SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. XLI.—No. 9. [NEW SERIES.] NEW YORK, AUGUST 30, 1879. [$3.20 per Annum. [POSTAGE PREPAID.]

BESSEMER STEEL.

The Bessemer process of making steel stands prominent among modern inventions as a great success, both practically and financially. From a scientific standpoint it commands our attention, as being a remarkably simple and yet very effective process. Just now the Bessemer works of this country are very active, and it seems likely that the existing works will prove insufficient to supply the increasing demand for Bessemer steel.

The facts given in this connection were furnished us by the Albany and Rensselaer Iron and Steel Company, of Troy, N. Y., portions of whose works are shown in the engraving on this page. Two converters are used in the Bessemer steel department of this establishment, having a capacity of seven tons each. They are about 9 feet external diameter and 16 feet high. They are made of a refractory material, the walls being about 1 foot thick. The exterior iron shell is made of ½ to ¾ inch wrought iron plates, and is mounted on trunnions, so that it may be inverted by a hydraulic cylinder by means of a rack and pinion.

Fig. 2.

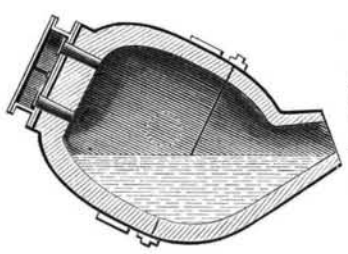
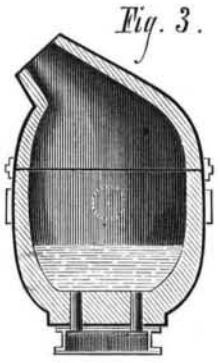


Fig. 3.

