BRIDGE FOR THE HUDSON.

THE BOARD FAVORS A 3,100-FOOT SPAN SUSPENSION BRIDGE.

A Plan Worked Out in Detail and Submitted for Such a Structure, with Six Tracks, Which the Board of Engineers Appointed by the Secretary of War Declares Would Meet Every Possible Demand and Be Absolutely Safe, and Could Be Built for $35,000,000—A Cantilever Bridge, with 2,000 Feet Span and a Pier in the Centre of the River, Would Be Safe and Practicable and Would Cost About $27,000,000—A 3,100-foot Span Cantilever from Shore to Shore Could Be Built and Would Be Safe, but Is Impracticable on Account of the Great Cost.

WASHINGTON, Sept. 1.—The report of the New York and New Jersey Bridge Board to Secretary Lamont was made public to-day. It is as follows:

NEW YORK, Aug. 23, 1894.

The Hon. Daniel S. Lamont, Secretary of War, Washington, D. C.

SIR: The Board of Bridge Engineers appointed by the President under the act of Congress, approved June 7, 1894, authorizing the New York and New Jersey Bridge Companies to construct a bridge across the Hudson River, met at the Army building, New York city, Monday, June 25.

Your Board began the examination of the question submitted to them and gave it careful and continuous consideration up to the present time. They have held twenty-nine regular meetings.

The duties of your Board as prescribed by the act are to "recommend what length of span, not less than two thousand feet, would be safe and practicable for a railroad bridge to be constructed over said river." The act provides that this bridge "shall not be located below Fifty-ninth street, New York city, nor above Sixty-ninth street, New York city." Your Board, therefore, understand their duties to be to recommend what length of span, not less than two thousand feet, would be safe and practicable for a railroad bridge to be constructed over the Hudson River between Fifty-ninth and Sixty-ninth streets in the city of New York.

In making comparative estimates, your Board selected a location midway between Fifty-ninth and Sixtieth streets, but the differences between this location and one further north within the limits of the act has been considered so far as it affects the general conclusions.

The minimum length of span which may be considered is 2,000 feet, which your Board has interpreted as meaning 2,000 feet in the clear. The maximum length of span would be a clear span between the pier head lines, this distance varying from 3,130 feet at Fifty-ninth street to 3,080 feet at Sixty-ninth street.

The objections which have been raised to a pier in the river apply with equal force to any pier located between the end of a 2,000 feet span and the pier headline, the pier being objected to as interfering with the use of the river for harbor purposes rather than for through navigation. The plan submitted to your Board have located the 2,000-foot span in accordance with the requirements of the New York charter, next to the New York pier headline, thus placing the west pier about 1,000 feet from the New Jersey pier headline. If the span is increased beyond 2,000 feet any injury done to the harbor by obstructing the approach to piers on the New Jersey shore would be greater than any benefit gained by increased width of channel span. Your Board has considered that navigation would not be benefited by making a span of greater length than 2,000 feet, unless such span could reach from pier headline to pier headline. They have therefore confined their examination to a span of 2,000 feet in the clear, as compared with such single plan. It must be noted, however, that the pier headlines are artificial and are subject to change under existing laws. The width between pier headlines at this location is about 400 feet greater than at a point two miles below. A small encroachment beyond these pierheads could be permitted without essential harm; it would obstruct navigation no more than a vessel lying across the head of a pier. A span of 3,100 feet in the clear would meet all the requirements of a single span.

The plans submitted by the bridge companies provide for a cantilever bridge carrying six railroad tracks. This number of tracks is the least that has been proposed by any company which has contemplated bridging the Hudson River opposite the city of New York. Your Board have therefore thought it right to make estimates for a bridge furnishing this accommodation. The fact that the river must be kept unobstructed during erection limits the plans to cantilever and suspension bridges. The plans submitted by the bridge companies provide for a steel cantilever bridge, a description of which is given in appendix B: A cantilever bridge is a rigid structure, subject to those changes of shape only which are due to strains; it is well adapted to railroad uses.

In the first place your Board are of the unanimous opinion that a cantilever span 3,100 feet in the clear could be built and would be a safe structure.

In the second place your Board has considered that the practicability of such a structure would depend upon its cost, and to determine this practicability has made comparative estimates of the cost of two cantilever bridges with clear spans of 2,000 feet and 3,100 feet, respectively. These estimates are comparative rather than absolute; the benefit of doubt, where any exists, has been given to the longer span. The estimates include both substructure and superstructure, but have been made in round numbers and do not include the cost of tracks and other features which would be common to both plans.

A series of borings, covering virtually the limits permitted by the act, have been made by the bridge companies, under the direction of Mr. C. B. Brush, C. E., at the request of your Board, to determine the character of the bottom of the river. These borings have found rock at varying depths, but as the borings were not extended into the rock, the absolute information before your Board is that no rock exists above the reported elevation rather than that solid rock exists below it; but your Board have considered themselves justified in assuming that it is a substantial rock, suitable for foundations. The borings outside of the limits of the special line considered have confirmed the accuracy of the others.

The depth to rock is about 125 feet at each pier headline; it is about 260 feet at the site where the pier of the 2,000-feet span bridge would come; the rock rises rapidly from each pier headline shoreward. The depth of water at the site of the river pier is about 50 feet. Under the water is a layer of mud or silt about 100 feet deep. Below this mud is a fine sand, filled with fresh water under a pressure exceeding the head due to its depth.

The mud or silt is not a suitable material for the foundation of the bridge piers. For the comparatively moderate weights carried by bridges of usual dimensions, the sand would be a suitable foundation. For the extraordinary weights and dimensions of the bridge authorized by the act, your Board is not satisfied that the piers would be safe unless founded on rock, and the comparative estimates have been made for rock foundations.

The lateral provisions to resist wind, and the longitudinal provisions for stability during erection, require a considerable base. The plans submitted by the bridge companies proposed to use a pier consisting of four cylinders placed 200 feet between centres in each direction. The total erection, including the effects of wind pressure, carried on each cylinder is estimated at 25,000 tons.

In proportioning these piers your Board has found it necessary to adopt limits of stress. They have based their estimates on the supposition that the pressure between the metallic bedplates and the top of the masonry should not exceed twenty tons to the square foot, and that the pressure within the masonry and on the foundation should nowhere exceed ten tons to the square foot. They consider, however, that in determining these pressures the weight of the material displaced should be deducted. The weight of masonry per cubic foot was taken at 150 pounds in air, at 87 pounds in water, and 50 pounds in mud, and at 30 pounds in sand. While these pressures have been exceeded in some structures, they are higher than usual practice, and call for masonry of good quality and more than ordinary cost.

Your Board have assumed that the masonry would finish fifty feet above water, and have estimated the cost of these piers, including excavation and sinking, at $1 per cubic foot above a plane 125 feet below water, and have added eight mills to this for each additional foot of depth.

2,000 FEET CLEAR SPAN CANTILEVER.

