termini which extend at angles to the direction of great watercourses—is to skirt the country in which they head, or to pass over the lower delta where they have deposited, in broad terraces, the earth from the deep channels excavated by their flowage, rather than to adopt the intermediate region, broken by their transit. Reconnaissances for the loca-

tion of Pacific railroads only differ from those of minor lines as the broad divisions of a continent differ from the limited sections of the county and the State, and as the choice of routes is affected by the claims and contingencies of construction, brought forward by the extreme length of line to be traversed, in the wear of the road during deferred connexion of termini.

The inclinations of gradients are affected by the character and length of the approach, as much (in general terms only) as by the elevation of the summit to be overcome.

A line which reaches, by the long inclined surface of the Platte valley and the Sweetwater, the level plains of the South Pass, and thence, without surrendering height accomplished, passes over the gradual slope toward the west of the valley of the Snake, and thence, by the low pass of the Pannack, reaches the plains of the Great Basin, necessarily avoids the steep grades induced by a descent into the great valley of the Colorado, (see route 39th parallel, and in less degree 42d parallel,) and the subsequent rise over and descent from the Wahsatch mountains, to the plains of the Great Basin. The intermediate country, broken by the passage of water, is avoided by detour.

Therefore, were this surface of the swamps and sand-plains of the Great South Pass not at so great an elevation above the sea as to place it near the regions of perpetual snows, the argument would be unanswerable regarding its selection in reference to the extension of a preliminary road. This is an evident conclusion, because *the engineering requisition to be answered* is, the finding of a continued line of flat or slightly inclined surface, over which a rail may be extended to the Pacific within seven years.

But if the preliminary road traverse the plateau of the South Pass, and the long flat line of country beyond it, fully 7,400 feet above the sea, it would be exposed to the inevitable dangers and embarrassments of this elevated region, regarding snow and frosts.

To expedite preliminary arrangements, it has been proposed to use the natural surface (where of gravel or sand substrata) without grading.

Over the South Pass this could only take place during half the year. But in a more deferred mode of extension, the facile line of approach to the South Pass will permit, by the adoption of steeper gradients, of the erection of an embankment road-bed, which will in some measure guard against the obstacle of snow. Even an open structure, through which snow would drift, and over which trains could pass, might thus be adopted, or (with the surface road) a covered way under which trains could make transit. But in reference to snow, the elevation of the summits of the broken and undulating surface in the vicinity of the Bridger's Pass, are but slightly below that of the flat plains of the South Pass. The excavation of cuttings and the erection of culverts and bridges for the passage of water, would there unquestionably postpone communication, and in a measure prevent the earliest use of the carrying road. Again, every railroad employee knows the difference between a cutting and an open road, regarding embarrassments from snow. The mountaineers of this section state that they can travel over the plains of the South Pass in winters, when the gorges of the more southern Bridger's Pass line are filled with snow and impracticable of passage.

Early communication is the desideratum, and this is resolved to the most rapid extension of a preliminary railroad. Therefore, in view of the extension of a similar line as a winter road over the sand-plains of the extreme southern frontier route to California, I should give the preference to the route by the detour of the South Pass. Notwithstanding some increase of distance and of the cost of rails, it would probably be less expensive than the other, and would sooner reach the plains of Snake river and the Great Basin, and carry supplies for a working section across those plains.

But returning to the engineering presumption first submitted, we might more reasonably infer that, from the difficulty of arriving at a conclusion at the present time, this question of choice between two lines of a route should be left open. It should be determined by future examinations during the construction of that first section of the line of the emigrant road, which is the grand approach to both the South and Bridger's Passes of the mountains; although, to

prevent postponement and delay, the construction of the first section should most certainly not be compelled to await the solution of this engineering question.