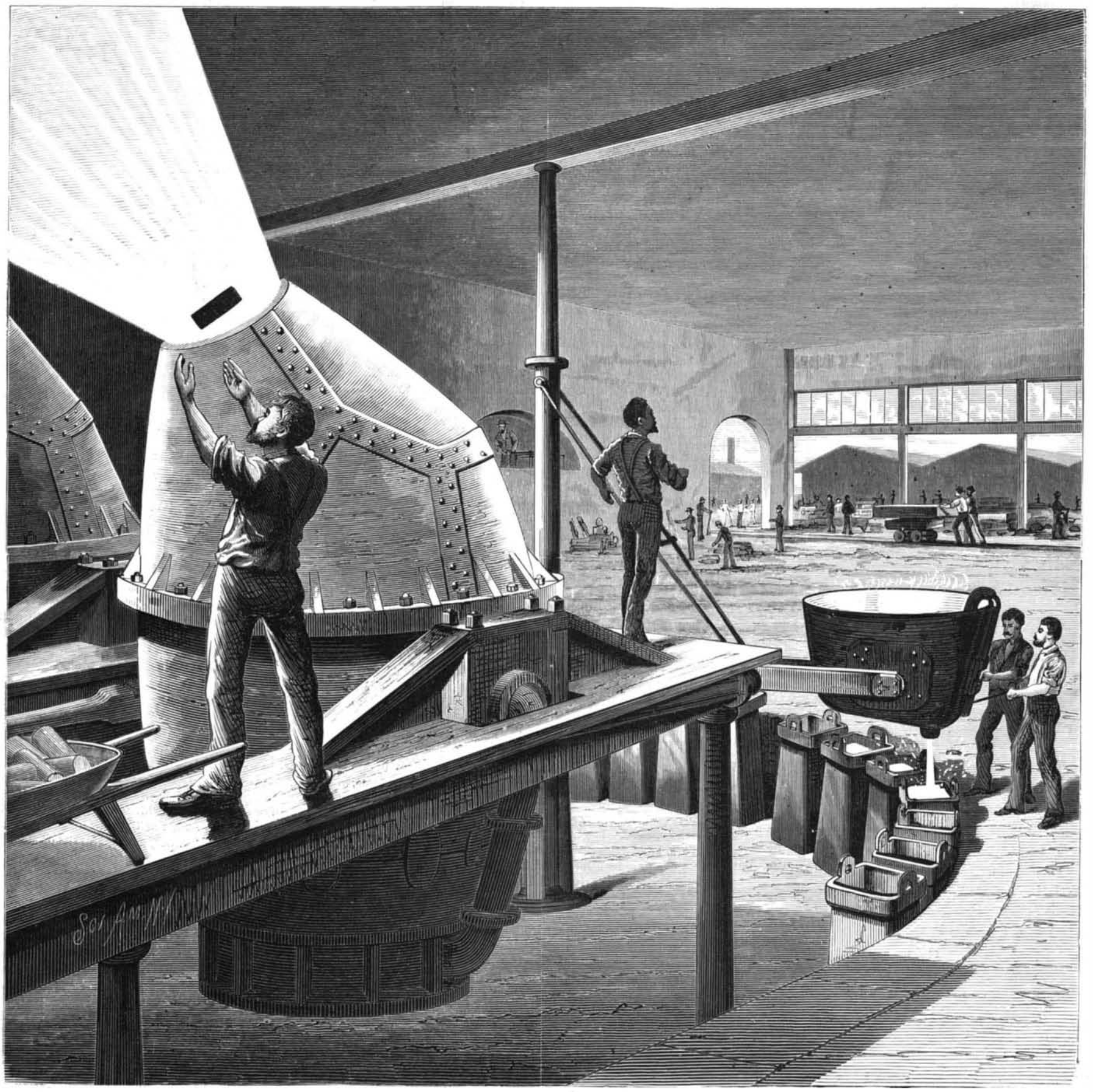


The construction of the converter is shown in the sectional views, Figs. 2 and 3. At one end it has a nose 18 inches in diameter, and at the other a tuyere box, communicating with the blowing engine through one of the trunnions.

Each bottom has 12 tuyeres, 6 inches in diameter and 24 inches long, made of fire clay, fire sand, and ganister, a stone belonging to the quartzite group. The tuyeres are each pierced by twelve ⅜ inch air holes through which the blast enters the converter. The converter is turned down, as shown in Fig. 2, to receive its charge of iron; it is of sufficient size to contain the entire charge below the nose and tuyeres.

The process of decarburizing iron requires about twenty

[*Continued on page* 137.]



MACHINERY FOR THE MANUFACTURE OF BESSEMER STEEL.

BESSEMER STEEL.

[*Continued from first page.*]

minutes. The charge of iron is first melted in a cupola and allowed to run into the converter, previously heated to redness. Before the converter is turned up into a vertical position, the blast is turned on to prevent the entrance of the melted iron into the blast holes of the tuyeres. The air, at a pressure of 20 to 25 pounds per square inch, penetrates the melted metal from 144 apertures, coming into contact with every particle. At first a reddish yellow, faintly luminous flame issues from the neck of the converter; soon it becomes more brilliant, the metal becoming in the meantime hotter and being violently agitated. Sparks appear, consisting of particles of iron and slag, which are thrown out by the rapidly disengaged gases. At this point the roar of the flame becomes terrific, and the light is intense.

During this portion of the process the iron, if it contains much silicon, would be overheated were it not for the introduction of masses of cold pig iron, which keep the temperature down. It is sometimes necessary to introduce cold iron to the amount of two tons. The iron is thrown in at the mouth of the converter in the manner represented in the engraving. This is necessary in case the iron is rich in silicon, as the very high temperature which would otherwise be produced would generate gases in great quantity, which make blow holes, cracks, and imperfections of various kinds in the ingots.

After some minutes blowing the sparks cease, the action becomes less violent, and the flame presents the bluish violet characteristic of carbonic oxide; finally, when the whole of the carbon is oxidized, the carbonic oxide flame is replaced by a stream of intensely heated gas, consisting chiefly of nitrogen resulting from the oxidation of the iron by the air. At this moment the foreman turns down the converter and shuts off the blast. A few seconds delay at this point may entirely spoil the product. A quantity of spiegeleisen, equal to 8 or 10 per cent of the whole, is now run into the converter, when another flame reaction occurs. The converter is turned still further down, and the steel runs into the ladle supported by the hydraulic crane standing in the center of the circular pit. Around the side of the pit, opposite the converters, there are fourteen heavy iron ingot moulds, seven of them being always in reserve while the other seven are being filled. These moulds contain one ton each. They are lined with a clay wash to prevent grooving and to insure the easy separation of the mould from the ingot. The ladle containing the charge of melted steel is swung around over the moulds, and the melted metal is allowed to escape through a valve opening in the bottom into the several moulds in succession.