The east pier of the bridge, with a clear span of 2,000 feet, would be immediately back of the New York pier headline, where the rock is 125 feet below mean high water. The west pier would come in the river, where the rock is 260 feet below mean high water. The east anchorage would be within the shore line, where the rock is not more than 20 feet below mean high water, and the west anchorage would be immediately west of the New Jersey pier headline, where the rock is 125 feet below mean high water. The site of the west anchorage calls for an anchorage span 100 feet long, as shown on the plans submitted by the bridge companies.

The east pier would consist of four cylinders, each containing 866,000 cubic feet, and costing, on the basis given above, $866,000, making for the four cylinders $3,464,000.

At the site of the west pier the average depth of rock is not less than 260 feet. A foundation carried to rock here would be nearly 100 feet deeper than any foundation which has ever been put in. Such a foundation involves very careful consideration, and your Board believes that the additional price allowed for so much of the work as is more than 125 feet below water is none too large. Each of the four cylinders would contain 1,880,000 cubic feet, of which 1,014,000 would be more than 125 feet below water, making the cost of each cylinder $2,427,500 and the cost of the four cylinders $9,710,000.

The east anchorage pier would be founded on rock about 20 feet below mean high water, and the west pier on rock 125 feet below water. Each of these piers should be estimated on the basis of a pier finishing 150 feet above high water, 20 feet thick, and 100 feet long on top, built with a batter of one in twenty, and founded on a caisson 40 by 120 feet for the east pier, and 45 by 125 feet for the west pier. Taking the cost of the work above water at seventy-five cents per cubic foot, and of the work below water at $1, the cost of the east pier becomes $431,000, and that of the west pier $1,038,000. The cost of the substructure for the bridge with the 2,000 foot pier span would be:

East anchorage	$431,000
East pier	3,464,000
West pier	9,710,000
West anchorage	1,038,000
Total	$14,431,000

A careful estimate prepared by the bridge companies makes the weight of the superstructure 230,000,000 pounds, including the main span, the towers, and the two anchorage spans, covering a total length of 4,120 feet. This weight has been checked and may be taken as approximately correct. The plan was prepared for a location at Seventy-second street, where the distance between pier headlines is 3,070 feet. At Fifty-ninth street the west anchorage span would be lengthened 100 feet, and if the bridge is kept symmetrical the whole length will be increased to 4,320 feet and the total weight to about 240,000,000 pounds. This estimate is based on a moving load of 3,000 pounds per foot of track and on maximum working stresses of from 20,000 to 22,500 pounds per square inch, or about one-third of the ultimate strength of the material; 240,000,000 pounds, at 4½ cents per pound, would cost $10,800,000. The cost of this bridge would then be $25,443,000.

This is the cost of a cantilever bridge of the minimum span which your Board is authorized to consider, the length of the entire structure from anchorage to anchorage being 4,320 feet. As this plan of bridge is the one which the New York and New Jersey bridge companies have selected as the bridge they wish to build, its cost must be accepted for present purposes as the cost of a practical structure.

3,100 FEET CLEAR SPAN CANTILEVER.

The site of the east pier for the span of 3,100 feet in the clear would be the same as that for the 2,000-foot span; the site of the west pier would be the same as that of the west anchorage for the 2,000-foot span. Both piers would be founded at practically the same depth, or 125 feet below mean high water.

The weight of the trusses of the long span would be about three times the weight of those of the short span, and the weight of the floor and moving load would be about one and a half times that of the short span. The total reaction on the piers would be at least two and one-half times that of the short span. On this supposition each of the four cylinders would have to carry 62,500 tons.

The piers in both bridges are so large that their volume can be proportioned directly to the weights they have to carry. This would make the volume of each pier of the 3,100 foot span bridge two and one-half times that of the east pier of the 2,000 foot span bridge. The estimated cost of the east pier of the 2,000 foot span bridge was $3,464,000, so that we may estimate the cost of each of the two piers of the 3,100 foot span bridge at $8,660,000.

The anchorage piers required for the long span bridge need be little larger above the water level than for the shorter span. The anchorage pier on the east side would be on rock about twenty feet below mean high water; its cost would be about the same as that for the 2,000-foot span. The anchorage pier on the west side would be on rock forty feet below mean high water and is estimated to cost $527,000. The total cost of the substructure for the 3,100 feet clear span bridge would then be:

East anchorage	$431,000
East pier	8,660,000
West pier	8,660,000
West anchorage	527,000
Total	$18,278,000

Estimates by this Board show that the weight of the superstructure of this bridge would be approximately 730,000,000 pounds, about three times that of the shorter span bridge. Seven hundred and thirty million pounds at four and one-half cents per pound is $32,850,000.

The total cost of the 3,100-foot span bridge, covering a length of 6,100 feet from anchorage to anchorage, may therefore be estimated at $51,128,000, though this estimate is probably too low.

The estimated cost of the 2,000-foot span bridge was $25,443,000 for 4,320 feet. To bring it into proper comparison with the longer span bridge, 1,780 feet of viaduct must be added. Estimating this viaduct at $1,000 a foot, the cost becomes $27,223,000. The estimated cost of the long span cantilever bridge is $23,905,000 more than this amount. Your Board is of the opinion that the additional cost of the long span cantilever bridge is so great that it must be considered impracticable.

SUSPENSION BRIDGE.

A suspension bridge is another possible form of construction at this location. Like the cantilever, it can be erected without false work; unlike the cantilever, it has not generally been considered well adapted to railroad uses. It has less rigidity than the cantilever, and deflects more from the combined effect of temperature and load. The flexibility of the cables tends to cause vertical undulations of the platform under a moving load, which are more objectionable for a railroad bridge than for a highway bridge, where the live load is less concentrated and is applied less rapidly. These objections lessen in importance as the span of the bridge and the proportion of the dead to the live load increase.

In a bridge with six independent tracks the condition of railroad service approaches that of highway service, and the position of trains which will produce a maximum disturbance would be of very rare occurrence. The inclination of the platform longitudinally and transversely, arising from the undulations of the cables under the effect of moving trains, can be reduced within unobjectionable limits by a proper system of stiffening; the effect of wind on cables and platform can be taken care of by cradling the cables, and by a lateral system of bracing in the platform similar to that used in truss bridges. A single railroad track suspension bridge of 850 feet span has been in continuous use, under restrictions of load and speed, for nearly forty years at Niagara. With this example before us, a six-track railroad suspension bridge of 3,100 feet clear span cannot be dismissed without careful consideration.

Your Board has therefore investigated such suspension bridge with great care, and it is its opinion that it could be built and that it would be a safe structure. As this opinion may be thought a departure from general opinion as to the adaptability of the suspension bridge to railroad service, it is proper that the Board should state their reasons therefore, and explain the features of the plan adopted by them for a comparative estimate in more details than was done for the cantilever plans.

The essential differences between a cantilever and a suspension bridge are: First, that in the place of compression chords of the cantilever we have land anchorages built of eye bars and masonry; second, in place of the tension chords of the cantilever we have cables built of wire of a superior grade of metal; third, in place of the web bracing of the cantilever we have a composite system of suspenders and stiffeners.

