

in the country a more solid and substantial road bed, stronger culverts and bridges, easier curves and grades than has the B. & A. The rails are of steel and weigh 70 lbs. to the yard. The rolling stock is first class in every particular, and the passenger cars are specially neat and comfortable.

The stations, awnings, tanks, coal sheds, etc., are all of sufficient capacity for present and future needs, and



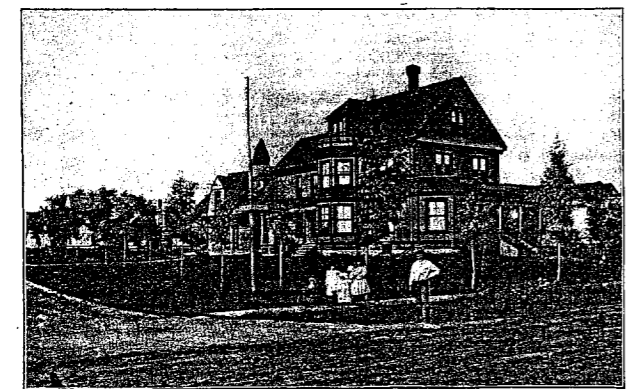
JOHN WATSON'S RESIDENCE, Charles St.

the waiting rooms are all neat and comfortable. The rolling stock is fitted with the most improved Westinghouse air brake, and the passenger coaches are provided with the latest apparatus for heating by direct steam from the locomotive.

The railroad is one of the finest in the country, and unlike many roads which have to struggle many years before paying even running expenses, the B. & A. R. R. is placed at once on a paying basis, and the outlook for the future is brighter than the friends of the enterprise ever dared to hope.

The following article may be termed a technical description of the construction of the Bangor and Aroostook Railroad. We are indebted to Chief Engineer, Moses Burpee, for the very full, accurate and valuable information contained in the article. It will well repay perusal by all who take an interest in Aroostook county, and in the successful completion of the most important enterprise ever undertaken in this State or in New England. The article explains many features of railroad construction that the general reader has no knowledge of, and does it in an intelligible and interesting manner.

The Aroostook Division of the Bangor and Aroostook Railroad, or



GEO. H. GILMAN'S RESIDENCE, Cor. Pleasant & Elm Sts.

the newly built portion of the road, The Canadian Pacific Railway Crossing is made by

gradients and curvatures are used by any first-class road in the country which requires them.

The rails are steel, weighing 70 lbs. per yard, and with only a few exceptions they are 30 feet long. The fastenings are four hole angle bars, weighing 50 lbs. per pair, and the screw bolts used with them weigh about a pound each. The spikes weigh as a rule, 2816 ties per mile, but fre-

ment and the pedestal south of the brook rest on hard pan. The pedestals north of the brook, except the last pair, are on concrete beds, the last pair and the north abutment, on pile foundations.

The West Branch of Penobscot has four spans, one at each end being through girders, 75 feet long each, and the middle two, through truss spans of 105 feet each. The foundations are on ledge or boulder beds. Considerable difficulty was encountered in putting in the foundation of center pier where the current is very quick.

Smith brook bridge is a 30 feet deck girder with pile foundations under the abutments.

The Millinockett bridge is a 105 feet through truss span. There are pile and timber foundations under the abutments.

The Schoodic stream bridge is a through girder, 50 feet span.

The East Branch of Penobscot has two through truss spans of 150 feet and on the east end a deck girder of 30 feet span, crossing the Medway road. The foundations are on rock, and the bottom of the pier is a mass of concrete about 7 feet deep.

Hay brook is a 20 feet span with abutments on pile foundations.

West Branch of Molunkus bridge is a 30 feet span deck girder.

Molunkus bridge is a 40 feet span deck girder with pile foundations under the abutments.

Cold brook bridge is a 40 feet span deck girder.

Fish stream bridge is a 75 feet span through girder with pile foundations under the abutments.

West Branch of Mattawamkeag has two spans, 60 feet each, through girders, with pile foundations under all the masonry.

Dyer brook bridge is a 50 feet span through girder.

In the town of Dyer Brook between Dyer Brook and Oakfield stations is a wooden trestle, 648 feet long on a five degree curve.

