water, and at the termination of the construction of a cutting undertaken by the town for widening the railway. These works were conducted with but few precautions, in a soil where the utmost care was necessary, and where narrow headings ought to have been made, and retaining walls constructed. Whatever the cause, two houses of considerable value were destroyed, a large hotel in course of construction was so shaken that it must be taken down, and a new building which owing to its resting on piles, resisted the shock for a considerable time, is now yielding. It is true that this latter is in the vicinity of a tunnel in course of construction, and it is difficult for the moment to judge either the actual cause or the comparative success that will be attained by the system of subterranean galleries now being made to drain the soil, which consists of marl, clay, and sand. It would appear that the galleries have been driven a little too low; but it was supposed that if they were higher the inhabitants of the Rue de Midi would have been alarmed, and it is hoped they have nothing to fear. Careful investigations have been made, but the reports of successive commissions have not yet been published. No doubt a litigious discussion will take place, on accounnt of the large number of parties interested.

Invention and Introduction of the Engineer-s Transit.

The first Transit instrument was made during the year 1831. It was a long stride in the improvement of Engineering instruments; and that it should to day retain its almost identical first form, proves the value of its introduction and the good judgment of the inventor. The English Theodolite, capable of performing the same work, found, if we are to credit the traditions of earlier members of the Engineering profession, but little favor with the American Engineers. Its workings were slow and inconvenient. Few cared to trust the prolongation of a straight line by reversing the Theodolite on its centre, and trusting to the vernier readings; and as few fancied the trouble of reversing the telescope on its Y bearings, "end for end." Forgetfulness in the fastening of clips resulted in a fall of the telescope, while if clips were too tight there was the danger of shifting the instrument in fastening, or if too loose the telescope rattled. Such were some of the discomforts attending the use of the Theodolite, an instrument well fitted for many purposes, and whose peculiar merits still cause many of our English brethren to cling to its use.

From the Theodolite, the change was to the Magnetic Compass. This, in its simplest form, or in its modified form, made to read full circle angles independent of the needle, was high in favor with many, especially those surveyors, who, from their local knowledge, (and some with naught besides), were selected to "run" the preliminary lines of railroads. By dint of labor, these surveyors mastered the intricacies of the vernier, but could never be brought to doubt the superior virtues of compass sights in seeing past a tree or other obstruction. With the transit the tree has to come down; they would not undertake to say the staff on the other side of a tree was in the line of the cross-web, but were sure that they could make it "just right" with the line of sights. Nevertheless, though frequently doing close work, the needle would play pranks that produced much trouble; and though to be commended for speed on the preliminary, was rather too uncertain for location.

In the year 1831, the first transit was made by Wm. J. Young. It was graduated to read by vernier to 3 minutes, it being in earlier days a favorite idea of the inventor that graduation of three minutes could be easily read to one minute, and was less perplexing to use. The instrument had an out-keeper for tallying the outs of the chain, and a universal or round level. The needle was about 5 inches; the telescope 9 inches, of low power. The standards were of almost identical pattern now used by some makers. The centre between plates was of flat style, vernier on inside of needle ring, and the plates moved upon each other by rack and pinion. The plates and telescope detached from the tripod, fastened, we believe, when attached, by a snap-dragon, as in later instruments.

For whom the first Transit was made, the records, as far as we can find them, do not positively show; as well as it can be gathered from them, and from other data, the first one was used on the state works of Pennsylvania, but whether on the Mountain Division, or on the incline plane of Columbia R. R., is uncertain.

The distinguished Engineers of the Baltimore and Ohio R. R., also claim the use of the first Transit; and as illustrative of their belief, we append the following extract from the *Railroad Journal* of December, 1855:

"The Transit is now in common use in this country, and is a comparatively cheap instrument. Such, however, is not the case in Europe. In England, the old mode is still in vogue, to a great extent, of laying out curves with the use of Ordinates; we are not sure, indeed, that any other course is not an exception."

"Some years since, Mr. Charles P. Manning, an accomplished American Engineer,—now the efficient Chief of the Alexandria, Loudoun and Hampshire R. R.,—went to Ireland, and on the Limerick and Waterford Railway, initiated the method, so common in this country, of laying out curves with the Transit."

"The first instrument of this name was made by Mr. William J. Young, the ac-

complished Mathematical Instrument Maker, of Philadelphia, for the Baltimore and Ohio Railroad Company, the Engineers of which made the first suggestions modifying the old Theodolite. We have in times past used this instrument, which is much like those made at the present time by the same manufacturer, and is, if we are not mistaken, still in the field."

