to ascertain the angle of elevation. One observer at the creek saw it under such circumstances, that he could scarcely mistake in identifying its true angle of elevation when at the highest point, which, by measurement, is found to give a height of 223 feet above the ground at the factory. According to the observations of others, who, however, saw it under less favourable circumstances, its greatest height would seen to have been something less than this. On the whole, we shall not exceed the truth in saying it rose from 200 to 220 feet.

Some attempt has been made to determine the height to which it rose by ascertaining the time it was in the air; and this method would be very correct if the time could be determined accurately. This, however, is very difficult, as under such circumstances it is nearly impossible for persons to form any opinion of the lapse of time, and are always prone to over estimate it. In the present instance, some persons who heard the explosion, and either heard or saw the boiler strike the ground, thought it must have been in the air a minute, others, half a minute, and others estimated it at only a quarter of a minute, but the last estimate would have given it a height (making no allowance for the resistance of the atmosphere,) of more than 900 feet. It probably was in the air about seven and a quarter seconds.

But our article is increasing to an undue length, and we refrain from adding more, except merely to say, that in preparing it we have had no personal or party purposes to serve. Our statement is made with the best of feeling towards all parties concerned. The facts stated, with the exception of one or two unimportant points, which will not be disputed, were fully established before the jury of inquest. If they do not seem to any one fully to confirm our opinion of the cause and manner of the accident, we may be allowed to remark that there are many other facts and considerations, all of which tend to confirm our views, that cannot be compressed into a single article like the present.

We have been assisted in determining the height of the boiler, by Prof. A. W. Smith.

JOSEPH K. F. MANSFIELD,
JOSEPH BARRATT,
JOHN JOHNSTON,
} Committee appointed by the Jury of Inquest.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by FRANCIS ANTHONY CHEVALIER DE GERSTNER, *during his sojourn in the United States, in* 1839.

[Translated from the German, by L. KLEIN, Civil Engineer.]

[CONTINUED FROM PAGE 173.]

LETTER X.

Cape May, New Jersey, July 29, 1839.

My ninth letter, dated from Cincinnati, contained a description of the rail roads in Belgium, and a comparison of the same with those in the United States;* in the present, I intend to give a sketch of the rail roads in the other parts of Europe.

1. *Rail Roads in Austria.*

The first rail road constructed in Austria for the transportation of passengers and freight, is that between the Moldau and Danube, or from *Budweis to Lintz;* the project for the same originated in the proceedings of the commissioners from the ten States bordering on the river Elbe, who met at Dresden in 1819, in consequence of the congress act of Vienna, and held a convention for the regulation of the navi gation upon the Elbe. The free navigation upon this river commenced in 1821, and the commission at Dresden had, before its dissolution, applied to the Austrian government with the request, to regulate also the navigation of the river Moldau as far as Budweis, and to establish from that point to the river Danube, a canal or rail road, in order that goods may be transported upon this line of communication from Hamburg to the Danube, and back. In the year 1822, I was requested by the President of the Court of Commerce, to place myself at the head of this undertaking, and proceeded immediately to make the local reconnoissences. I then went to England to consult there upon the best plan of locating the rail road over the mountains which divide the waters of the Moldau and Danube, and which have an elevation of 1000 feet above the surface of the water on the one, and of 1500 feet on the other side.

At that time, the engineers in England were unanimously of opinion that every rail road which leads over a mountainous country, must be composed of horizontal or nearly horizontal sections, connected by

* This letter the author has translated into English, at the request of some friends of internal improvements, to whom the contents were shown; it was afterwards, in consideration of the important information it embraced, republished in the Journal of the Franklin Institute. See page 145, vol. xxiv.—2d series.

steep inclined planes, which are to be worked by stationary steam engines. My explanation, that I regarded a rail road, in the principles of its construction as well as its ultimate objects, as nothing more than a very good turnpike road, and therefore could, in no case, agree to the adoption of inclined planes, was entirely disregarded.