East Branch of Mattawamkeag bridge has 3 spans, a central one of 70 feet, and one at each end, 50 feet long, all deck girders. The north pier is on a pile foundation, the other masonry on rock or hard pan.

Thomas brook bridge is a 40 feet span deck girder.

Titcomb lake outlet has a 50 feet deck girder. This bridge is on a 3 degree curve. It has also about 150 feet of wooden trestle, which eventually will be filled with earth.

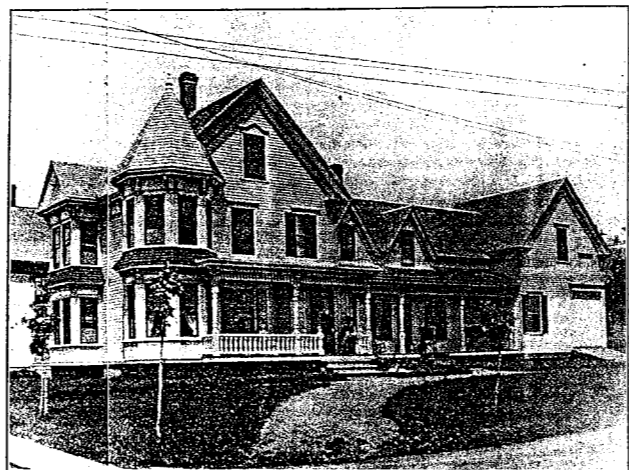
Philpot stream has a 50 feet span deck girder.

McCarty brook has a pile trestle bridge 277 feet long.

Moose brook has three spans, 50 feet each, deck girders supported on trestle bents on the intermediate piers, and on abutments at the ends.

The first crossing of Meduxnekeag is a skew bridge of three deck truss spans of one hundred feet each. The south abutment is on hard pan and both piers and the north abutment are on rock.

The second crossing of Meduxnekeag is the first bridge north of Houlton. It begins at south end with a timber trestle, 245 feet long. At its north end the permanent bridge begins and this is 410 feet long, in five spans, a deck girder of 55 feet at each end, and three deck truss spans between. This is also a skew bridge. The south abutment and piers 1 and 2 are on pile foundations. Pier 3 is on concrete, 7 feet deep on rock bottom, and pier 4 and north abutment are on rock. A second wooden trestle joins on to the north end of the permanent bridge. It is 237 feet long and extends to the 45 feet



I. H. DAVIS' RESIDENCE, Cor. Kelleran & Heywood Sts.

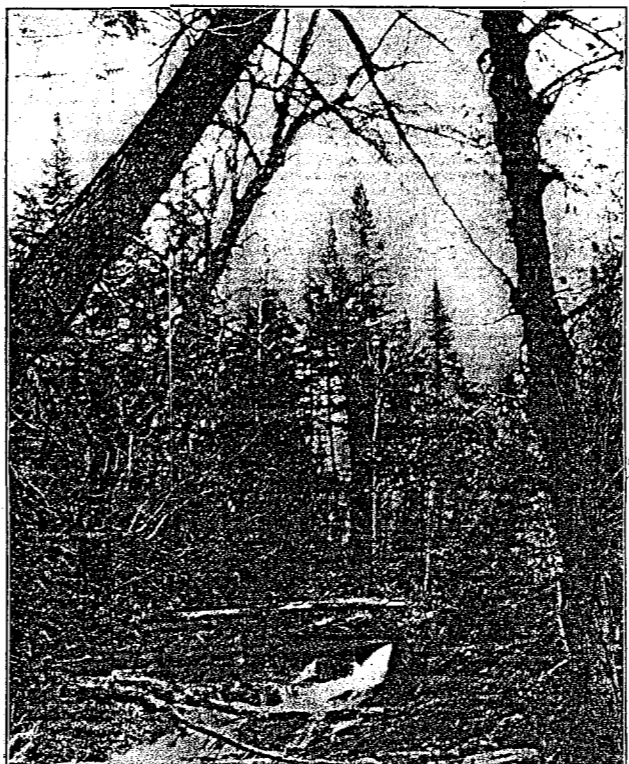
whole length of the structure at present is nearly 1,100 feet. At the south end is a timber trestle 189 feet long, and north of this the viaduct approach of the permanent bridge 150 feet, followed by three spans of 150 feet each, deck trusses, and these again, by 180 feet of viaduct extending to the north abutment, and north of the abutment, a short piece of temporary wooden trestle which is to be filled shortly. The three large spans exactly cross the river from bank to bank. Piers 1, 2 and 3, are on pile foundations; all others on hard pan or gravel. The temporary trestle, with the pile and timber foundations was put in in two months. It contains about 21,000 lineal feet of piling and round timber, 180,000 feet of sawn timber, and 22,000 pounds of iron. Since winter set in, all the masonry, about 1,400 cubic yards, has been built and the iron work of the bridge erected.

