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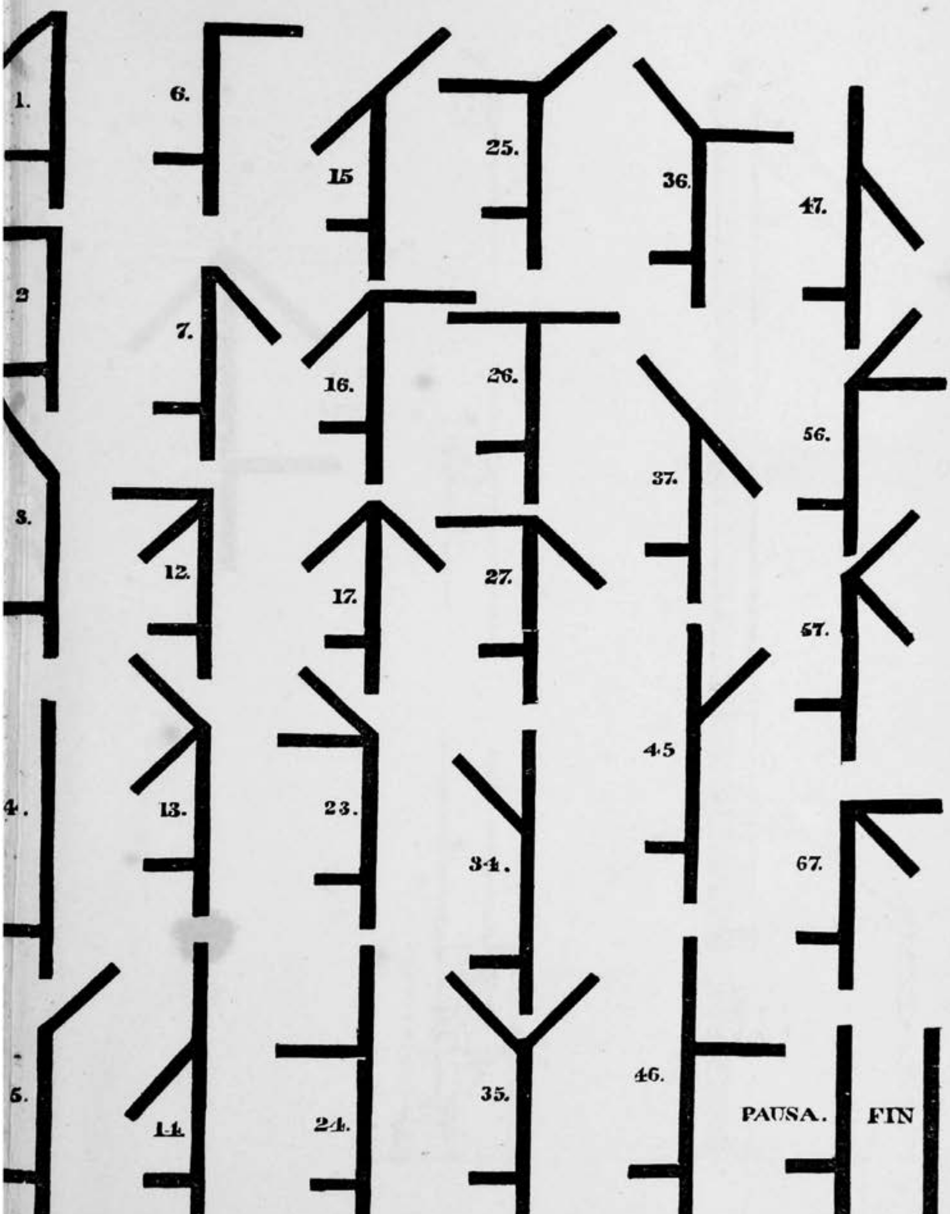
A Reward of Merit
Presented to Miss J. Thumbridge
By Miss Bark.
Midsummer
1852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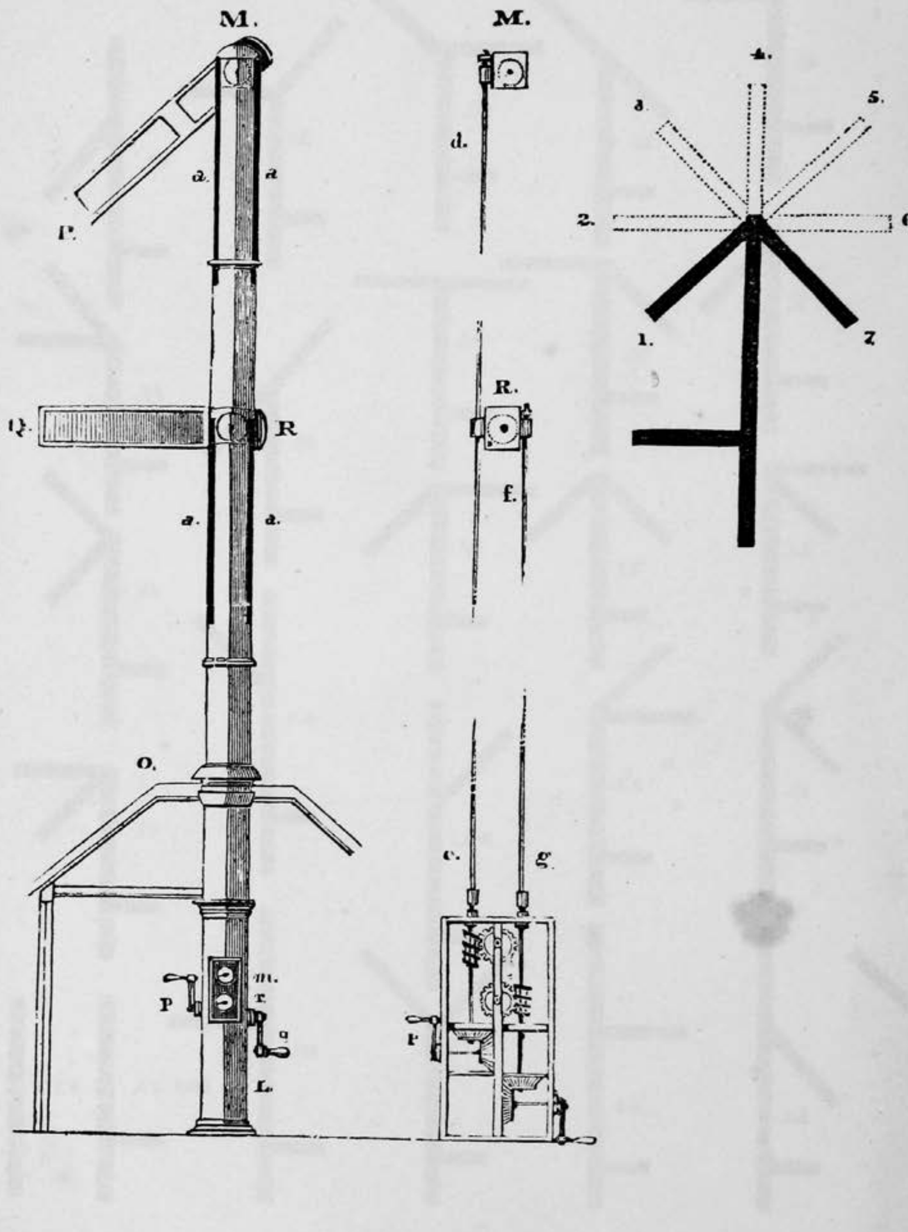