"Since then, Transits have been little improved, but have been changed in the wrong direction. They are generally much heavier than formerly, containing as much brass and mahogany as one man can well stand under. This great weight is not only useless, but dangerous. Heavy instruments are much more liable than light ones to get out of adjustment on transportation—even in the ordinary field service. They are not a whit steadier in the wind; being generally made with clumsy tripods and large plates, they expose a greater area to the breeze. *If the feet of the tripod be firmly planted*, the instrument is rarely disturbed by the wind. Besides this, a heavy instrument is much more liable to danger from accident in a rough country."

And the following, from the same journal of Jan. 5, 1856:

THE FIRST TRANSIT COMPASS.

"In our issue of the 15th of December, 1855, in noticing the field book of C. E. Cross, C. E., we took occasion to state some facts concerning the first Transit Compass, an instrument made by Young, of Philadelphia. We have since then received an interesting letter from Mr. Chas. P. Manning, whom we mentioned as having initiated in Ireland the American method of laying out curves. Mr. Manning disclaims the honor in favor of 'Richard B. Osborne, Esq., an Engineer who received his professional education in the service of the Reading Railroad Co., under Messrs. Moncure and Wirt Robinson (where he finally occupied the responsible position of Chief of the Engineer Department, during the early struggles of that corporation, in its competition with its rival, the Schuylkill Navigation Co.), and from which road he went to Ireland, and took charge of the location and construction of the Waterford and Limerick Railway in 1846.'

"Mr. Manning says further: 'I obtained from Mr. Young, and sent to Ireland, probably, the first Transit Compass ever known in that country or in England, and soon afterwards joined Mr. Osborne as his Principal Assistant, for the purpose of aiding him in the effectual introduction, at least upon that road, of the American system of location and construction.'

"We were familiar with these facts when we made the statement which Mr. Manning desires corrected. But our object was not so much to mention the party to whom the credit of introduction was due, as to state a few facts immediately connected with the history of the instrument. Mr. Osborne introduced the instrument into Ireland, Mr. Manning initiated its use among the junior assistants.

"'Mr. Osborne was the first to construct an iron bridge upon the plan of Howe's Patent Truss—several of which he put upon the W. &. L. Railway; and, I believe, he also built and placed upon the same road, the first eight-wheeled double-truck passenger and freight cars (American plan) that were ever used in Great Britain.'

"Mr. Manning gives us a very entertaining sketch of the history of that first Transit, made by Young, of which we remarked that we had in time past made use.

"'Twenty and odd years ago—when a mere boy—I saw that instrument upon a lawyer's table, and afterwards in a court room—a dumb witness in behalf of the patentee. Nineteen years ago, after considerable service in tracing the centre line of the Washington Branch of the B. & O. R. R., it was used in making surveys for the extension of the last named road, westward from Harper's Ferry, and your humble servant carried and used it at that time in Washington County, Maryland, and in Ohio County, Virginia.

"'In the last seven years the instrument accompanied me as a duplicate, and was occasionally used upon the location and construction of the B. & O. R.R., through the wilderness, west of Cumberland, and now rests upon its laurels in the office of the Baltimore and Ohio R. R. Company, in Baltimore.

"'It was *instrumental* in setting the first peg that was driven for the extension of the B. & O. R. R. west of Harper's Ferry; and it was 'hard by,' and able to do duty, when the last peg was set for completing the track of that road upon the banks of the Ohio River.

"'In all material points Mr. Young has never been able to improve upon this original work of his hand, but in some of its minor parts he has effected desirable changes—such as the tangent screws connected with the clamp of the tripod—the substitution of a clamp and tangent screw for the old rack and pinion movement of the two compass plates—the subdivision of degrees into minutes, by an improved graduation of the vernier, &c.

"'The original instrument had an index for counting the number of deflections made at one sitting; also a small bubble upon the exterior of the telescope, for the purpose of defining a horizontal line, without resorting to the aid of its companion, the ordinary Level,—but these superfluities were soon thrown aside; and one of its peculiar features was, and is, a vernier, graduated only to *three* minutes,

TO BE CONTINUED.

Keel Ridge furnace, Sharon, is in the third year of its blast.

Invention and Introduction of the Engineer's Transit.

[CONCLUDED.]

Mr. Manning but expresses the facts when he says, that in all *material* points but little change has taken place. The changes that have taken place, have been those called for by peculiar circumstances —modifications, which, while retaining the characteristics of the Transit, have approached more nearly to the peculiarities of the Theodolite. Transits in the after years became divided into the two distinct classes, FLAT CENTRE, as first introduced, and LONG CENTRE, with centres as previously used on Theodolite; but it was not for many years that the long centre—for accurate work the best construction—became other than the exception. It now is the rule, and the flat centre the exception.

Engineers of the present day, unaware of the actual difference in these two styles, and unacquainted with the circumstances of early introduction of instrument, are apt to treat the flat centre with a disrespect it is far from deserving.