The line of the South Pass, as connected with the northern detour, was only developed by my reconnaissance of the branch route from Puget Sound. Since my arrival in the States, I had proposed making, at my own expense, a thorough examination of this and the dotted line of the sketch which extends north of Snake river; but learning that it was the intention of the War Department to send an exploring party over it, I abandoned the idea of a private expedition, and offered my services to go with a small party in advance of the exploration, and aid its progress by the rapid service of preliminary reconnaissance, which, from my knowledge of the country and of the needs of the line, I thought might prove serviceable.

Between the South Pass and the eastern slope of the Black Hills, (so called,) the preliminary line would in some instances be confined to the narrow, but by no means costly, passage of the Sweetwater river, while the main route would necessarily adopt a more direct location. The whole section is of favorable character. In the adjacent mountains excellent timber can be readily procured, and first-class material for masonry exists contiguous to either line. The earth excavation is in clear gravel, of that superior quality which best preserves superstructure from the effects of severe and sudden changes of temperature, and frosts, and which gives the most perfect drainage when formed into a road-bed. Reaching the valley of the Platte, all difficulties of location cease, and a broad bottom land, falling at scarcely perceptible inclination to the very banks of the Missouri, and overlaying a substratum of clear gravel or sand, offers every facility for cheap construction.

This broad surface of bottom land breaks toward the north into ranges of low sand-hills. Clear streams flow from these low summits at irregular intervals of distance; and from the facility with which their waters can be delivered at sufficient elevation above the rail for the use of locomotives, will prove of great value to the line; the turbid waters of the Platte not being so well suited to that important purpose. In the edge of these sand-hills, and beyond all danger of freshets, a preliminary road can be extended towards the mountains.

Stone of medium quality occurs upon the Platte, and at the junction of the line with the Missouri.

I am compelled to state, however, that, with all its attendant advantages, the route through the valley of the Platte labors under what may be termed a peculiar objection to any railway line to the Pacific. Two hundred (200) miles of the distance between the first broken country and the Missouri is entirely destitute of timber, and the remaining portion but sparsely wooded with the cotton. The waters of the river are broken by sand-bars, which would probably prevent rafting from the mountains. This peculiar feature of the line should be especially regarded, from the fact that the State of Iowa, which is the eastern terminus of the route, is also scantily timbered, and that the whole upper valley of the Missouri can give but slight aid in the connexion. The northern route labored under difficulties of a similar character in its passage to the mountains, but, by changing the location after the liability was developed by reconnaissance, it may now be readily overcome by the construction of the road over the detour line of Little Falls.

A line from a point on the Mississippi opposite the mouth of St. Croix river, and extending to the Missouri near the mouth of the Platte, would deliver the superior timber of northern Minnesota and Wisconsin at the debouche of the present line, and provide the great Territories of Nebraska and Kansas with the lumber of which they are so deficient, and which the whole upper valley of the Missouri does not afford. The want of timber upon the Platte does not extend to the deficiency of fuel for locomotives. Coal of excellent quality abounds upon the Northern Platte, and evidently underlies the whole eastern portion of the routes. Less bulky than wood, it is easily transported.

Sufficient timber is now growing in the Missouri valley, and near the lower waters of the Platte, to admit of the immediate extension of a preliminary road; and, in event of its con-

struction, operations should be commenced by which the fertile country in the vicinity should be made susceptible of improvement in this respect.

The mere suspension of the prairie fires will tend to the object; but well-instituted experiments have demonstrated that several varieties of timber are readily grown from the seed upon the western prairies, and that a period of ten years is sufficient to make their results available. In connexion with the estimate of the northern route, I have been compelled to propose the planting of twenty-four thousand (24,000) acres of surface, for the mere purpose of making steam, with an additional surface of ten thousand (10,000) acres for fires in depot buildings. If such tedious operations are to be attempted, the location, climate, soil, &c., are abundantly preferable for the purpose upon the present line.

The coal-beds of western Iowa, and of the whole great section near the base of the mountains, with the existing probability of abundant supplies beneath the intervening surface, are of great importance in sustaining the character of the present route, by removing all absolute necessity of planting timber for the mere purposes of fuel.