There are a number of small pile trestles between Presque Isle and Caribou, the longest one being at Presque Isle brook, 165 feet long.

Caribou stream bridge is two 75

feet spans. It may be that the latter should govern in the choice between routes, for it is better to build a line which is needed and will at once furnish traffic, even if the line must have grades and curves, than to build one which may be mechanically perfect, and yet be an unnecessary thing. As railroads are commercial institutions it follows that they should be built where they will serve the largest interests and develop the greatest resources. After this principle has been adopted, the service and skill of the engineer and contractor should be made to avoid all possibly avoidable obstacles, and to overcome by the most careful possible location the resistances to traffic that are sure to be found everywhere.

In the selection and location of the B. & A. R. R. the above principles were kept uppermost in view by the Company, and such points as North Twin dam and Grindstone Falls, without any development as yet, but with good possibilities, and Island Falls, and New Limerick with partial development, were selected as points on the route which ought to be con-



L. O. LUDWIG'S RESIDENCE, Court St.

Molunkus and the Cold brook.

Fish stream, the west branch of Mattawamkeag, and Dyer Brook are crossed near Island Falls, and the valley of the latter is followed about six miles to the highest ground south of Houlton, namely at Dyer Brook station, where the elevation is 646 feet above sea level. The grade at once descends to the East Branch of the Mattawamkeag, near which is Oakfield station, 560 feet above the sea. From this the valley of Thomas brook and Spaulding lake takes the line to the true



E. L. CLEVELAND JR'S RESIDENCE, Kelleran St.

summit of the road, viz.: the divide between the Penobscot and the St. John waters near Timoney's, where the elevation is 645 feet above sea level, one foot less than at Dyer Brook.

From this summit the valley of a rapidly descending brook running into Titcomb, or Cochran lake, is followed. The foot of the maximum grade is reached a little west of Smyrna station, which is situated on the north side of Titcomb lake. Continuing eastwards, in a half mile or so, the outlet is crossed at an elevation of 495 feet. The grades from this to Houlton are undulating, as there are several streams to be crossed. The more important are Philpot, McCarty and Moose brooks, and at Houlton the South Branch of the Meduxnekeag. There is a gradual descent, however, and the elevation at Houlton is 362 feet.

On leaving Houlton station northward, the second crossing of the Meduxnekeag is made immediately and just below the confluence of the south branch and B stream; and the valley of B stream is followed for a short distance until well on to the table land. There is a very gradual ascent until about the center of Littleton township, from which it rapidly descends to the crossing of Johnson brook, and immediately rises again to the table land, just south of Littleton

station, where the elevation is 446 feet above sea level. From this point the line follows the valley of the South Branch of the Meduxnekeag, and Dyer Brook are crossed near Island Falls, and the valley of the latter is followed about six miles to the highest ground south of Houlton, namely at Dyer Brook station, where the elevation is 646 feet above sea level. The grade at once descends to the East Branch of the Mattawamkeag, near which is Oakfield station, 560 feet above the sea. From this the valley of Thomas brook and Spaulding lake takes the line to the true summit dividing the Presque Isle of the St. John from the Presque Isle of the Aroostook at an elevation of 654 feet. This is the highest point on the main line between Brownville and Caribou, being 8 feet higher than Dyer Brook and 9 feet higher than Timoney's summit.

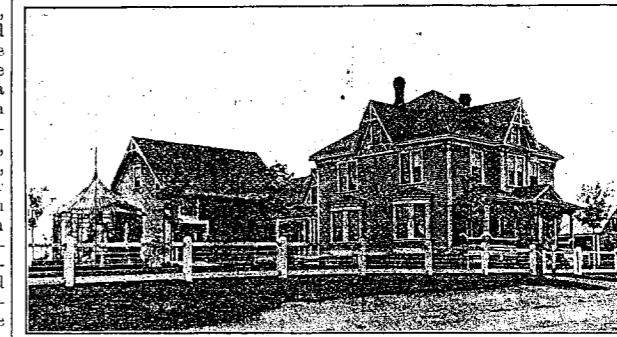
From this to Presque Isle village is a continuous descent of one per cent., the elevation at the station in the village being 456 feet.