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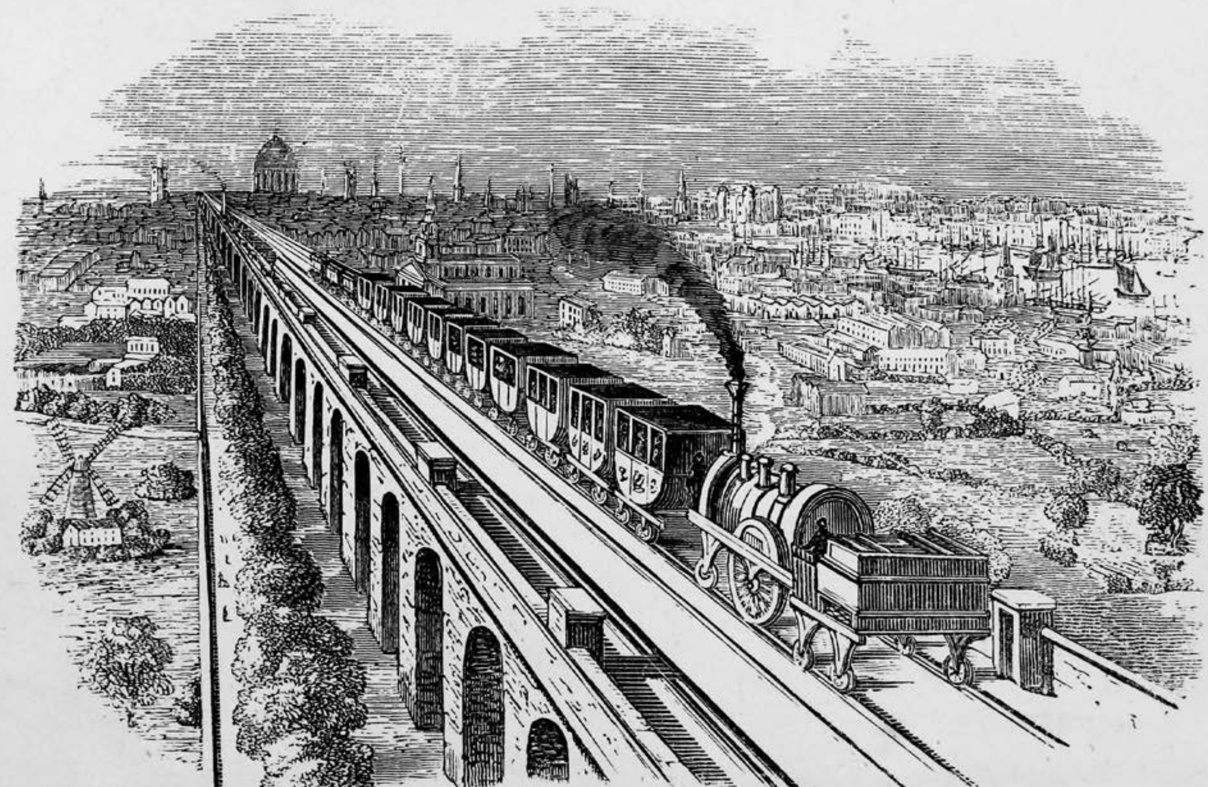