No question can be raised as to the safe and permanent character of the anchorages if built with a sufficient factor of resistance and proper provisions for thorough protection of the anchor chains against rusting. They have the advantage over the compression chords of the cantilever, that their weight is supported directly on the ground instead of forming a part of the dead load to be carried.

As regards safety and efficiency, the wire cables are fully equal to the eye bar chords, if built with the same margin of strength. Experience shows that they can be effectively protected against rusting by wire wrapping and painting. Wire at least three times as strong as eye bar steel is a merchantable article, and cables made of this wire have the advantage over eye bar chords of less weight to be carried by the superstructure.

The objections made to suspension bridges arise only from the third difference. It is often claimed that a sufficient degree of rigidity cannot be secured for railroad purposes, and that the stiffening members cannot be properly proportioned, owing to the uncertainty which exists in the intensity of stresses due to changes of temperature and elastic deformation in the composite system. The Board has given careful consideration to these objections and believes that for practical purposes they are met in the plan selected.

Three principal methods have been employed to secure greater rigidity in suspension bridges: First, by inclined stays extending from the top of the towers to the platform. This system was advocated and applied extensively by the late John A. Roebling. Second, by trussing the cables either with straight chords, as in the Point Bridge at Pittsburgh, or by a system of braces between two cables, as proposed by Mr. G. Lindenthal for his projected North River bridge. Third, by a stiffening girder fastened to the platform and extending from one tower to the other. This system is a feature common to nearly all suspension bridges, but has seldom been applied in the most approved form to give the best results. The first method is at best incomplete, as a stiffening truss must be used for the middle half of the span. The second method might prove the most economical, but its application to wire cables is still untried. Your Board has therefore selected the third method, that of the stiffening truss.

The suspension bridge which your Board has selected for this location would consist of a single span of 3,200 feet between saddles, thus giving about 3,100 feet in the clear, the two towers being located at the pier headlines and the cables being carried in straight lines from the top of the towers to the anchorages, making equal angles on each side of the towers. This form of bridge has no side spans, but the tracks would be carried on viaducts between the towers and the anchorages. While the use of cables outside the towers to sustain side spans is generally considered economical, the arrangement selected gives the least length of cable and reduces deflection from strains and temperature to a minimum.

The two towers would be located in practically the same position as the towers of the 3,100-foot cantilever. The substructure would be of masonry, finishing at the same height as the masonry of the cantilever bridge piers. The towers themselves would be of steel, and would be 570 feet high from top of masonry to saddles, or 620 feet from surface of water. For towers of this height there is no question of the economy and expediency of using metallic construction. The anchorages would be of masonry, each located about 1,000 feet back of the towers. Both towers and anchorages would have to be founded on rock.

The cables would be of wire, and the plans have been based on cable containing about 6,000 No. 3 wires (0.259 inches in diameter). Wiremakers are prepared to furnish a wire of this size, of the guaranteed strength of 180,000 pounds per square inch, at moderate prices, and a much stronger wire at a higher price. Your Board has adopted as the unit stress on cables made of straight wire of this character 60,000 pounds per square inch of one-third of the breaking stress, this being the same proportion of the ultimate strength that the 20,000 pounds adopted in the cantilever structure bears to the probable strength of eyebar steel.

Your Board has estimated on a versed sine of 400 feet or one-eighth of the span. In the East River bridge the versed sine is less than one-twelfth of the span, and about the same as in other long span suspension bridges. In the East River bridge the cables are of steel wire and the towers of masonry. With the introduction of steel towers the economical proportions are changed, and it becomes practicable to adopt a greater versed sine than has hitherto been considered wise.

Stiffening Truss.—There are several admissible forms of stiffening truss. To justify the particular form selected by the Board for their estimate it is proper to give a short explanation of its duties and mode of action.

A stiffening truss is a girder supported by the cable and extending from one tower to the other. It is fastened to the platform at the several points of suspension to the cables, and it may be fastened to the towers in two ways; it may be held in the vertical direction, anchored down as well as supported, and acting as a girder resting on two supports, or it may be fastened also in the horizontal direction, acting as a girder fixed at the ends. The Board has confined itself to the first case, which has the advantage of greater simplicity in computation of stresses without material sacrifice of economy.

The function of a stiffening girder is to distribute a load covering only a part of the span over the entire span. If this function could be performed without any deformation of the girder, the distribution would be perfect, and the symmetrical shape of the cables would be preserved, but as the girder deflects under the load that it carries, it exerts, through the suspenders, a downward pull on the cables as far as the load extends, and beyond that point the cable exerts a pull upward on the girder. If it is continuous it will take the shape of a reverse curve, with its point of contra-flexure at the end of the load. The strain in all the suspenders will be uniform for the whole length of span. The weight to be carried by the loaded portion of the stiffening truss will be the moving load upon it, less that carried by the suspenders. The suspenders over the unloaded portion, where the cable tends to rise, are strained by the resistance of the stiffening truss against flexure upward. The weight per unit of length carried by the suspenders will always be equal to the live weight per unit multiplied by the length of load and divided by the length of span. Over the loaded portion this is the actual weight per unit of length, less the portion carried by the stiffening truss. Over the unloaded portion this represents the upward pull resisted by the stiffening truss. The upward force per unit of length which tends to lift the unloaded portion is therefore the assumed weight per unit multiplied by the length of load and divided by the length of span. The weight per unit of length carried by the stiffening truss on the loaded portion is the total weight per unit of length, less that weight multiplied by length of load and divided by length of span.

When one-half of the span is loaded the weight will be equally divided between suspenders and stiffening truss; the stresses in the chords of the stiffening truss will be one-eighth those caused by the same load extending over the whole length of the span if the truss were not supported by suspenders.

The greatest stresses occur in the continuous stiffening truss when either two-thirds or one-third of the span is loaded. In the former case the loaded portion must carry one-third of the load, and the chord stresses at the middle of that two-thirds will be 4-27 of the maximum stresses at the centre of the span if the truss were fully loaded and not supported by suspenders; in the latter case the chord stresses at the centre of the loaded portion will be only 2-27, while the chord stresses at the centre of the unloaded portion will be the 4-27, but reversed. As the two-thirds load may be placed anywhere in the truss, it follows that the chord stresses over the whole central third may be 4-27 of the maximum stress at centre of span, if the truss were fully loaded and not supported by suspenders. The shearing stresses in the webs of the stiffening truss are determined by the same distribution of loads.

It must be remembered that the only stresses in the stiffening truss are those due to moving load, all dead weight being carried directly by the suspenders to the cables.

While this is the simplest explanation of the duties of the stiffening truss, it does not take into consideration all elements. The downward and upward deflection of the stiffening truss must be accompanied by corresponding changes in the shapes of the cables, but as these changes are in the direction in which the cables would move if no stiffening truss existed, it follows that the weight is not distributed equally among all the suspenders, and the stiffening truss is relieved of resisting so much inequality as is taken by the cables. The elongation of the suspenders is also a slight element of disturbance, but not sufficient to be described here. An analysis of it will be found in Appendix E.