After the steel solidifies and cools sufficiently, the moulds are removed from the ingots, leaving them standing. A hydraulic crane outside of the pit, armed with a grapple something like a pair of huge ice tongs, picks up the red hot ingots and places them on an iron car, to be trundled off to the rolling mill, where they are converted into rails, each ingot being sufficient for three or four rails. The largest production in a single day of 24 hours at these works was on December 5, 1878, when 35 tons 19 cwt. (2,240 lb. to ton) were made.

The facility with which these huge pieces of machinery are made to handle such masses of hot metal is something wonderful. The movements of the converters, the air blast, and the ponderous cranes are all controlled by the foreman, who sits in the gallery seen in the background, and by the movement of a few levers admits water here and there under a pressure of 400 pounds to the square inch, moving the strong iron arms with a celerity and precision that could not be attained by other means.

It may not be uninteresting in this connection to give the chemical changes that take place in the converter, as indicated by the changes in the composition of the gas evolved at different stages of the process.

	2 Min.	4 Min.	6 Min.	10 Min.	12 Min.	14 Min.
Carbonic oxide	....	3·95	4·52	19·59	29·30	31·11
Carbonic dioxide	10·71	8·57	8·20	5·58	2·30	1·34
Oxygen	·92	....	....	....	....	....
Hydrogen	....	·88	2·00	2·00	2·16	2·00
Nitrogen	88·37	86·58	85·28	74·83	66·24	65·55

The corresponding alterations in the composition of the metal are shown by the following analyses by Snelus of portions taken out of the converter during different stages of the operation:

	Gray pig operated upon.	Composition of metal after blowing.			Steel.	
		6 Min.	9 Min.	13 Min.	Ingot.	Rail.
Carbon { graphitic	2·070	..	....	....	....	....
Carbon { combined	1·200	2·170	1·550	·097	·566	·519
Silicon	1·952	·795	·635	·020	·030	·030
Sulphur	·014	Trace.	Trace.	Trace.	Trace	Trace.
Phosphorus	·048	·051	·064	·067	·053	·053
Manganese	·086	Trace.	Trace.	Trace.	·309	·309
Copper	....	....	....	....	·039	·039

It will be seen that a portion of the sulphur present in the pig is eliminated; the greater part of the silicon is also separated, together with the carbon, and almost in the same proportion; but the phosphorus is not removed, and owing to the oxidation of some iron the amount is actually greater in the finished steel than in the pig iron. The copper and manganese present in the steel are due to the manganiferous pig iron added at the end of the operation.

The *Manufacturer* furnishes the following list of Bessemer steel works now in operation in the United States:

The Bessemer steel works of the Albany and Rensselaer Iron and Steel Company, Troy, N. Y., was the first erected in the United States, having made its first blow February 15, 1865. It has two 7-ton converters. The next was the Pennsylvania steel works, at Baldwin station, near Harrisburg, Pa., which has two 6½-ton converters, and made its first blow in June, 1867. The third was the Cleveland Rolling Mill Company's Bessemerworks, at Cleveland, O., which made its first blow October 15, 1868, and has two 6-ton converters. The remaining eight works went into operation on the dates following: Cambria Iron Company's plant, Johnstown, Pa., July 10, 1871; two 5-ton converters. Union Rolling Mill Company's plant, Chicago, Ill., July 26, 1871; two 6-ton converters. North Chicago, April 10, 1872; two 6-ton converters. Joliet, Ill., March 15, 1873; two 6¾-ton converters. Bethlehem, at Bethlehem, Pa., October 4, 1873; two 7-ton converters. Edgar Thomson steel works, Pittsburg, September 1, 1875; two 7-ton converters. Lackawanna, at Scranton, Pa., October 23, 1875; two 5-ton converters. Vulcan, St. Louis, Mo., September 1, 1876; two 7-ton converters. The last named have been idle for several years, but we understand they will be put in operation on the 1st of October, the company already having orders to keep the works busy for six months. The Bessemer works throughout the entire country are rushed with work. They were, perhaps, never so busy before. Some years ago it almost appeared as if this business had been overdone like so many other branches of manufacture in the United States; but it does not look so now.