For the same strength, the flat centres are far the lightest. Said an experienced Engineer to us, within the few days past, "The first requisite of a Transit is lightness, and portability." Judged by these requisites, the flat centre is the instrument of to-day. But he spoke for his own peculiar branch—railways; and while we are by no means ready to endorse this opinion, we have no hesitation in saying that the circumstances existing at the time of first use of Transit were such, that had the instrument been constructed with the long centre, its usefulness andgeneral introduction would have been very much retarded. The great peculiarity of the first made Transits was their ability to stand hard usage, and non-liability to get out of order under ordinary usage. The centre is a broad metal plate—thick, which it is impossible to bend, or injure in any manner, except by wear; the plates were thick, not easily bent, and the spring vernier, in case of bending of plates, followed the motions and allowed the readings to be made sufficiently accurate to continue work. The rack and pinion had nothing that could break, while the tangents, as then constructed, were equally simple. If the standards, by a fall, were bent so that the telescope wonld not revolve in a vertical plane, the construction was such, that with the ax as a screw driver, the standards could be loosened, and a piece of paper inserted to correct them.

In fact, the opinion of the writer with means of observation, and the use of such an instrument, is: *That a flat centre Transit, rack and pinion, and spring vernier, cannot be made totally useless by any accident short of absolute breakage of parts.*

Not so, however, with the long centre. There, the least injury to centres or plates ends the usefulness of the instrument for its work, and it can stand comparatively ltittle rough usage without receiving this injury.

Of the good judgment of the first form of construction, the length of time that many of them have been in use—for some are still doing duty—is the best of evidence. Twenty-five years ago, as rodman, we followed and worked with a flat centre Transit, that to us then looked old enough to retire upon its laurels. So constant had been its use, that its corners, of hard hammered brass, the edges of its standards, and other parts, had then been rounded in carrying against clothing. Ten years afterwards we followed behind it, on the location of one of our main lines across the mountains, where, for a long time, it had been the sole available instrument; and one year ago it was in the shop for repairs, the owner still believing that for railway work it had no superior. This instrument was light, weighing between fifteen and sixteen lbs.; had seen at least 40 years' service, large part of the time in the hands of Assistants, and in the rough, wooded country. We doubt the possibility of a long centred instrument leading an equally long life.

While in charge of some Railway works, we kept in office, where there were several Assistants, both styles of instruments, and the Assistant's choice, in all cases, was for the flat centre.

It is not our intention to argue any superiority in the first form of Transit. It is not the equal, for accuracy and smoothness of motion, of the long centre. Its day of universal application has passed, and its field of usefulness narrowed; but it yet *has* its field, and the Engineer will do well in making selections to give it fair consideration. Our desire is simply to do it justice, and to offer for it a slight defence to our younger Engineers, who having never seen or used it, can know but little of its faults or merits.

In the Transit's early days, no Express, on call, drove to the door, receipted for the boxes, and relieved all anxiety, no matter how many thousand miles away, nor what obscure point was the destination. Instead of this, they had in many cases to be consigned to the top of the stage, or to the Connestoga wagons, unless the destination was near the coast, when the sea became the best route. Thus we find the following extracts, looking at random into the books of shipments:

1833. Aug. 13. Sent, per ship Chester, to F. Beaumont, Natchez, care of Florchell & Co., New Orleans.

1833. Aug. 16. Sent, per brig Mohawk, to Boston, to W. G. Neil, for Boston and Providence R. R.

There is no difficulty in understanding why the call was for a Transit that nothing much short of entire annihilation would render necessary to send back, over its slow, long, and uncertain journey, for repairs.

The spread of internal improvements in this country had, at this time, fairly commenced, and with it the demand for the new instrument increased rapidly. So great was this increase, and so much did it outgrow the facilities of manufacture, that the inventor was compelled to send to England an order to have the greater part of a limited number of transits made. This was in 1835, and these were the first transits, or parts of transits, made in England. About three dozen were thus obtained, the more particular parts being made here. They proved far from remunerative; some few were passable, others more troublesome, requiring alterations and repairs; while a fatal fault to a needle instrument, iron in the metal, was found to exist in nearly a dozen.

Of the latter, most were broken up; several remained in the establishment, in an unfinished condition, until recently, one of the last being taken to adorn the monument of a Civil Engineer, in Laurel Hill Cemetery, Philadelphia.

The earlier manufacture of the transit instrument was, for want of conveniences, attended with many difficulties. The art of Graduation had as yet made but little progress, and the introduction of the transit called for nearer approach to perfection. The first Graduating machines were extremely primitive, consisting simply of a circular plate of about 18 inches diameter, upon which degrees and half degrees were marked off, either by mechanical sub-divisions, or from a similar plate. The one in the establishment of W. J. Young, bears the name of ADAMS, Maker, LONDON, and consists of such a plate as we have described.