There are two other strains which the chords of the stiffening truss may be called upon to resist. The first of these is due to the deflection of the cables under temperature and under load. As the stiffening truss is not supposed to carry any of its own weight, it must deflect with the deflection of the cables, and this deflection must be accompanied by the transfer of a portion of its own weight to itself with corresponding stresses in its chords, these chord strains being determined entirely by their deflection. The other additional stress is due to wind pressure if the chords of the stiffening truss are made the chords of the lateral system as in ordinary truss bridges.

The greater the depth of truss the less the chord stresses due to its stiffening duty, and the greater the stresses due to deflection of cables. The wind stresses depend on the horizontal distance between the two trusses.

To avoid the strains due to deflection of cables the stiffening truss may be hinged at the centre, which can be done by cutting one chord and putting a pin joint in the other. This arrangement fixes the point of contrary flexure at the centre of the span under all conditions of load, and leaves the stiffening truss free to rise and fall with changes of deflection in the cables without additional strain. As the bending stresses at the centre are now eliminated, the only function of the pin joint will be to transfer the shearing stresses. With the introduction of the hinge and the fixing of the point of contrary flexure, the work of the stiffening truss is modified and the investigation becomes more complicated; it is given in Appendix E. The truss still equalizes the weight on all the suspenders, but the total weight carried by the suspenders is equal to the whole moving load only when that load covers one-half the span. The greater chord stresses in either direction occur at a distance equal to 0.234 of the span from each end, and will be 0.1500 of the maximum stresses at centre of a continuous span if the truss were fully loaded and not supported by suspenders.

The maximum chord stress in the hinged truss is therefore 1.017 times that in the continuous truss, but it is a maximum only at two points instead of over one-third the span.

The continuous truss is better adapted to resist wind than the hinged truss, but its chords have to bear the additional stress due to deflection. As the hinged truss is practicable and more economical than the other, it has been used in the estimates made by your Board.

The form which your Board has selected for a stiffening truss is a riveted lattice girder 120 feet deep, the two trusses being placed 100 feet between centres. The web members are all inclined at an angle of 45 degrees, and are in eight systems, so that the truss is divided into 30-foot panels, and the unsupported length of each web member is about 21 feet. The floor beams are hung from the suspenders and carry the stiffening truss, the weight of which is never entirely overcome by the action of the moving load. The top lateral system is a comparatively light riveted lattice. The whole lateral work to resist wind pressure is done by the bottom lateral system, in which the floor beams form lateral struts and the diagonals are strained in tension. Cross bracing is provided at every panel point to sustain the floor beams at their centres and to transfer wind pressure to the bottom chord, the pull of this cross bracing being resisted by the top lateral system.

Proportioning the trusses for a moving load of 3,000 pounds per foot on each of the side tracks, the maximum chord stress at the centre of the half span would be 14,481,400 pounds, and the maximum chord stress in the bottom chord at the centre, taken on the basis of a wind pressure of 2,000 pounds per lineal foot, would be 25,600,000 pounds. As the chords are subject to reversal of strains, your Board have limited the stresses in the chords due to moving load to 12,500 pounds per square inch in each direction, making an extreme variation of 25,000 pounds, but have allowed the stresses from the combined effects of moving load and wind to run up to 22,500 pounds, believing that with the arrangement of cradled cables hereinafter described the wind strains will never be anything like what should be estimated on. They have also estimated on the chord sections never being less than 400 square inches. With these conditions the average section of the bottom chord becomes 900 square inches, and that of the top chord 905 square inches, the two averaging 950 square inches. Allowing 25 per cent. excess for details, the average weight of each chord will be 4,037.5 pounds per lineal foot.

The average shear in the web system will be 3,000,000 pounds, in addition to which the web system has to do a duty in transferring weight from the upper to the lower chord equivalent to a shear of 1,300,000 pounds per lineal foot, making the total duty of each web equivalent to an average shear of 4,300,000 pounds.

If the web is proportioned on the basis of 12,500 pounds per square inch, with an allowance of 50 per cent. for details and connections, the weight of each web becomes 3,509 pounds per lineal foot.

The calculated weight of the top laterals is 500 pounds per lineal foot. The calculated weight of the bottom laterals, on the basis of 25,000 pounds stress per square inch, with an allowance of 25 per cent. for details, is 1,150 pounds per lineal foot, making total weight of laterals 1,650 pounds per lineal foot.

The floor beams weigh 90,000 pounds each, or 3,000 pounds per lineal foot of bridge. The stringers weigh 1,800 pounds per lineal foot of bridge. Floor beams and stringers are proportioned for a consolidated locomotive, weighing, with tender, 104 tons. The total weight of the suspended superstructure per lineal foot may then be taken as follows:

Four chords, at 4,037.5 pounds	16,150 pounds
Two webs, at 3,509 pounds	7,018 pounds
Laterals	1,650 pounds
Cross frames and hangers	1,920 pounds
Floor beams	3,000 pounds
Stringers	1,800 pounds
Total steel per lineal foot	31,538 pounds

This amounts to 100,921,600 pounds for the 3,200 feet of span. If to this we add 2,400 pounds weight of the ties and rails and 18,000 pounds for moving load, we have as the total weight carried by the suspenders 51,938 pounds, or 26 tons per lineal foot.

This stiffening truss is a very different structure from the stiffening truss of any existing bridge. It is what it purports to be, a stiffening truss, with a heavy floor system like that used in the cantilever design, and with stiff connections throughout. This stiffening truss, 3,200 feet long, with its floor system, weighs two-fifths as much as the entire 4,320 feet of steel work of the 2,000-foot cantilever bridge.

Suspenders.—The suspenders would be either wire ropes or cables of straight wires like the main cable. They have been proportioned on the basis of a stress of 30,000 pounds per square inch of section, and on this basis, with an allowance of 20 per cent. for connections, will weigh 1,425 pounds per lineal foot, making the whole weight transferred to the cables 53,363 pounds. The suspenders weigh 4,560,000 pounds for the 3,200 feet.

Cables.—The average weight of the cables will be 14,792 pounds per lineal foot of bridge. The total weight to be carried by the cables may therefore be taken at 63,100 pounds per lineal foot, amounting to 217,920,000 pounds, or 109,000 tons for the span of 3,200 feet. The versed sine assumed is 400 feet, or one-eighth of the span. The greatest strain in the cables will be next to the saddles, and will be equal to the weight carried multiplied by 1.118, amounting to 243,724,000 pounds, which, at 60,000 pounds per square inch, will require 4,062 square inches. Six thousand No. 3 wires have a total area of 316 square inches. The 4,062 square inches may be divided into twelve cables of 338.5 inches each. Your board believes that these cables can be constructed now as easily as those of the East River Bridge were at the time it was built.