The Greenwich Railway.

# THE BEAUTIES & WONDERS

OF

# NATURE AND SCIENCE:

A COLLECTION

OF

**Curious, Interesting, & Valuable Information,**

FOR THE

INSTRUCTION & IMPROVEMENT OF THE ENQUIRING MIND.

EDITED BY LINNEY GILBERT, A. M.,

Assisted by his Literary Friends.

The Peak, Derbyshire.

WITH NUMEROUS ILLUSTRATIVE ENGRAVINGS.

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THE BEAUTIES AND WONDERS

OF

# NATURE AND SCIENCE.

" There are more things in heaven and earth, Horatio,
Than are dreamt of in your philosophy."

*Hamlet.*

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The Editor of the following pages has culled a few of Nature s gems, but claims only the string that binds them; from the unbounded mine of Creation's wonders, he has selected a few of the most prominent, as affording *only a sample* of infinite wisdom and goodness; to mention all, would require a library. As a fitting accompaniment, he has added some of the brightest conceptions of man's vast ingenuity, which he has endeavoured to describe, faintly, but truly.

To trace with minuteness, or follow in any manner that could be said to approach to fidelity of description, the mighty progress of science within the last half century, would be a gigantic task, which the Editor has neither attempted nor pretented to have accomplished. To follow in its wake, at a very humble distance, has been to him a pleasure and duty; and if his labours induce but one inquiring mind to participate in that pleasure, his purpose will be gained—his utmost wishes realized. At the very threshold of science, many, too many, "shrink back affrighted;" these pages, it is hoped, will prove, that if it is not wholly " a path of primrose dalliance," it is, at least, free from those difficulties which it is usually imagined environ it.

Like the Trumpeter in the Fable, if he did not fight himself, he has blown the *pas de charge* to other's valor; let us hope that he may be permitted to join in the *Te Deum* of victory.

Where all is beautiful, it is difficult to select the brightest, yet the Editor trusts that he has neglected nothing which could in any way increase his reader's store of intelligence and pleasure.

He also takes the opportunity of returning his best acknowledgments to several talented friends, who have enriched the work with the results of their researches.