The reduction of coal to coke for the use of locomotives may be readily attempted at those points where the raw material is abundant in deposit. The yield of the present variety would average about two-thirds of the weight of coal.

The erection of coke ovens in the vicinity of the coal district will reduce cost of transportation; and the reduction of coal to coke, which is peculiarly adapted to making steam, will prove the better economy.

The use of coke is not common in America, from the abundance of wood at the numerous way stations of all inland lines.

Experiments have been conducted upon several of the best eastern roads on the use of coal in locomotive furnaces. Engines have been constructed for the purpose of carrying out the results thus obtained; but, although demonstrated as practicable, the burning of coal for the purpose of making steam has not hitherto been thought an economical procedure. Any direct need or necessity of such an application would undoubtedly lead to its immediate accomplishment.*

A favorable bridge-crossing of the Missouri occurs at a point a few miles north of the mouth of Platte river, at the old ferry of the Indian trading-post, and adjacent to the present Omaha Indian Mission. Other crossings of the Missouri are practicable, both north and south of that point. A Grand Trunk line, assuming the most direct route from the first pass of the Sweetwater to the present bridge-crossing of the Mississippi, can procure a position farther north; and that of a route avoiding the great eastern bend of the Platte can readily be adjusted farther south.

The whole subject will be fully solved by the numerous surveys of private lines seeking connexion with the great road to the Pacific; and, in this respect, the eastern terminus of the route, which the present report embraces, might properly be located at the head of Grand Island, near Fort Kearney, where all roads of local character can make connexion with it.

REVIEW OF NORTHERN AND SOUTHERN ROUTES TO PUGET SOUND.

As I have passed over both the northern and the southern routes to Puget Sound, a brief review of their relative characteristics is not out of place. As connecting with eastern lines now

* "COAL *vs.* WOOD IN LOCOMOTIVES.—The Boston and Lowell Railroad Company have lately been making a trial with one of their locomotives of the relative value of wood and coal for fuel. The result of the trial is reported as follows: The whole distance run was 2,366 miles, of which 1,868 miles were with freight, using one cord of wood in 26 miles, or 68 cords, at $7—amounting to $476; and 598 miles, with passengers, using one cord of wood in 30 miles—amounting to $199 51. Total expense of working by the use of wood, $615 51. The expense of running the same distance with coal, at the rate of $6 50 per ton, (the cost in Boston,) amounted to $265 46; being a saving in favor of coal of $350 05, or above one-half. This is quite an item."—*Lowell News*, 1855.

Since the completion of this report, experiments made on the Illinois Central Railroad the present year (1856) have solved this question; coal is proved more economical than wood, and will now come into general use as fuel for locomotives.

completed, they are of about equal length. The crossing of the Mississippi is already accomplished upon at least one line, extending towards Chicago upon the southern, while upon the northern it is yet to be completed. The crossing of the Missouri is yet to be attempted on the southern, while on the northern it is wholly avoided. On the northern, the crossings of the Marais, Sun, and Teton rivers, which are problems in engineering, are (as combined) more difficult than the bridging of the Missouri. The crossings of these rivers cannot be avoided by a preliminary line, and occur on the northern route before reaching the mountains. That of the Missouri river need not be attempted by the preliminary road at all. If the line of detour of the northern route, by Little Falls, is adopted—which will necessarily occur from the great needs of construction on the inland sections regarding timber—a quite elaborate process of building must take place ere the extension of a preliminary road can occur. From Little Falls to the plateau Bois des Sioux, the country "is broken and springy, needing a large increase of culvert masonry and ballasting throughout." Thence, after reaching the Great Cheyenne river of the north, the fine country of northwestern Minnesota is of broken and undulating surface, over which a constant reduction of minor summits must inevitably occur. The erection of masonry must take place, and excavations and embankments of equalized work be used in reducing a rolling country to practicable gradients. The substratum of this grand section, against which the waters of the Missouri are thrown, and turned back or directed toward the south, is of gravel and clay admixture partaking of the nature of hard-pan. It is costly of reduction, and, when placed in road-bed, must be ballasted. The need of ballasting is imperative in making use of the rail over such material, when exposed to the action of severe frosts and sudden changes of temperature. In contradistinction, the southern route traverses a gravel plain, upon which the rail can be placed without any tedious operations. By the use of practicable curvatures to avoid minor obstacles, which a locomotive engine cannot readily accomplish, loaded trains can probably pass to the broad surface west of the mountains. They can certainly pass, with very slight reduction, directly to the mountains, and, as over the main stem of both the California and Oregon routes, aid the construction of both lines west without delay. The obstructions to the navigation of the Missouri will not practicably prevent water transportation to Westport, or to the mouth of the Platte, for the southern line, but during eight months in the year will interfere with building the northern by water carriage.