One and a half miles further is the Aroostook River bridge, the largest yet erected on the line. Its grade ele-

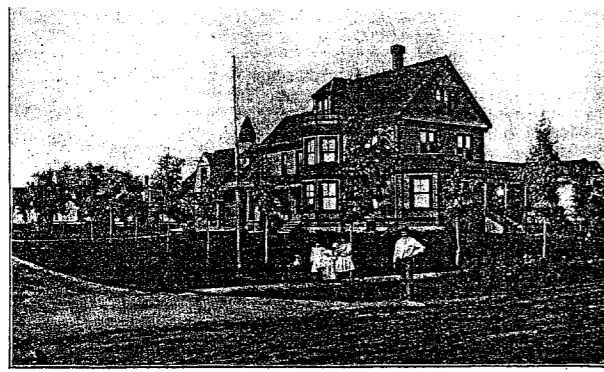
vation is 460 feet above the sea. From this to Caribou, 13 1-2 miles, the fall is very little, the elevation of Caribou yard being 405 feet.

The Fort Fairfield branch at the Junction is 581 feet above the sea. This is in the valley of a tributary of the Presque Isle of the St. John. A table land between this and Aroostook valley must be crossed before reaching Fort Fairfield. The greatest elevation of the line on this table land is 673 feet, the highest point on the Aroostook division. From this the descent is gradual and not continuous until the elevation 600 is reached from which to elevation 402 is made in a little more than 3 miles, or at the rate of about 66 feet per mile, which is in some places slightly increased and in others slightly decreased. Neither grades nor alignment of the branch are so good as on the main line, for, though in a comparatively smooth country the direction of the line is almost at right angles with that of its principal valley necessitating almost certainly a steep grade, and the adoption of which ever ravine might offer itself for a route without the chance to make any choice is likely to incur sharp and frequent curves.

The above description must have made it clear to the reader that the line has not followed for any great distance any of the rivers or larger



streams, but runs across country, so



GEO. H. GILMAN'S RESIDENCE, Cor. Pleasant & Elm Sts.

the newly built portion of the road, which runs from Aroostook Junction in Brownville to Caribou, is 154.5 miles long and the branch to Fort Fairfield is 13.3 miles, making a total of new line 167.8 miles.

Its grades rising north are never more than one and a quarter per cent. or sixty-six feet per mile, and rising south are one per cent. or nearly fifty-three feet per mile. There are but two exceptions to the latter, where for only a short distance, a steeper grade has been used temporarily owing to the insufficiency of material within any practical distance for the heavy embankments the standard gradient would have required. These will eventually be brought up by ballast trains.

The sharpest curve used except in some special case is six degrees, in which there is a gradual, uniform change of direction of six degrees in every hundred feet until the end of the curve is reached. The number which expresses the degree of a curve is thus the same as the number of degrees change of direction per hundred feet. The exceptions to the above maximum curvature are at Pleasant River, West Branch of Penobscot, East Branch of Penobscot and the first crossing of the Meduxnekeag, where there is in each place an eight degree curve instead, in leaving the north ends of the bridges. These curves are necessary to permit the line of the road to conform to the direction of the valley after crossing the stream at nearly or quite a right angle, and as in each of these cases the direction of the valley has to be followed for some miles before the line can by means of a gradual rise get out of it. The above

The Canadian Pacific Railway Crossing in North Brownville is made by an overhead bridge. It is a through plate girder, 60 feet clear span, and on a skew. Its abutments are founded on the hard pan below the influence of frost.

The above is followed by a pile trestle, 227 feet long, and extending to the south abutment of Mill Brook viaduct. This trestle is considered only as temporary and will eventually be filled with earth.