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# LIST OF PLATES.

# WONDERS OF NATURE AND SCIENCE.

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## CONTENTS.

# MONT BLANC.

The summit of this mountain is a ridge, nearly horizontal, lying east and west; the slope at each extremity is inclined from 28 to 30 degrees; the south side between 15 and 20, and the north side about 45 or 50. This ridge is so narrow as scarcely to allow two people to walk abreast, especially at the west end, where it resembles the roof of a house. It is wholly covered with snow, nor is any bare rock to be seen within 150 yards of the top. The surface of the snow is scaly, and, in some places, covered with an icy crust, under which the snow is dusty, and without consistence. The highest rocks are all granites, those on the east side are all steatites, those on the south and the west contain a large quantity of schoerl, and a little *lapis corneus*. Some of these, especially those on the east, which are about 150 yards below the summit, seem to have been lately shivered with lightning. Sir George Shuckburgh made the height of Mont Blanc, by trigonometrical measurement, 15,973 English feet, or nearly three miles above the level of the sea. M. de Saussure found, by his electrometer, that the electricity of the air on the summit of the mountain, was positive. Water boiled at 68.993 degrees of a thermometer, which rises to 80 with the barometer, 27 French inches high. The wind was north, and extremely piercing on the summit, but southward of the ridge the temperature of the air was agreeable. The experiments with lime water and with the caustic alkali, show that the air was mixed with carbonic acid, or fixed air. Mont Blanc is the highest of the Alps, and encompassed by those wonderful collections of snow and ice, called the *Glaciers*. Of these glaciers there are five, which extend almost to the plain of the vale of Chamouni, and are separated by wild forests, corn fields, and rich meadows, so that immense tracts of ice are blended with the highest cultivation, and perpetually succeed to each other, in the most singular and striking vicissitude. All these several valleys of ice, which lie chiefly in the hollows of the mountains, and are some leagues in length, unite together at the foot of Mont Blanc.

The summit of these mountains was deemed inaccessible, before Dr. Paccad, a physician of Chamouni, reached it, in August, 1786. Soon after it was again successfully attempted by M. de Saussure, in

1787, and it has been several times accomplished since, particularly by Mr. Auldjo, very recently.