The difference in the cost of constructing two first-class lines of the present day over these routes—say of two thousand (2,000) miles each—would not probably range less than twenty-five millions (25,000,000) of dollars in favor of the southern. It lies chiefly in the difference of moving the loose gravel and sand of the southern road, which, at eastern prices, can be readily accomplished (including hauling) at fifteen (15) cents per cubic yard, and of moving the harder material, with an admixture of clay and large pebbles, in some instances verging on hard-pan, and in all instances so closely packed as to require picking, of the northern route. The latter class of excavation is worth, at eastern prices, twenty-five (25) cents per cubic yard, and also requires the large additional cost of transporting clean gravel and sand very long distances for ballasting, or for the formation of a road-bed.

The difference also consists in the amount of excavation. In the one instance, the line being confined to elevated plateaux, where an excellent quality of loose, clear gravel, thrown in from side-ditches, and dressed two (2) feet above the surrounding surface, is sufficient for the rail; in the other, as passing over the before-mentioned undulating or broken surface, requiring continued cart-work and culvert masonry at long haul. Some of the best portions of the northern line (through Milk-river valley, for instance) extend over a level river bottom; but the road is prevented using such advantages by reason of spring freshets, which cause the necessity of more than double the amount of work to elevate the grade far above the surrounding surface.

In the mountain sections the difference is extreme; the severe work on the southern route being confined to a limited section, and upon the northern extending through nearly imprac-

ticable gorges. In the general grade of the roads, when completed, the preference is with the northern; that is, if the descent west from Cadot's Pass can be accomplished by side-hill location, which by great care in adjustment may occur. In sudden changes of direction, and sharp rates of curvature, both regular and reversed, the advantage is immeasurably with the southern. In practicability of repair, it is entirely with the southern. The danger of demolishment being with the northern—the latter, very great in its passage of Blackfoot and Bitter Root rivers.

In time of construction, the advantage is entirely with the southern line; immeasurably so, in the extension of a preliminary road; fully so, in the completion of a Grand Trunk line. It arises from the occurrence of continual ledge-cuttings upon the northern, where circumstances will prevent the employment of large numbers of laborers, and where the character of the work is a single face and long haul, and from the greater length of the time required for excavating rock. Both the northern and southern routes to Puget Sound possess an undeniable advantage over all other Pacific roads, with the exception of the extreme southern line—at least, over all lines encountering the Sierra Nevada mountain range—from the fact that upon these routes the line of rail may be extended from both the Atlantic and Pacific sides of the continent at one and the same time, reducing the season of opening the line of communication nearly one-half, and the cost of distributing materials for construction in nearly an equal degree. I refer to the passage of the Columbia valley, already reduced to a low grade by the action of nature.

The twenty-five (25) millions difference in cost between the northern and southern lines would construct a branch road, of medium character, from the point of junction with the California route to Puget Sound. Therefore, this question resolves itself into the following presentation: By adopting a line to California located so far north as to admit of the connexion of the branch-road to Puget Sound, the amount required to construct the spur to Puget Sound becomes a clear profit. This deduction being obvious if the northern, the line of extreme cost, were to have been adopted to Puget Sound, and a distinct route built to California.