Mill Brook viaduct, 360 feet long, with greatest height of trestle of 59 feet, is on a four degree curve and is supported by two abutments and nine trestle bents. Eight of these are arranged in four groups or towers, connected with struts and braces so as to have ample stiffness in all directions. The ninth trestle bent is the one next the north abutment. Those trestles which are grouped into towers are 30 feet apart longitudinally, and carry 30 feet plate girder spans on top. All the other girders are 40 feet long, and these span the spaces between towers, so that the 30 and 40 feet lengths, alternate. The girders on the outside of the curve are six inches higher than those on the inside, and the center line of bridge is also slightly outside of the center line of track, for the purpose of balancing or compensating the natural centrifugal force of trains in motion on the curve to which the viaduct is built. This arrangement makes it easy to give the necessary elevation to the outer rail of the curve and also prevents an unduly heavy stress from coming on the legs under the outside of the curve.

The foundations of the south abut-

The first crossing of Meduxnekeag is a skew bridge of three deck truss spans of one hundred feet each. The south abutment is on hard pan and both piers and the north abutment are on rock.

The second crossing of Meduxnekeag is the first bridge north of Houlton. It begins at south end with a timber trestle, 245 feet long. At its north end the permanent bridge begins and this is 410 feet long, in five spans, a deck girder of 55 feet at each end, and three deck truss spans between. This is also a skew bridge. The south abutment and piers 1 and 2 are on pile foundations. Pier 3 is on concrete, 7 feet deep on rock bottom, and pier 4 and north abutment are on rock. A second wooden trestle joins on to the north end of the permanent bridge. It is 257 feet long and extends to the 45 feet through plate girder which bridges the County road. At present this is a continuous bridge, 947 feet long, but when the wooden trestles have been replaced with earth embankments, the second crossing 410 feet and the overhead crossing 45 feet only will remain.

Johnson brook bridge is a 50 feet span deck girder, with rock foundations under the abutments.

Monticello viaduct is 400 feet long. There are two central deck truss spans of 100 feet each. The south approach is a viaduct of three 30 feet deck girders, and the north approach has one 30 and two 40 feet deck girders. The trusses and girders are supported by heavy steel columns resting on masonry at all intermediate points, and by the abutments at the two ends. The arrangement of the columns at the ends include one tower in each approach. The foundations south of the stream are on rock. The middle pier is on a pile foundation and all north of this are on hard pan.

Whitney brook bridge is a 50 feet span deck girder.

"Three brooks" bridge is a 50 feet span through girder.

Young's brook bridge is a 40 feet span through girder.

Clark brook bridge is a 50 feet span through girder.

In Presque Isle, just south of the crossing of Main Street is a pile trestle 193 feet long.

About one and a half miles north of Presque Isle village is the crossing of the Aroostook river. Including the timber trestle approaches, the



COOK'S BROOK--THE OLD DAM.

feet span deck girders. The pier is on a pile foundation and the abutments are on hard pan.

There are no bridges of consequence on the Fort Fairfield branch.

Besides the above bridges there are three 20 feet spans, nine 10 feet spans and one 8 feet span.

The pile and timber trestles including those mentioned, number in all twenty-three structures with an aggregate length of 3,120 lineal feet. There are four open culverts, 5 to 8 feet span, and all other water ways are carried through box or arch culverts. Of the latter there are two, of 8 feet width, and of the former, about 600.

Where stone for culverts was obtainable, it was used, and elsewhere, timber. The latter will be renewed by iron pipes as becomes necessary.

Something has been said above about the ruling grades, but it may be of interest to know more about them in detail, and about the reasons for adopting them. The main point was to connect Houlton and the rest of Aroostook County by a railroad with the nearest Maine city or port, through which the world might be brought nearer. The existing line of the B. & P. R. R. could be utilized as far as Brownville. Surveys had been previously made through Brownville to the East Branch of Penobscot, and from Mattawamkeag to Houlton, which were believed to demonstrate the feasibility of a route from Brownville to Houlton. When, however, a line is drawn on the map connecting the two ends of an important division or route, a very interesting study begins. We not only look to see where the air line crosses the rivers and ridges, and whether for these purposes it can be advantageously broken up, and diverted to the right here, or to the left there, so as to secure bridges which shall be either safer or cheaper, and grades which will give little resistance to traffic, but we also inquire whether it strikes water powers, manufacturing sites, good agricultural districts, or, in short, whether it links together the greatest possible number of places capable of development in any line of