The arrangement of cables which has seemed most feasible to your Board, and which has been used for the basis of these estimates, places six cables on each side, the cables being twenty feet apart on top of towers, the two cables next to the centre on each side being in vertical planes, and the other cables cradled into planes which intersect in the lines of the pins which sustain the floor beams. A separate suspender reaches from each pin to every cable, the suspenders being in the same planes as the cables.

Vertically the cradling of the outside cables is 100 feet in a height of 460 feet, or one in 4.6. Horizontally it is 100 feet in a total length of 3,200 feet, so that the horizontal cradling of the two outside cables is 200 feet in 3,200 feet, or one in 16. A sufficient cradling is obtained not only to resist the entire wind pressure on the cables, but to relieve the lateral system very materially. The distance between the cables will favor simultaneous construction. The suspenders at each point will be of uniform length and will pull together. The length of the suspenders at the centre of the span must be enough to allow the cables to clear each other where the attachment is made, and this places the lowest parts of the cables sixty feet above the pins. The total height of the towers above high water is made up as follows:

	Feet.
Clearance required by law	150
Camber	10
Shortest suspender	60
Versed sine	400
Total	620

The total length of each cable from anchorage to anchorage is 5,600 feet. The weight of each of the twelve cables per lineal foot of cable, including wrapping, is 1,183 pounds. The weight of the twelve cables is 14,200 pounds per lineal foot and the total weight of the cables 79,647,800 pounds.

Towers.—The weight transferred by the cables to each tower is 218,000 pounds. The towers are 570 feet high from top of masonry to saddles. As these towers are only in compression and the members so large that they may be treated as short compression members, a stress of 20,000 pounds per square inch at the top is permissible. This requires 10,900 square inches of section. The weight of each tower, with an allowance of eighty per cent. for details and connection would be 38,023,500 pounds, or 76,047,000 pounds for both towers. The total weight to be carried on the lower part of the tower would be 128,000 tons, making a pressure of less than 24,000 pounds per square inch at the base of the steel columns, which will be very slightly increased by the wind pressure and by the horizontal deflections at the top of the towers if the saddles do not move freely.

Anchor Chains.—The cables are carried in straight lines from the saddles to the anchorages, each anchorage being on two parts, each part anchoring the six cables in its side of the bridge. The upward pull of the cables at each anchorage (one side) is 54,500,000 pounds, and the horizontal pull 109,000,000 pounds. The estimates have been made on the basis of connecting the cables with the anchor bars outside of the masonry of the anchorage, placing these anchor bars in tunnels, and connecting them with bearing plates at the lower ends. Everything would be accessible for care and repairs. The chains would be of steel-eye bars, which have been proportioned for a stress of 20,000 pounds per square inch, with an allowance of 20 per cent. for details. The estimated weight of the bars and pins in each of the four half anchorages is 6,825,000 pounds, while the plates at the bottom would add 600,000 pounds to this amount, making the total weight in each half anchorage 7,425,000 pounds, or 29,700,000 pounds in the four.

Structural Steel.—In estimating the cost of the structural steel work your Board used the same price per pound as for the work in the cantilever bridge, namely 4½ cents. On this basis the cost would be as follows:

Suspended superstructure	100,921,600 pounds
Towers	76,047,000 pounds
Chains	27,300,000 pounds
Anchor plates	2,400,000 pounds
Structural steel	206,668,600 pounds
At 4½ cents	$9,300,087

The majority of the Board believes that this price is too high, owing to the difference in character of steel work in the two structures, and that the total cost of the structural steel work should not be estimated higher than $8,500,000.

Wirework.—The cables and suspenders have been estimated at 8 cents per pound, making their cost:

Cables	(pounds) 79,647,800
Suspenders	" 4,560,000
Total wire	pounds 84,207,800
At 8 cents	$6,736,624

Superstructure.—The total cost of the superstructure is $16,036,711, on the basis of 4½ cents for all structural steel.

Substructure.—The substructure would consist of two anchorages and the bases for two towers. Each tower base has to carry the following weights:

Suspended weight on top of tower	109,000 tons
Tower	19,000 tons
Extra effect of wind	4,000 tons
Total	132,000 tons

Each of the tower bases of the 2,000 feet cantilever bridge carries 100 tons. In both cases the foundations can be made proportional to the weight carried. The east tower is in the same place as the east pier of the cantilever bridge. The cost of this base for the suspension bridge tower will be that of the cantilever bridge pier, or $3,464,000, multiplied by 1.32, making $4,572,480.

The west tower would come immediately west of the New Jersey pier head line, the average depth of rock being about ten feet more than on the east side, requiring 414,000 cubic feet additional in the foundation. Estimating on the same basis as for the west pier of the cantilever bridge, the cost of this 414,000 cubic feet of foundation would be $431,000, which would make the cost of the west tower base $5,003,480.

The anchorages have been planned on the basis of putting the entire weight which is to resist the pull of the cables above mean high water; and the quantities have been based on a co-efficient of friction of 0.6 and a factor of safety of two. The anchorage at each end of the bridge would contain 3,540,000 cubic feet above the foundation. The only duty of the anchorage is to act as weight, and a very cheap class of masonry can be used for this purpose; rubble made of the most available stone, with a facing of rough ashlar or brick, would do. The cost of this masonry has been estimated at 37½ cents per cubic foot, although the Board believed it could be built for much less. On this basis the cost of each anchorage above mean high water is $2,227,500.

The east anchorage would be founded where the rock is twenty feet below mean high water; the foundation could be put in with a coffer dam, and has been estimated as costing 75 cents per cubic foot. There would be 1,150,000 cubic feet in this foundation, making the cost $862,500, and the total cost of the east anchorage $3,090,000.

The foundation of the west anchorage would have to be sunk sixty feet to reach the rock, and would probably be put in by the pneumatic process. Its volume would be three times that of the east anchorage, and its cost may be estimated at the same price per cubic foot, or $2,587,500, making the total cost of the west anchorage $4,815,000.

The total cost of the sub-structure would then be: East anchorage, $3,090,000; base for east tower, $4,572,480; base for west tower, $5,003,480; west anchorage, $4,815,000. Sub-structure, total, $17,480,960.

The anchorages can be adapted to carry the tracks, but the tracks must be carried between them and the towers on viaducts, requiring 925 feet of viaduct on each side, or 1,850 feet in all, which has been estimated at the same price as before. The total length of the suspension bridge, including viaducts and anchorages, is 5,600 feet. The total cost will be as follows: Superstructure, $16,036,711; sub-structure, $17,480,960; total, $33,517,671. Viaduct, $1,850,000. Grand total, $35,367,671.