Such were the means of graduation in 1820. Mr. Young started, as soon as he commenced business, the construction of an engine of 24 inches diameter, worked by the endless screw and treadle; and shortly after introduction of Transit commenced another of 26 inches diameter, for finer work, in which a new and important principle of construction for these engines was introduced. A few years afterwards, this same machine was rendered automatic, and is yet doing active duty, second to none outside of the establishment for accuracy. About the same time, Mr. Edmund Draper constructed a graduating engine, which, amongst those acquainted with it, has a high reputation for accuracy.

The completion of the large 48 inch Graduating Engine, by W. J. Young, which he intended to be the perfect engine of the world, completed a line of Graduating Engines, which, for completeness of range, is certainly not equalled here, perhaps not in any establishment in Europe.

As Transits advanced to perfection, these advances in graduation became necessary. That they were not made at once, but were the result of almost a life of thought,

work, and patience, and source of expense, is evident from the fact, that from the year 1821 to 1860, or but 10 years before his death, W. J. Young was almost constantly engaged upon the making or perfection of these engines.

Another serious difficulty arose from the want of opticians of ability. The first glasses used were imported principally from England. With the slow communication across ocean at that period, it was long before an order given could be received; and the purchase of all glasses to be found here, of proper size and focal length, furnished but a short supply. What was more troublesome, was the next supply differed in size and length from the last. When an inquiry for a larger instrument, or one of different construction, came, the question which determined the practicability of its manufacture, was the capability of making the telescope.

About 1849, an optician named Worth, commenced in New York the manufacture of glasses of telescopes for Engineer's Instruments, and they proving so much better than those otherwise attainable, the writer of this was sent to learn, under Worth's instructions, the optical art. Before long, arrangements were made, Mr. Young purchased the tools and mechinery, and it was removed to Philadelphia, along with the workmen, and connected with his establishment, with which it continued connected for many years, until, from increasing business, the tax on personal attention became too onerous; the tools and machinery were retained, and Mr. Worth placed in position to start for himself. From the optical department, as carried on during this period, came the majority of those now engaged in the manufacture of glasses for Engineering instruments. It gave the impetus which established the business permanently in this country. Fitz, of New York, and one or two others, had been quite successful in making the larger glasses for Astronomical Telescopes, but we believe had not turned their attention to the others.

The Transit instrument having thus been brought nearer perfection, in graduation and optical performance, received but few more changes in construction. The decimal graduation of vernier, suggested at an early day, by S. W. Mifflin, C. E., proved great advantage in the turning off deflection angles for curves, and was adopted by many, notably by the Engineers of Pensylvania R. R., all of whose instruments were graduated in that manner.

The *loose* vernier and arc, for vertical angles, applied by the writer about the year 1850, was an improvement over the much-liable-to-be-injured full circle.

The shifting Staff-head, patented by W. J. Young, in 1858, was another of those little improvements which increase the value of the instrument much.

The many varied uses to which, from progress of science in this country, the instrument has been called, has brought forth instruments of greater delicacy and different constructions, until, today, the finest Transit of the conscientious instrument maker is a splendid instrument, not surpassed in its performances by the production of any other country.

Of later minor improvements, some beneficial, some the exploded humbugs of bygone days, we are not now to speak. The profession have other, perhaps less partial means of discovering them. Our desire is simply to keep from oblivion, the dates and circumstances of introduction of the instrument which has played so important a part in the ever memorable forty-five years of American railroad construction, and which might, perhaps, be lost in the whirl which has been crowding the Railroad mind ever forward, leave it no time to look back to the earlier laborers.

The Mechanical Age.

The London Times, criticising Lord Derby's Manchester speech, says:

"However quick other countries may have been to develop the great mechanical discoveries of the century, it is to England that those discoveries are mainly due; and our riches have been derived as much from the genius and patient intelligence of men like Stephenson and Faraday, as from our stores of coal and iron. But until recently manufactures and machinery were regarded very much as outlying provinces of human energy, which might be left to take care of themselves. They brought wealth to the country and fortunes to individuals, but they were regarded as no more a matter of general concern than any other trade. They are now recognized as a kind of public care; and even in his capacity of Foreign Secretady, Lord Derby was invited at Manchester to treat them as of primary importance. Without going the length of Dr. Playfair the other day and treating the natural science as almost a substitute for all human culture, it is evident that, as a matter of fact, all culture is being brought to bear upon them, and that they are absorbing energy and attracting thought in every sphere of life. In view of this remarkable revolution of thought, one is a little provoked by the very matter-of-fact reasons which are usually alleged in explanation of it, and Lord Derby, in the greater part of his Machester speech, was too true to his habitual caution in contenting himself with reiterating them. Labor, he says, is dear, and is becoming dearer; and it is consequently more and more necessary to invent labor saving machinery. Similarly, at Leed, the other day, even the apostles