The construction of a Pacific railroad by aid to private parties, is alone within the limits of a rigid interpretation of the powers of the constitution, when the development of what must necessarily appear a project is confined to the mere completion of a road of unelaborated character, as a means of military defence, or is confined to such length of route in local sections as to remove from it the character of an experiment. But as a means of military defence, a railroad should not pass along an exposed frontier, where it would necessarily incur the hazard of needing protection by augmentation of the standing army.

It would seem that the resolution of this project, north of latitude thirty-nine, to the construction of a line of reasonable cost, touching at the important way-station of Salt Lake City, with a main trunk extending to California, and a northern branch reaching Puget Sound, through the Grand Level Pass of Columbia valley, was the presentation of the question as a mere national undertaking in its salient points, as connecting and defending isolated territory at minimum cost. Even as an experiment, (if such an experiment is to be made,) by passing over the great route of emigration to Salt Lake City, Oregon, and California, developing the Territory of Nebraska, through the great valley of a river entirely unnavigable, admitting an important connexion through Kansas, with Westport and St. Louis, while solving the question of Indian defence by the transportation of troops and supplies, at a few days' notice, to the far interior, it would seem that the building of the first section of a railway, at the low sum of twenty-two thousand five hundred ($22,500) dollars per mile, (see Introduction,) might be deemed a warrantable undertaking, were it never to extend beyond the mountains. But should this line then pass to the valley of Snake river, and at length reach Puget Sound, transport the supplies of western commerce toward the east, grow up commercial emporiums at that

western terminus, and defend and develop the isolated Territories of the north, it would in itself exist as a solution of the Pacific railway problem.

Yet, traversing broad gravel plateaux, both east and west of the dividing range, if attempted in a proper manner, it must speedily reach its destination, and the important spur through the low pass of the Pannack be as rapidly pushed to the base of the Sierra Nevada, and the vicinity of those severe and costly works which should be at once undertaken at the favorable point for a passage to California. At the mere nominal outlay of its construction, even for national defence, such a road might be deemed a *necessity*—the cheapest and the best means of restraining the savage tribes, and providing facilities of approach to the Pacific, the very knowledge of which would prevent the aggressions of an enemy.

For when, by the aid of the genius of American engineers, even the Autocrat of Russia unites his extended possessions by the construction of military railroads, it is a suggestion to the policy of a free people, whether they do not hesitate too long in adopting that means of rapid communication, which will continue to confine the military operations of the country to their present simple and effective character. Forts and standing armies were once deemed national means of protection, but now methods of defence may be made the causes of aggrandizement.

When a city is the growth of a year, and the passage of an ocean but a fortnight—when the newsboy cries the morning message of the telegraph, and the aged man is whirled through space by the flight of the locomotive—when the farthest settlements of a mighty nation are still the children of one great republic, indivisible and forever to be united—then, as I have already stated, and will continue to assert, the military road can no longer be deemed the passage of a hill-side, or the crossing of a river; but it must become the means of rapidly moving the suddenly organized forces of that volunteer soldiery which have made the wars of America immortal, to the utmost verge of her remotest borders. How important, then, should become the choice of location for such a road, and of what paramount consideration all that shall tend toward the expediency of constructing it—its prospect of remuneration to private, its means of augmentation to public interests, its opportunities for cheap grading and for early reaching its destination.