The estimated cost of the 2,000-foot cantilever bridge was $25,443,000 for 4,320 feet. To compare it with the 5,600-foot suspension bridge, 1,280 feet of viaduct must be added. This makes the cost $26,723,000. The estimated cost of the suspension bridge is $8,644,671 more. The fairest comparison is by percentages; the cost of the suspension bridge is nearly 32½ per cent. more than that of the 2,000-foot cantilever bridge. If allowance is made for cost of structural steel in accordance with the views of a majority of the Board, the difference will be reduced to $7,844,584, or nearly 30 per cent. The general conclusion which your Board has reached is that the cost of a suspension bridge of a single span, designed for its whole length for the same moving load as the 2,000-foot cantilever bridge, would be less than one-third more than that of the cantilever.

Deflections.—The structure described is one of unusual rigidity. The expansion of the metallic towers counteracts in a degree deflections due to elongations of cables under an increase of temperature, this deflection being further reduced by the large versed sine. Of the thirty-four tons per lineal foot, only nine are moving load, so that the stress per square inch on cables caused by a maximum moving load is less than 16,000 pounds; it would not exceed 5,000 pounds with an ordinary freight train on every track, or 2,500 pounds with a passenger train on every track. The deflections have been calculated for a full moving load with the following results:

Conditions.	*Effects of.*
60 degrees F.	— + 2 cable between towers.
Max. mov. load.	— 2.75.
	— + 0.1 back stays.
	— 0.14.
	— + 0.22 towers.
	— 0.11.
	— + 0.03 suspenders.
	— 0.02.
	— + 1.91 total.
	— 3.02.
Combined.	— 4.75.
	— 0.24.
	+ 0.11.
	— 0.05.
	— 4.93.

In other words, the total deflection at the centre of the span below a mean is about five feet; the deflection above a mean is less than two feet; the total range is less than seven. These deflections are within satisfactory limits for railroad service.

A deflection of five feet in a length of 3,200 feet, calculated for a modulus of elasticity of 28,000,000 pounds, corresponds to a chord stress of 7,870 pounds per square inch in a stiffening truss 120 feet deep. This is the stress which has been eliminated by the use of the hinge.

Lighter Structure.—The calculations of the cost of the suspension bridge, which has been described, have been made as nearly as possible on the same basis as the estimates for the cantilever bridge, without taking into consideration the fact that the cantilever bridge would be strained nearly to its full capacity by a load 1,000 feet long, while the suspension bridge would be fully strained only when covered by a load three times that length. Furthermore, no allowance has been made for the fact that the maximum strains in the stiffening truss would occur only under combinations which might not arise once in a century, and which could be prevented by simple police regulations.

A moving load of 3,000 pounds per foot, 1,000 feet long, on each of the six tracks, crossing the bridge without change of relative position, would produce practically maximum effects in upward movements on a continuous stiffening truss, but it would produce only one-half these movements downward. In other words, the chords of the stiffening truss would be strained 12,500 pounds per square inch by upward bending, but only 6,250 pounds by downward bending, on the assumption as before that all the moving load is distributed by the stiffening truss; as only about 88 per cent. is distributed by reason of the unsymmetrical deflection of the cable, the maximum chord stresses are reduced and become respectively 11,000 and 5,500 pounds. The greatest upward deflection from the action of the cables occurs from the effects of temperature when the bridge is unloaded; under a full load it is eliminated, and under a 1,000-foot load it is reduced to about one foot, which corresponds to a chord stress of 1,570 pounds, making a total of 12,570. The downward deflection would never exceed three and one-half feet with the limited length of train, which corresponds to a chord strain of 5,509 pounds, or a total of 11,069, so that a continuous truss could be used without exceeding the assumed limits of stress.

It should be noted that the only condition which would produce these stresses would be the passage of six maximum trains side by side. A single freight train in the most unfavorable position would produce a stress of not over 3,500 pounds in the chords of the stiffening truss, and a single passenger train a stress of not over 1,800 pounds. In providing for a lighter structure, adapted to trains 1,000 feet long, it should be thought best to make no reduction in the weight of the stiffening truss or the floor system, but the continuous form of truss might be selected.

If the stiffening truss did its complete duty in the distribution of weight, the greatest strain which a train 1,000 feet long, weighing 3,000 pounds per foot, could throw upon the cables would correspond to a uniform load of 937 pounds. If the stiffening truss did no duty whatever, but the weight was distributed strictly according to the laws of leverage, the greatest strain which such 1,000-foot train could throw upon the cables would correspond to a uniform load of 1,582 pounds per lineal foot. Under these circumstances it seems safe, while not reducing the stiffening truss, to provide for a moving load on the cables of only 1,500 pounds per foot of track. For this approximate calculation the weights per lineal foot may then be taken as follows:

Suspended superstructure and tracks	34,000 pounds.
Moving load	9,000 pounds.
Cables and suspenders	14,000 pounds.
Total	57,000 pounds.

This is 28½ tons per lineal foot instead of 34 tons, the reduction in the total carrying capacity being about 16 per cent. It should be observed that the live load is only 15.8 per cent. of the whole, so that the additional stress put on the cables by the simultaneous passage of six maximum trains would, without allowance for the work of the stiffening truss, be only 10,000 pounds per square inch. The stress imposed by a 1,000-foot passenger train under the most unfavorable conditions would not be over 1,200 pounds.

For the purposes of present comparison, the suspended superstructure remains unchanged; all other parts may be taken at 16 per cent. less than in the previous estimate. The weights and cost of such a bridge may then be estimated as follows:

	Pounds.
Suspended superstructure	101,000,000
Towers	64,000,000
Chains and anchor plates	25,000,000
Structural steel	190,000,000
4½c	$8,550,000
Wire work	5,659,000
Total superstructure	$14,209,000
Substructure	14,684,000
	$28,873,000
And for viaduct	1,850,000
	$30,743,000

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NEWS OF THE NAVY YARD.

The Machias to Be Tested for Stability This Week.

A dock trial of the engines of the new second-class battleship Maine, which was taken out of the granite dry dock at the Navy Yard last Thursday, is to be begun to-morrow.

This trial is held in order that the adjustment of the engines may be perfected. It is thought that a two day's run will be sufficient. After the engines have been adjusted a preliminary trial will be made with the ship under way, and then will follow the official trial in open water.

The cruiser Atlanta will probably not sail until Tuesday or Wednesday. Some temporary repairs on her engines are being made to enable her to get to Norfolk. Her new crank shaft is now on her deck. This is to be put in the ship at Norfolk in place of the one now there.

The crank shaft of the cruiser Boston, the Atlanta's twin, has also been changed once.

The gunboat Machias the work of lengthening which is now almost finished, will probably be put into the dry dock early this week, to be tested as to her stability. If satisfactory, she is to be put into commission and sent to China.

A Court Martial to Try Paymaster Wham.