I returned from England in November, 1822, superintended, during the following two years, the necessary surveys, and obtained, on the 7th of September, 1824, from His late Majesty, Emperor Francis I, a charter for the construction and management of a rail road between the Moldau and Danube. In March, 1825, I formed a company of stockholders in Vienna, and completed, up to the end of 1828, the first thirty-nine miles of this road from Budweis to the summit. The principles upon which this section was constructed, were, to have no greater ascent than forty-four feet per mile, (1:120,) and no smaller radius of curvature than 622 feet; finally not to lose again any ascended height. As the road was intended principally for the transportation of salt, the superstructure was made of wood, with flat bars fastened upon longitudinal sills, and the adopted maximum rise was founded upon the experience, that the railway cars, as they were then constructed, commenced at that inclination on plate rail roads, to descend by their own gravity. In the fall of 1828, the section of thirty-nine miles was opened, and used, as intended, with horse power.

Plain as these principles of construction must appear to every body, and though their results realized all expectations, propositions were made for altering the same, and adopted by the directors of the company without further inquiry. I therefore once more explained in a report, published in February, 1829, the motives for adhering to the former principles, and proposed, at the same time, the introduction of light locomotive engines for carrying on the transportation on this road; but my propositions were disregarded by the directors, who prefered to have the other section of the road, from the summit to Lintz, constructed on a plan in which grades of 115 feet per mile, (1:46) were adopted for considerable distances, ascended heights were lost again, (the road was made undulating,) and curves with radii of sixty feet were frequently introduced. In the year 1832, the whole line of eighty miles in length was put in operation, and since that time, has been used without interruption, in summer and winter, although the country is covered with snow through five months in the year. The company had formerly let the transportation of salt and merchandize to a contractor, who received three kreutzer in silver per 100 lbs., on those thirty-nine miles of road, the construction of which I had superintended; this is equal to one and one quarter cents per ton, per mile; after the opening of the whole line, never less than

ten kreutzer was paid for double the former distance, or eighty miles, which is at the rate of two cents per ton per mile; and there can hardly be any body, from the engineer to the cart driver, who, in passing over this rail road, does not sincerely regret, that the principles adopted in the construction of the first half of it, were not adhered to in the construction of the other half. The company would thereby have saved at least one cent per mile for every ton of goods transported, which, for 25,000 tons, per annum, would amount to 20,000 dollars, while the additional cost of the road, if constructed according to my principles, would have been only 120,000 dollars; besides it is now impossible to use locomotive engines upon this rail road, which would be of the greatest advantage, since wood is so cheap in this section of country. There certainly exists no other rail road, neither in Europe nor in America, on which the principles of construction were so different in its two halves, and where the consequences are at the same time so apparent; and it is to be wished for the sake of instruction, that a great many persons may visit this road, and convince themselves of the results of both plans of construction.

Under these circumstances, it is surprizing that this rail road, which has cost 800,000 dollars, or 10,000 dollars per mile, has paid, since its opening in 1833, *five per cent.* annually, on the capital expended in the construction, although only 6000 passengers, and 25,000 tons of goods, (principally salt,) are conveyed annually, over the same. If 925,000 dollars, or 11,562 dollars per mile, had been expended for the construction, the profit would have been six and one half per cent., and with the application of locomotive engines, perhaps eight per cent. on the cost of construction. The stockholders of this rail road labour under the disadvantage that a part of the capital was obtained in loans on short terms, while another part was received for shares, sold below their par value; the dividends for the first subscribers are thereby lessened, and will be sufficiently large only after the debts are liquidated.

The rail road from Budweis to Lintz, was afterwards continued to the salt depots, in Gmunden, and forms now an uninterrupted line of 130 miles in length, which has been for three years in full operation. The plate rails of this road are of the same dimensions as on many of the American rail roads, upon which locomotive engines are used without difficulty; but unfortunately, the road from Lintz to Gmunden has also been constructed upon such principles as will exclude the use of locomotives for ever. The total cost of the whole rail road of 130 miles in length, is 1,170,000 dollars, or 9000 dollars per mile, which appears very low, considering the great number of bridges and frequent rock excavations. Upon the road from Lintz to Gmunden,