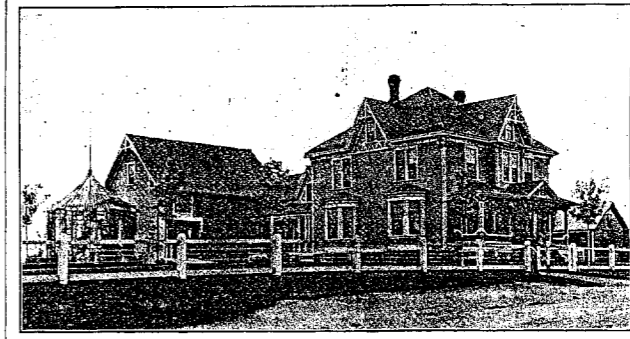
connected. Thus it is that having selected the route, a rough examination of the country with the assistance of guides is made, first ascertaining the feasibility of crossing the ridge between Pleasant River and Schoodic lake, and where to cross it, then the ridge between Schoodic and Sebosis lakes, and next, the high of land between Sebosis and South Twin lakes. After settling on a crossing of the West Branch of Penobscot, below North Twin dam, a way must be found to the Millinockett stream, and then from that to Grindstone Falls, on the East Branch of Penobscot. This was a piece of work which took some time in location, but after it was done, seemed all plain enough. From Grindstone Falls to Staceyville, it is impracticable to use a lighter gradient than 66 feet per mile. From Staceyville to Houlton and north of Houlton there is no country which requires any steeper grades than that south of Houlton. The ruling grade therefore adopted as against the heaviest trains is one per cent., 53 feet per mile. This is opposed to the trains going south, and as it is always fair to consider that very much lighter trains will be hauled in the opposite direction, or northward, it is concluded not worth while to spend money unnecessarily in making grades of 53 feet per mile where 66 feet per mile will answer just as well, and better, because they cost less and save distance.

The elevation of grade at Aroostook Junction is 349 feet above the sea. From the Pleasant River bridge the line follows the east bank, gradually rising until at the crossing of the Canadian Pacific R'y it is 469. At this point the location and construction are quite interesting. Three things presenting opposing influences have to be considered. First the crossing of the Canadian Pacific R'y, which at this point ought to be, as it is, carried over it by a bridge. Second, the deep ravine of Mill Brook which, were it possible, ought to have a grade several feet lower than at the C. P. crossing, but it is within so short a distance that no practical difference is possible; and third, a heavy summit

nines pich, Grand Falls and Shaw Falls. As the Millinockett and Twin lakes are about the same elevation, we have to look for the rapids and falls of Millinockett above the bridge where they really are. Crossing the Millinockett opposite the mouth of a small brook, entering on the north side, the line follows this little valley to a summit about 50 feet higher, and very soon with scarcely any fall, crosses the Schoodic stream, another tributary of the West Branch. From this, after crossing a few spurs from a high ridge on the northward, a decided descent is begun and, at a difference of level of about a hundred feet, comes into the valley of Meadow brook, a small tributary of the East Branch of Penobscot, emptying into it below Rocky Rips. Meadow brook valley is the lowest ground on the whole line, 319 feet above the sea. There are evidences of its once having been the bottom of a lake. Between Meadow brook and the East Branch there is a high gravel horseback or kame; and it is through a depression in this that the line runs before crossing the East Branch.

As the direction of the line has been about parallel with the river, a sharp curve is necessary before crossing. A cutting through the horseback still further reduces its height, and the line emerges at once on to the river where a very beautiful view of a quiet reach of water between Grindstone and Crowfoot Falls is seen. Another sharp curve after crossing brings the line again parallel with the river, which direction it follows for about three and one-half miles, with no change in elevation. At this point Hay brook is crossed and an ascending grade begins. This is necessary to cross the ridge which divides the East Branch from the Molunkus. The rise is 183 feet in three miles, followed by undulating grades, which, however, rise more than they fall, until Staceyville is reached at an elevation of 523 feet. The line is here in the valley of the Molunkus and its various branches are separated by such low ridges that they are scarcely noticed, and do not form a feature in deciding the location of a road, and a twelve mile straight line extends nearly to Island Falls, having run through Sherman and Crystal, and crossed the two branches of

the table land, just south of Littleton distance any of the rivers or larger



L. O. LUDWIG'S RESIDENCE, Court St.

station, where the elevation is 446 feet. There is a descent into Littleton swamp and then a gradual ascent to a summit near the south line of Monticello, at an elevation of 516 feet.