I have already shown that, by the proper location of the branch road from the Missouri, or from Grand island to the St. Peter's, the Upper Mississippi and St. Croix, northern Minnesota and Wisconsin may be drained of their rich lumber upon the line of this southern and grand central route, aid in its construction, and find a market for a valuable home product absolutely needed in Nebraska, Kansas, and Utah. This branch road would eventually reach Lake Superior. Again, should the great interests of the Canadas persist in their efforts to construct a distinct Pacific railroad along the northern frontier, either north of the severe mountainous country of Washington Territory, or by the route of the United States northern governmental expedition, as it is now proposed, to secure the trade of the Pacific ocean to the valley of the St. Lawrence—then the Northwestern railway, from Chicago to the Great Bend of the Missouri, would drain a portion of the traffic of this line toward central American territory; and it is certainly more expedient to build a Minnesotian American railway, to tap the carrying trade of a British Pacific road, than to build an American road over nearly impracticable mountain ranges, to be drained of its business, on reaching level country, by a British line.

For this reason, the aiding of the construction of a local railroad from Chicago, *via* St. Paul, on the route of the northern exploration, is worthy of the direct notice of government. Such a road would develop a section as fertile as any other of the public domain. It would connect the waters of the great Red River of the North with the Mississippi; it would carry the lumber of eastern Minnesota to the grand unpenetrated divisions of the northern bison ranges, and furnish the means of extending a hardy population to the very limits of the cultivable eastern sections. This road would extend over a rough surface, but, in developing this rich agricultural country, could progress as fast as required by the needs of the civilization which would keep pace with it.

The aiding in a different manner of the first section of the main stem of the Platte Valley line, or, as regarding the surface passed over, in reference to more rapid extension, would resolve this question to its salient points, north of latitude 39.

Finishing, then, the comparison of these two great routes to Puget Sound, I will conclude by remarking that, while the impracticable nature of the western mountains shuts the northern route from the Pacific terminus, it was the very facility of connexion with the Pacific that first gave character to the southern. While the one passes along exposed frontier for a distance of fifteen hundred miles, and in direct vicinity of a great navigable river, the other becomes, for over half its length, the main trunk of a more important road through central American territory which is entirely undeveloped. The one has been reduced to a local; the other is still a national requirement. Upon the one, facilities for communication can only exist by artificial means; upon the other, they are already abundant by the act of nature. The lumber of the north is needed in the south; connexion with the west is claimed by the east. The northern route affords neither, and the southern route offers both. I claim, then, the question for the southern.

REMARKS.

No elaboration in office of the rough data of field reconnaissance can entitle them to be regarded as the results of survey.

The profile of the map transmitted, although comparing favorably with that of other routes, does not delineate the actual railroad line.

When the preferable route of a Pacific Railroad is selected, by the comparisons of reconnaissance, the location line of that route will be placed, by careful instrumental survey, and it may then be accurately delineated; but the lineal section of barometric levels, with which the side examinations of reconnaissance have been connected, must not be supposed to occupy that position. Presented as the profile of a route, when *not* accurately placed, it will lead to erroneous conclusions on its merits; and even *when* accurately placed, the mere approximations of the instrument used do not furnish a result regarding time nor undulations of surface. Again, from the small scale on which a profile of two thousand (2,000) miles of line must be presented, the remarkable differences between the flat plain over which the rail may be used without grading, and the broken country, which needs costly and tedious operations for reduction to grade, are not perceptible.

Two examples may be given:

The height of the Pass of the Walla-Walla, (Blue mountains,) compared with the level of the Grande Ronde valley, both measured by Colonel Fremont, on the common emigrant wagon-trail to Oregon, would show it as impracticable for a railroad; yet, the approach to that pass, by the side-hill location—afforded for over forty (40) miles, by which the grade of the road is "*kept up*" and never allowed to descend to the level of the Grande Ronde valley at all—shows the fallacy of presenting the profile of the wagon-road as that of a railroad line. Again, in the second instance, a profile of the extreme northern route would show (on paper) a flat, or slightly inclined surface, approaching the Rocky mountains on the east, and descending from them on the west; whereas, in reality, of the country on the east, the greater part of the line is undulating and of slopes, over which the locomotive engine cannot pass without grading. On the west, the line shown on the profile would appear of facile gradients; while, on the contrary, from being confined to almost impracticable mountain gorges, to adopt such gradients the road must absolutely lie in the beds of torrents, where occur freshets of thirty (30) feet in height. The barometric profile is serviceable in showing the relative height above the sea of the grand divisions of the route, as follows:

The plateau at the western base of Blue mountains, a point to which the South Pass line is readily brought by gradients of (in excess) 50 feet per mile is above the sea	3,426 feet.
Thence by the northern detour line, say	4,000 "
By eastern approach to Blue mountains, Pass of Walla-Walla, side-hill line	4,112 "
General level of first grand plateau of Snake river	3,050 "
Second grand plateau	4,201 "
Mouth of Port Neuf	4,409 "
Summit of line of rail at South Pass	7,490 "
Plains of Great Basin, southern connexion line	4,200 "
Level of general eastern approach, through the valley of Sweetwater river, to South Pass	5,000 "
Fort Laramie, Missouri river	1,280 "

These heights as above the sea, in proportion to the lengths of route, (not given) are in excess. It would be entirely out of place to apply the equation of grade by maximum loads to the ascents and descents of this route, as compared with the northern route. The northern route is emphatically a line of ascents and descents; of undulating grades, which are not shown by the data of preliminary reconnaissance, but would (with full through traffic) materially add to the working length of the road. It would be preposterous to apply such equations to the profile of the emigrant wagon-road, or make the profile of the wagon-road the basis of a detailed estimate.

CONCLUSION.

The broken falls and rapids of the Snake river, near the mouth of the Salmon (see sketch), were measured by the barometer.

The water falls 328 feet in a distance of 15 miles.

At about (by the river) sixty-five (65) miles above these falls occur those of the Shoshonees (so called). They have been rarely visited by white men. At a distance of 12 miles, a white column may be seen in the plain, resembling the smoke of a fire. The sound of falling water is heard at a greater distance. The bed of the river is six hundred and twenty (620) feet below the surrounding level country. The water flows in a contracted channel of about four hundred (400) feet. The sides of the ravine are nearly perpendicular. The fall is one hundred and eighty-five (185) feet, and is slightly broken at a point fifty (50) feet from the upper level. Five hundred (500) yards from the foot of the fall occur rapids of eighteen (18) feet.

The height of the American Falls, near Fort Hall, is fifty-four (54) feet.

The exploration would have been still more extended, had the party retained its first effective organization. Of the whole number of men who accompanied me from Oregon, but a single individual arrived with me at the Missouri river. This individual, Mr. J. F. Moffet, had conducted the meteorological observations of the extreme northern expedition. He gave his attention to the same duty under the more trying circumstances of the recent exploration. He was a native of Virginia. He had educated himself from the proceeds of his own industry; studied as a lawyer, and was admitted to the bar of Washington Territory. In the performance of his last patriotic service, his system received a shock from which it never recovered; and he died, of the privations incident to a passage of the continent without the comforts of a train, after his arrival at Missouri river.*

I am indebted to Mr. R. R. Thompson, Indian agent of the Umatilla; Mr. J. T. Jeffreys, of

* Mr. Moffet left a small family unprovided for. If the exposure and hardships of the frontier citizens of America are of too common occurrence to gain public attention, the exemplary conduct and resolution of this gentleman, ending only with his life, are entitled to this passing notice.

Oregon, and Captain Hector McArthur, late Hudson Bay factor near Fort Hall, for valuable assistance. Leaving my own tired party and worn-out horses in camp, Captain McArthur accompanied me, with a single half-breed, in a long reconnaissance of the numerous passes of the upper rim of the Great Basin during many days' forced marches in hostile Indian country, and continued exposure to violent storms of snow and sleet.

I take this public method of acknowledging my obligations to the officers of the military stations of Vancouver and the Dalles for the courtesy and assistance received from them in organizing the expedition.

All of which is respectfully submitted by

FRED. W. LANDER.
Civil Engineer.

WASHINGTON, *July* 21, 1856.

[This Report has been revised since its first transmission to the War Department.]