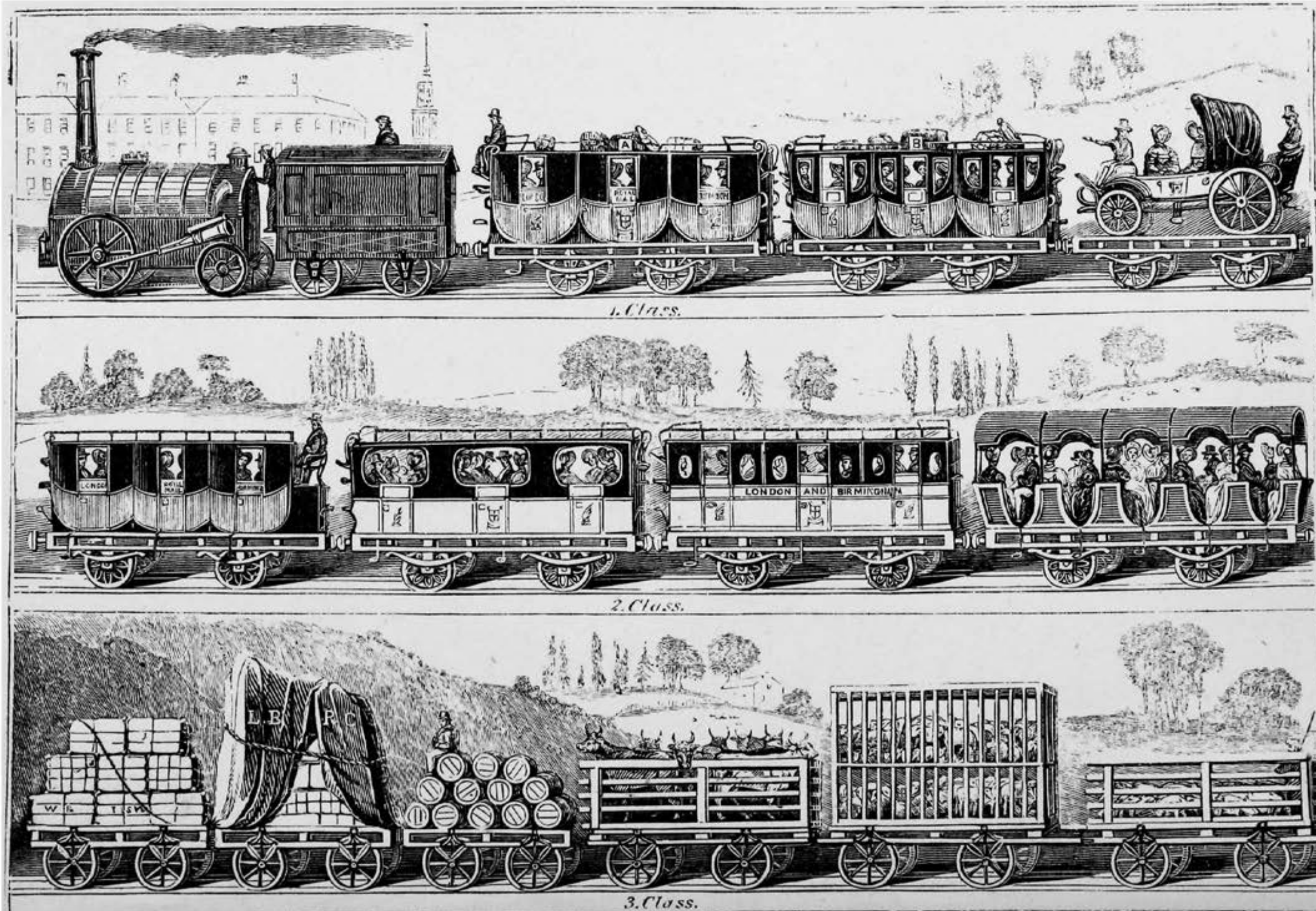
Although it is scarcely six miles and three quarters in a straight line from the priory of Chamouni to the top of Mont Blanc, it requires, nevertheless, eighteen hours to gain the summit, owing to the bad roads, the windings, and the great perpendicular height of the mountain. To the priory the journey was free from danger, or even difficulty ; the road being either rocky or covered with grass ; but thence, upwards, it was wholly covered with snow, or consisted of the most slippery ice. The ice valley on the side of the hill must be passed, in order to gain the foot of that chain of rocks bordering on the perpetual snows which cover Mont Blanc. The passage through this valley is extremely dangerous, since it is intersected with numerous wide, deep, and irregular chasms, which can only be crossed by means of bridges, naturally formed of snow, and these, often very slender, extended as it were over an abyss. The difficulties they had to encounter in this valley, and the winding road they were obliged to take through it, occasioned their being more than three hours in crossing it, although in a straight line its breadth is not above three quarters of a mile.

After having reached the rocks, they mounted in a serpentine direction to a valley filled with snow, which runs from north to south to the foot of the highest pinnacle. The surface of the snow in this valley has numerous fissures, and when this is broken perpendicularly, affords an opportunity of observing the successive horizontal layers of snow, which are annually formed.

The party passed the night at a height of 3,100 yards above the priory of Chamouni, and 4,250 yards above the level of the sea, which is 200 yards higher than the Peak of Teneriffe. They dug a deep hole in the snow, sufficiently wide to contain the whole company, and covered its top with the tent cloth. In making this encampment, they began to experience the effects of the rarity of the atmosphere. Robust men, to whom seven or eight hours' walking, or rather climbing, were an absolute nothing, had scarcely raised five or six shovels full of snow, before they were under the necessity of resting and relieving each othe almost incessantly. One of them had gone back a short distance to fil a cask with some water which he had seen in one of the crevices of the snow, but found himself so disordered in his way, that he returned without the water, and passed the night in great pain. The principal inconvenience which the thickness of the air produces, is an excessive thirst. They had no means of procuring water but by melting the snow, and the little store which they had carried with them afforded but a feeble supply for twenty men.