WASHINGTON, Sept. 1.—Another army scandal at Vancouver Barracks, where a court martial will meet on Sept. 5 to try Capt. W. P. Goodwin on a charge of drunkeness, was developed to-day in the appointment of a court martial for the trial of Major and Paymaster Joseph W. Wham. Army officers on duty at the War Department refuse to talk about the case, but it is understood that Major Wham is to be tried for irregularities in his personal affairs, involving non-payment of his debts. Major Wham's career in the army has been interesting. A number of years ago, while stationed in Texas, road agents held him up, with his escort, and took from him $15,000, with which he was to pay troops. Some months ago he could not get his Paymaster's bond renewed and his usefulness in the pay department came to a standstill. While this was pending Major Wham applied for retirement on account of disability, and report had it that he did so at the suggestion of the War Department. But when he appeared before the retiring board he opposed favorable action on his request, and the retiring board was obliged to report that his disability, which consisted in an affection of the eyes, was not permanent, and Major Wham was accordingly retained on the active list. Major Wham was made a paymaster by Gen. Grant on the last day of his service as President.

Treasury Order Revoked.

WASHINGTON, Sept. 1.—Acting United States Treasurer Meline has revoked the special notice issued June 18, 1894, under which small notes have been sent by express from the Treasury here at Government contract rates for deposits of gold and gold certificates, and shipment of the notes from the United States Treasury here under its provisions are discontinued. Small notes, hereafter, may be furnished by Sub-Treasurers at their counters to the extent that such notes are on hand in excess of the requirements of the current business of their offices in exchange for gold and gold certificates and large denominations of legal-tender notes. Small notes will be shipped from here on Sub-Treasurers' orders to the extent that they can be spared.

This order, in effect, prevents shippers from obtaining the benefit of the Government's contract rates. Its issue shows that the Treasury has no further concern about being able to replete the gold reserve.

Arrived on the Paris.

Among the passengers on the steamship Paris, which arrived yesterday morning from Southampton, were the Hon. J. H. Kasson, Judge Roger A. Pryor, Thomas F. Gilroy, Jr., Lars Anderson, Charles S. Peabody, H. C. Duval, Edward S. Stokes, Signor Perugini, Miss Blanche Walsh, and W. L. Elkins, P. A. B. Widener, and C. T. Yerkes, who were met at Quarantine by the revenue cutter Perry, having on board John R. Read, Collector of the Port of Philadelphia; William F. Harrity, and a party of Philadelphians.

An Alleged Bookmaker Arrested.

Harry Robinson of 122 West Twenty-eighth street was arrested last evening charged with taking money and registering bets on the races. He was found in a saloon at the northwest corner of Twenty-eighth street and Broadway making entries in a small book.

The Dolphin Quits Bass Fishing.

NEWPORT, Sept. 1.—The United States ship Dolphin sailed from West Island shortly before noon to-day, with Secretary Herbert and party on board, for Wood's Holl.

The Weather.

An area of high pressure has taken a commanding position over the country generally east of the Mississippi, with its centre resting on the middle Atlantic coast, and it is holding in check the storm area which started to move east from the Northwest States, and is likely to force it northeastward into Canada over the lake regions. This precludes the possibility of any rainfall to relieve the drought for one or two days longer at least.

There was a light fall of rain in Montana and South Dakota and also in the Gulf States. Elsewhere the weather was fair, save for the general smoky and hazy condition of the atmosphere around here.

It was fair and slightly warmer in this city; highest official temperature, 88°; lowest, 62°; average humidity, 60 per cent.; wind, generally southwest; average velocity, 8 miles an hour; barometer corrected to read to sea level at 8 A. M., 30.18; 3 P. M., 30.13.

The thermometer at Perry's pharmacy, Sun building, recorded the temperature yesterday as follows:

	1893.	1894.		1893.	1894.
3 A. M.	66°	67°	3:30 P. M.	70°	78°
6 A. M.	66°	67°	6 P. M.	68°	75°
9 A. M.	66°	69	9 P. M.	62°	72°
12 M.	76°	77°	12 Mid.	61°	70°

Average ... 74¼°

Average on Sept. 1, 1893 ... 67⅜°

WASHINGTON FORECAST FOR SUNDAY.

For the District of Columbia, New England, eastern New York, eastern Pennsylvania, New Jersey, Delaware, and Maryland, fair; slightly warmer; south to southwesterly winds.

For West Virginia, western Pennsylvania, western New York, and Ohio, fair; slightly warmer, except stationary temperature in vicinity of Cincinnati; south winds.

FLEETWOOD'S PROGRAMME

SOMETHING ABOUT THE HARNESS FLYERS TO BE SEEN THIS WEEK.

Alix Will Start Against Nancy Hanks's 2:04, but She Cannot Accomplish Impossibilities—Many Very Speedy Horses Will Try Conclusions Over the Old Course—Plenty of the Trotters and Pacers Will Be Out for an Airing To-day.

The New York trotting meeting in the Grand Circuit begins to-morrow at Fleetwood Park, continuing five days, or it may be the entire week, the programme provided by the Driving Club being a mammoth one, which a good many horsemen believe it will be found impossible to run off on schedule time.

If the published list of entries to the various events of the week correctly indicates the character of the racing to be expected, there is a treat in store for the followers of the trotters in and about New York. Nearly all the Eastern stables of importance, and many of those that have been in the West since the close of the Buffalo meeting, will reunite at Fleetwood, infusing into the metropolitan series in the Grand Circuit a fresh element of uncertainty, which is lacking when the same horses come together week after week in the same classes. In addition to the regular programme of class races, the wonderful mare Alix, 2:05¼, has been engaged to start against the champion record of 2:04, now held by Nancy Hanks, and, as a further special feature, Directly, the champion two-year-old pacer, is to try to beat his record of 2:10¾, made last week at Washington Park, Chicago.

To-morrow's programme is a strong one, with the New York purse of $3,000 for 2:30 trotters, the Fleetwood purse of $3,000 for 2:20 trotters, and the 2:18 pacing race all on the card, and a dozen or more prospective starters in each class. The Fleetwood purse will be looked upon as the star event, with such fast ones as Lesa Wilkes, 2:11½; Mary Best, 2:12¾; Aunt Delilah, 2:12½; Dodgeville, 2:15; Strontia, 2:15¾; Ora, 2:16¾; Gretchen, 2:17, and Ruby, 2:17¼, among the entries. Mary Best, winner of the $15,000 race for four-year-olds at Hartford, will probably be the starter from John A. Goldsmith's stable, and she is likely to start favorite, although her latest races at Terre Haute and at Hartford seem to indicate that the Guy Wilkes filly is not quite up to her best form at present. Aunt Delilah looks formidable on the strength of her brilliant victory over Cobwebs and J. M. D. at Poughkeepsie, and the Missouri mare's subsequent defeat in ridiculously slow time at Hartford will probably deceive nobody.