Up to this point the course has been about due north, but here it swings to the north-west in order to follow a hillside which allows the grade to drop to a convenient height for the crossing of the Monticello stream, which it does at an elevation of 439 feet. The same course is continued along the valley of the Monticello stream until the summit is reached, 543 feet above sea level, on the west side of Sugarloaf hill. When once clear of this hill the line turns to the east of north and recovers the easting which was lost south of it. This, however, was not by choice, but by necessity, owing to hills to the westward in the vicinity of Bridgewater Corner. The above summit divides the Meduxnekeag waters from those of the Presque Isle of the St. John, and the valley of Whitney brook is the way taken to reach it, which it finally does at the mouth of "Three Brooks," near Robinson's Mills, 366 feet above the sea.

This valley is followed closely until within the town of Presque Isle, but of course the grade is now an ascending one. At Mars Hill station the elevation is 431, and at Fort Fairfield Junction 581 feet above sea level.

From this station the line sweeps to the westward and crosses the central line road in Presque Isle at the

streams, but runs across country, so to speak. This increases the liability of having steep and frequent grades and a large amount of curvature, but it is possible that it may also be productive of a much greater degree of development in the country, and that each stream may be made to some extent a feeder of business to the line.

An analysis and comparison of the alignment of the different sections of the road is as follows:

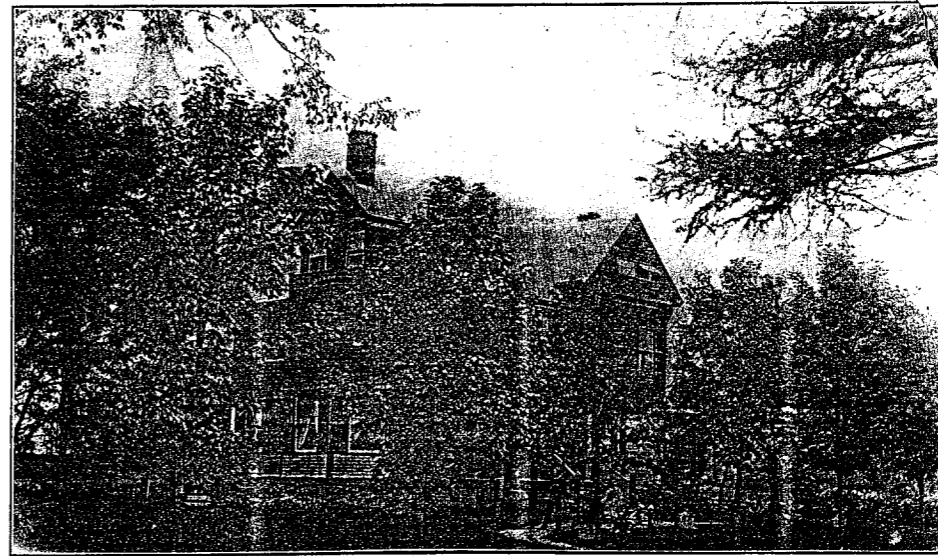
From Aroostook Junction to Houlton the total distance is 94 1-4 miles. About 72 per cent. of this is straight line or tangent, and 28 per cent. curved line. Of the curved portion the average curvature is three degrees per hundred feet. The total amount of curvature is about 4,271 degrees or about 45 degrees per mile for the whole distance. This is about equally divided into right and left curvature.

From Houlton to Caribou the total distance is 60 1-4 miles. About 68 1-2 per cent. of this is tangent and 31 1-2 per cent. is curved line. The average curvature of the curved portion is about two and a third degrees per hundred feet. The total amount of curvature is about 2,332 degrees, or 38 7-10 degrees per mile of the whole distance, and is about equally divided into right and left curvature.

The Fort Fairfield branch has a total length of 13 1-3 miles. About 67 per cent. of this is tangent and 33 per cent. curved line; of the curved



DR. F. A. NEVERS' RESIDENCE, Cor. Court & Military Sts.



WM. S. PERKS' RESIDENCE, Cor. Main & Winter Sts.