This region of the mountain presents to the view nothing but snow of the purest and most dazzling whiteness, forming a very singular contrast with the sky, which appears remarkably black. "No living creature," says our author, "is to be seen in these desolate regions, nor is the least trace of vegetation to be discovered. It is the habitation of cold and silence! My guides were so firmly prepossessed with the fear of cold, that they shut every aperture of the tent with the utmost exactness; so that I suffered very considerably from the heat and vitiated air, which had become highly noxious, from the breaths of so many people in so small a room. I was frequently obliged, in the course of the night, to go out of the tent in order to relieve my breathing. The moon shone with the brightest splendour, in the midst of a sky, black as ebony. Jupiter, rayed like the sun, arose from behind the mountains of the east. The light of these luminaries was reflected from the white plain, or rather basin, in which we were situated, and, dazzling, eclipsed every star, except those of the first and second magnitude. At length we composed ourselves to sleep. We were, however, soon awakened by the noise of an immense mass of snow (*Avalanche*) which had fallen down from the top of the mountain, and covered part of the slope over which we were to climb the next day.

"We began our ascent to the third and last plain, and then turned on our left in our way to the highest rock, which is on the east part of the summit. The ascent is here very steep, being about thirty-nine degrees inclined to the horizon, and bounded on each side by precipices. The surface of the snow was so hard and slippery, that our pioneers were obliged to hew out their footsteps with hatches. Thus we were two hours in climbing a hill of about 530 yards. Having arrived at this last rock, we turned to the westward, and climbed the last ascent, whose height is about 300 yards, and its inclination above 28 or 29 degrees. On this peak the atmosphere is so rare, that a man's strength is exhausted with the least fatigue. When we came near to the top, I could not walk fifteen or sixteen steps without stopping to take breath, and I frequently perceived myself so faint, that I was under the necessity of sitting down from time to time, and in proportion as I recovered my breath, I felt my strength renewed. All my guides experienced similar sensations in proportion to their respective constitutions. We arrived at the summit of Mont Blanc at eleven o'clock in the forenoon. I now enjoyed the grand spectacle that was under my eyes. A thin vapour suspended in the inferior regions of the air, deprived me of the distinct view of the lowest and most remote objects, such as the plains of France and Lombardy; but I did not so much regret this loss, since I saw with remarkable clearness, what I principally wished to see, viz.—the assemblage of these high ridges, with the true forms and situations of which I had long been desirous of becoming thoroughly acquainted. I could scarcely believe my eyes—I thought myself in a dream—when I saw below my feet so many majestic peaks, especially the Needles, the Midi Argentiere, and Gêant, whose bases had proved so difficult and dangerous of access. I obtained a perfect knowledge of their proportion to, and connexion with, each other; of their form and structure; and a single view removed more doubts, and afforded more information, than whole years of study. While I was thus employed, my guides pitched my tent, and were fixing my apparatus for the experiments I had proposed to make on boiling water, but when I came to dispose my instruments for the purpose, I was obliged, almost at every instant, to desist from my labours, and turn all my thoughts to the means of respiration. When it is considered that the Mercury in the barometer was no higher than 16 inches and a line (17—145 inches English), and that this air had consequently little more than half the density of that on the plains, the breathing must necessarily be increased, in order to cause, in a given time, the passage of a sufficient quantity of air through the lungs. The frequency of respiration increased the circulation of the blood; more especially as the arteries on the surface of the body had not the pressure they were usually accustomed to. We were all in a feverish state, as will be seen in the sequel. While I remained perfectly still, I experienced but little uneasiness, more than a slight oppression about my heart; but on the smallest bodily exertion, or when I fixed my attention on any subject for some minutes together, and particularly when I pressed my chest in the act of stooping, I was obliged to rest, and pause for two or three minutes. My guides were in a similar condition. We had no appetite, and our provisions, which were all frozen, were not well calculated to excite it. Nor had we any inclination for wine or brandy, which increased our indisposition, most probably, by accelerating the circulation of the blood. Nothing but fresh water relieved us, and much time and trouble were necessary to procure this article, as we could have no other than melted snow. I remained on the summit till half-past three, and though I did not lose a single moment, I was not able to make all those experiments in four hours and a half, which I have frequently done in less than three hours by the sea-side. We returned much easier than I could have




Railway Travelling.