The local mare Anna Mace, owned and driven by W. H. McCarthy, is one of the fastest trotters entered in the New York purse, having finished second to Sixty-six in 2:15¼ at the Cleveland Grand Circuit meeting. But the daughter of Robert McGregor went lame at Buffalo, and she has not started during the past few weeks. Tomah, 2:17¾, and Almontine, 2:10¼, are others of the lot that have shown their quality by beating 2:20 in races this season. Of the fifteen pacers named in the 2:18 class, Judge Sterling, 2:15½, Highland L., 2:14¾, Berkshire Courier, 2:14¾, Amelia, 2:21¾, G. O. Taylor, 2:16¾, and Abetto, 2:21¼, started last week at Hartford, finishing in the order named, after a stubborn contest of five heats. In addition to these are Alice Director, 2:18, Ferndale, 2:20, Dalgetty, 2:17¼, Harry, 2:17¾, and others. While there are perhaps no John R. Gentrys or Joe Patchens among them, the field is one that gives promise of a fine race.

The double-team race, in which Azote, 2:09¾, and Cobwebs, 2:12; Lord Clinton, 2:08¾, and Miss Lida, 2:10¾, and Nelly W., 2:14¼, and Lady Bullion, 2:16¾, are entered, along with two other pairs, is the leading feature of Wednesday's programme. In this race, a subscription sweepstakes, subscribers have the right of substituting other horses for those originally nominated up to the night before the contest takes place, so that although the pairs have already been named, the make-up of the field is as yet altogether uncertain. It is said Monroe Salisbury will start Answer, 2:14¾, the horse he purchased from Congressman J. C. Sibley last week, as a mate for Azote, instead of hitching the latter with Cobwebs, and it is further reported that if Lady Bullion starts in the race it will be as a mate for San Pedro, 2:14½, instead of Nelly W.

In the 2:14 class race to be trotted on Tuesday, Oro Wilkes, Miss Lida, Silicon, and Jenny K. are the most prominent ones of the dozen or more named to start. Miss Lida gained a record of 2:10¾ at Lansing, Mich., ten days ago in a winning race against the game little New York mare Bush, by Alcyone. Oro Wilkes was a winner at Hartford last week, and at Terre Haute a fortnight ago he forced Trevillian to trot a fourth heat in 2:09¾. At the latter meeting Silicon defeated Mary Best for the $24,000 Futurity stake, trotting in 2:13½, but she brought up the rear in her Chicago race a week later, and it is said the great four-year-old has gone wrong. Jenny K., the daughter of Phallas, at her last appearance in public, trotted third to Trevillian and Oro Wilkes in Chicago, showing signs of a return to her form of last season, when she was unbeatable in her class.

There are thirty-one entries in the 2:18 trotting race on Tuesday's card, and the officials of the Driving Club are considering the plan of dividing the mammoth field into two sections and giving two races instead of one. Ralph Wilkes, 2:10¾; Caridon, 2:10¼; Lesa Wilkes, 2:11; Queechy, 2:14½; Baronet, 2:19¾, and Cocoon, 2:15, appear to be the best ones of a uniformly good lot, with the chances strongly in favor of the five-year-old from Boston, Ralph Wilkes, who has not yet met his match this season. Lesa Wilkes trotted in 2:11 at Terre Haute two weeks ago, her last appearance in public, and if her hard race against Bailona did not give her a backset she ought to make a strong bid for the victory at Fleetwood. The Advancement Purse, for three-year-old trotters, is the fourth race on the programme for Tuesday, and although nearly thirty youngsters are eligible to start, Gil Curry's great colt Red Bud, 2:15¼, looks to hold the race secure; Limonero, however, forced Expressive to trot in 2:15 at Fort Wayne, Ind., last week.

Wednesday's programme includes the 2:11 class, the 2:25 class, the class for four-year-old trotters, and the 2:14 pacing race. The fast class for trotters promises to be one of the great contests of the meeting, with Phoebe Wilkes (2:11), Mahogany (2:12¾), Alar (2:13¾), Billy A. (2:13¾), Cobwebs (2:12), Miss Nelson (2:13¾), Aunt Delilah (2:12½), Nelly W. (2:14¼), and David B. (2:12¾), among the prospective starters. Phoebe Wilkes's recent race in Chicago, wherein she defeated Pixley (2:08¼) and Nightingale (2:10¾), will doubtless make the Western mare a favorite. She has been slowly but steadily rounding into winning form ever since the date of the Cleveland meeting, and now that the big mare has struck her gait she is likely to be a hard one to handle. Mahogany's fine race against Ralph Wilkes at Hartford will probably give him a good following, and Nelly W., President Samuel McMillan's fast mare that forced Oro Wilkes to trot in 2:12¾ last week, is also among the formidable-looking candidates. Monroe Salisbury will probably furnish the favorite for the 2:14 pace in his fast five-year-old gelding Doc Sperry, a winner at Terre Haute and Chicago, whose record of 2:10 does not seem to be a measure of the Californian's amazing speed. Pitted against him are Whisper, 2:11¾, a Hartford winner; Ella Eddy, 2:12; Foggy, 2:13¾; Sterling, 2:14¾; H. J. Rockwell, 2:13¾, and others. Sally Simmons, 2:15; Arena, 2:15¼, and Psyche, 2:18¾, appear to be the best ones of a large field in the four-year-old race, and Dudley Olcott, 2:18¾; Clemmie G. H., 2:18¾; Happy Lady, 2:21½, and Tom Medium look like the contending horses of the 2:25 class.

The trotting free-for-all is scheduled for Thursday. What promised to be one of the sensational contests of the season seems now to have narrowed down to a duel between the two famous trotters, Lord Clinton and Ryland T. Alix, 2:05¼; Moquette, 2:10; Azote, 2:09¾; Ryland T., 2:07¾; Lord Clinton, 2:08¾, and Pamlico, 2:10, comprised the original entry list, but Pamlico is dead, Moquette has been retired from the turf on account of lameness, Azote is sore in addition to having struck himself in his race at Terre Haute, and Alix is very likely to be drawn from the free-for-all on account of her special engagement to trot against time. The two remaining trotters are fast enough to make a fine race, however. Lord Clinton lowered his record to 2:08¾ a few days ago in a driving contest at Lansing, Mich., while Ryland T., timed separately in the record-breaking race won by Alix at Terre Haute, trotted a quarter in 29¾ seconds, a half in 1:00¾, and a mile in 2:06¾, repeating in 2:06¾. The Progression Purse for two-year-olds of the 3:00 class, and the 2:27 trotting race complete the not very promising programme for Thursday.

Friday's four-race card brings the meeting to a close. The 2:10 pace, with the sensational Western five-year-old John R. Gentry on the list of starters, is likely to be a hollow, straight-heat affair, Gentry having fully recovered from the mishap which befell him in his race at Detroit last July. Two weeks ago he defeated the Hamlin crack Hal Braden and the champion four-year-old Online in 2:07¼, 2:07¼, and 2:09¾, winning with something to spare. Major Wonder, 2:09¾; Paul, 2:09¾; Tom Webster, 2:11¾, and Daisy de Spain, 2:12, are among the other entries. The 2:16 class, trotting, brings together the two fast fillies, Roseleaf, owned by Major S. T. Dickinson of New York, and Expressive, the half thoroughbred three-year-old from the stable of Monroe Salisbury. Roseleaf's last start was at Hartford, where she made Alar step in 2:11¾ to beat her.

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