ENGINEERING INVENTIONS.

An improved instrument for measuring the distance of a remote object has been patented by Mr. John Boger, of Powhatan Point, Ohio. The invention is based upon the general principle of the employment of two right-angular bars, one of which is provided with a sighting-glass, and is directed toward the object, and the other graduated and provided with another sighting-instrument, which, when adjusted to a certain position upon the bar and turned to the object, indicates by the angle at such position the distance of the object, the distances which the different angles and positions together indicated being previously determined by careful measurement.

Mr. William Jackson, of Millerstown, Pa., has patented an improvement in air-compressing apparatus for locomotives, which consists in forming the wheels of the locomotive, preferably the driving-wheels, with radial air-compressing cylinders and pistons that are operated by eccentric motion of the tire with reference to the main body of the wheel, so that as the locomotive moves forward the pistons act in succession to force air through the hollow axle of the wheel into a compression-chamber, where it is stored for use in driving the locomotive.

An improved swinging gate, that is to be placed across a railroad track to keep cattle and other animals off, has been patented by Messrs. David A. Walker and John R. Smith, of Fort Benton, Montana Territory. It is to be opened by the contact of the pilot or cow-catcher of the locomotive, and will close automatically immediately after the passage of the train.

A lubricator for journals, provided with a roller arranged longitudinally in contact with the journal, inclosed in a top slot of bearing, and connected by a corresponding slot directly with the oil-reservoir, has been patented by Messrs. C. H. Leonard and W. B. Hick, of Wilkesbarre, Pa.

The August Meteors.

On the 10th of August last the earth, in its accustomed journey through space, reached the outer edge of the supposed meteoric ring which it annually passes through at this period of the year. In the vicinity of New York large numbers of meteors were seen during the night of August 10, some of them being of comparatively large size, very bright, and leaving long trails. Dr. Lewis Swift, in a recent letter to the Rochester *Express*, gives the following information concerning these remarkable heavenly bodies:

Meteoric astronomy now takes rank as a distinctive branch of astronomical science. Not forty years have elapsed since it was ascertained that star showers are periodical. Even then, and for many years after, it was supposed there were but two, called the August and November showers. Now, not less than one hundred have been detected, and others are constantly being added to the list. The accounts of the showers that occurred in ancient times came down to us clothed in such extravagant language that, until the great star shower of November 13, 1833, astronomers were loth to believe them. Now they know not only the cause, but are able to predict their recurrence with almost as much exactness as eclipses, and the popular mind observes these displays with equanimity and delight instead of fear and alarm, or thinking the day of judgment has come. Science has disarmed not only them, but eclipses and comets as well, of their terrors.

All know what a shooting star looks like, but no living man can tell us what it really is, for not one has ever been known to reach the earth. Those heavy, stony, and still more weighty metallic masses, called meteorites, meteoric stones, etc., which occasionally fall to the earth from the celestial regions, of which the one that recently fell in Iowa was a remarkable example, belong to another class of objects entirely, of the origin of which man knows nothing.

A shooting star is only visible while undergoing the process of combustion, which lasts from one to three seconds, seldom longer. Previous to this they exist in a dark, probably solid condition, not much, if any, larger than peas, too small to be seen by daylight, and in the night, being in the earth's shadow, are eclipsed, and consequently invisible. Only while being burned are they visible to us, as then they shine by their own light.

Each meteoroid moves in an orbit, revolving around the sun with as much regularity as the larger planets. In fact, each is in every sense of the word a planet, obeying strictly the laws of gravitation and planetary motion. All space is filled with them; they are as numerous as the sand. The earth and they in their journey round the sun encounter each other; the earth by its superior attraction draws them toward it, but to reach it they must pass through the atmosphere, which not one is able to do. Only meteoric stones are able to reach the earth, and they have their surfaces blackened, and converted to scoria by the terrible heat engendered by the friction with the atmosphere and by arrested motion.

Shooting stars move in all directions, and at velocities probably equal to the earth's, nearly nineteen miles a second. One moving retrograde, therefore (from east to west), would plunge into the atmosphere at a relative velocity of some thirty-eight miles a second, and, if allowance be made for accelerated motion caused by the earth's attraction, probably double that, or seventy-five miles a second. The encounter is fearful, and but for the atmosphere which acts as a cushion, the effect would be disastrous, for not less than 800,000,000 would rain upon the earth every day.

The source from whence these meteoroids come is comets, especially from their tails. The tail of the great comet of 1811 was 150,000,000 miles in length and 15,000,000 in diameter. It is improbable in the highest degree that the comet could gather its tail to itself again. It is left behind, forming part of a ring, which in time may become continuous. Another comet comes and it does the same, and during the ages which are past this process has been going on till the interplanetary spaces are filled with not only meteoroids, but something still more marvelous.

In about three thousand years that great comet will return again and repeat the process, forming part of another ring, or adding to the first, depending on circumstances which need not be considered here. Whenever the earth, in its annual journey, passes through any ring made by some comet, no man knows when, we get a star shower. The four most notable ones in our times take place at the following dates, namely, on the mornings of August 11 and November 14, and the evenings of November 24 and 27. The last two are caused by the earth passing through the track of meteoroids left behind by the fragments of Biela's comet, which divided into two parts in 1846. In this way meteoric rings are formed, of which the solar system is filled, but none are visible to us, except those the earth passes through. By some such process was the August ring formed, which the earth passed diagonally through on the evening of the 10th and morning of the 11th of the present month.

The first August shower mentioned in history occurred on July 25th, A.D. 811, and has appeared with unfailing regularity down to our own time, except a break of eighty-three years between 841 and 924, and another and much longer one of three hundred and ten years, between 933 and 1243, owing, probably, to breaks in the ring, or, which is more likely, to a failure to record them. The period of the above comet is about one hundred and twenty-three years, and it will therefore make its next appearance about the year 1985.

The eccentricity of the August ring is very great, its perihelion distance being equal to that of the earth, and its aphelion distance far beyond the orbit of Neptune, making the circumference of the ring more than 11,000,000,000 miles, and as the earth is ten days passing through it, its thickness must be at least 16,000,000 miles.

A Fall of 260 Feet.

Recently Mr. David M. Anderson, of this city, joined a party of friends who had been picnicking on the Palisades, near Englewood, N. J. Being engaged in business during the day he did not join the party until evening. The horses were hitched near the edge of a deep gorge which indents the face of the cliff, and one of them becoming restless Mr. Anderson started to remove it to a safer position. As he stepped forward, horse and carriage began slipping over the precipice. Seeing this, and thinking he could save them, he sprang upon what he supposed was solid ground between two openings in the cliff. His footing proved to be nothing but a bush growing outward, and gave way as he stepped upon it. He was precipitated 260 feet, striking upon rocks and stones as he partly fell and partly slid. He was found in an upright position, tightly wedged between rocks and trees. His face was so cut and torn by the rocks that it could with difficulty be recognized. Near him lay the dead horse and broken carriage. Strange to say, Mr. Anderson was not killed; and though severely injured was, at last reports, likely to recover.

Mr. Gladstone on America's Future.

At the opening of the Art Exhibition at Chester (Eng.), August 11, Mr. Gladstone said that when America learned to trust entirely to her own splendid natural resources, the great genius of her people, and their marvelous proficiency in the adaptation of labor-saving appliances, in which she was at the head of the world, she would be a formidable competitor with the English manufacturer.

Are we to infer that America has not yet become a "formidable competitor" to England? If so, the attention which American manufacturers are receiving in England must be curiously out of proportion to existing conditions.