expected, since in descending we did not experience any bad effects from the compression of the thorax, our respiration was not impeded, and we were not under the necessity of resting, in order to recover our breath and strength. The road down to the first plain was, nevertheless, by no means agreeable, on account of the great declivity; and the sun shining so bright on the tops of the precipices below us, made so dazzling an appearance, that it required a good head to avoid growing giddy from the prospect. We pitched our tent again on the snow, though we were more than four hundred yards below our last night's encampment. I was here convinced that it was the rarity of the air, and not the fatigue of the journey, that had incommoded us on the summit of the mountain; otherwise we should not have found ourselves so well, and so able to attack our supper with a good appetite. I could now also make my meteorological observations without any inconvenience. I am persuaded that the indisposition in consequence of the atmosphere, is different in different persons. For my part, I felt no inconvenience at the height of four thousand yards, or nearly two miles and a quarter, but I began to be much affected when I was higher in the atmosphere. The next day we found that the ice in the valley which we had passed in our first day's journey, had undergone a considerable change, from the heat of the two preceding days, and that it was much more difficult to pass, than it had been in our ascent. We were obliged to go down a declivity of snow, of no less than fifty degrees of inclination, in order to avoid a chasm which had happened during our expedition. We at length got down as low as the first eminence on the side, about half after nine, and were perfectly happy to find ourselves on a foundation which we were sure would not give way under our feet."

We cannot close our account of this mighty work of Nature, better than by quoting the following beautiful apostrophe to it:

———————" Rise, O ever rise!
Rise like a cloud of incense from the earth!
Thou kingly spirit throned among the hills!
Thou dread ambassador from earth to heaven!
Great hierarch! tell thou the silent sky,
And tell the stars, and tell yon rising sun,
Earth with ten thousand voices praises God!"

*Coleridge.*

## THE GREAT ST. BERNARD,

Though it cannot boast of the height of its great neighbour, yet it rears its head in proud majesty. This mountain is situate in Savoy and Switzerland, between Valais and the Valley of Aoust, at the source of the rivers Drance and Doria. The top is always covered with snow, and there is a large monastery, called Hospice of Great St. Bernard, near to one of the most dangerous passages of the Alps. In these regions, the traveller is often overtaken by the most severe weather, even after days of cloudless beauty, when the glaciers glitter in the sunshine, and the pink flowers of the rhododendron appear as if they were never to be sullied by the tempest. But a storm suddenly comes on, the roads are rendered impassable by drifts of snow, the avalanches sweep the valleys, carrying trees and crags of rock before them. The hospitable monks, though their revenue is scanty, open their door to every stranger that presents himself. To be cold and weary, to be benighted, constitute the title to their comfortable shelter, their cheering meal, and their agreeable converse. But their attention to the distressed does not end here. They devote themselves to the dangerous task of searching for those unhappy persons who may have been overtaken by the avalanche or the sudden storm, and would perish but for their charitable succour. Most remarkably are they assisted in these truly Christian offices. They have a breed of noble dogs in their establishment, whose extraordinary sagacity often enables them to rescue the traveller from destruction by the overwhelming avalanche.

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## AVALANCHES

Are the most dangerous and terrible phenomena to which the valleys embosomed between high snow topped mountain-ranges are exposed. They are especially frequent in the Alps, owing to the steepness of their declivities, but they are also known in other mountain regions, as in the Pyrenees and in Norway. They originate in the higher region of the mountains, when the accumulation of snow becomes so great, that the inclined plane on which the mass rests can no longer support it. It is then pushed down the declivity by its own weight, and precipitated into the subjacent valley, where it often destroys forests and villages, buries men and cattle, and sometimes fills up rivers, and stops their course. Besides what is covered with masses of snow, persons are often killed, and houses overthrown, by the sudden compression of the air, caused by the incredible velocity with which these enormous masses descend. There are four different kinds of avalanches; viz.—drift, rolling, sliding, and glacier or ice avalanches; of which the first commonly take place in the early part of winter, the second and third at the end of winter or in spring, and the last only in summer. The drift or loose snow avalanches (the Swiss call them staub lauinen) take place when heavy snow has fallen in the upper region of the mountains during a still calm, and this accumulated mass, before it acquires consistency, is put in motion by a strong wind. The snow is driven from one declivity to another, and so enormously increased in its progress, that it brings down an incredible volume of loose snow, which often covers a great part of a valley. The damage caused by these avalanches is, however, generally not very great, because most of the objects covered by them may be freed from the snow without having sustained great damage; but they often produce such a compression in the air, that houses are overturned, and men and cattle suffocated.

The rolling avalanches are much more dangerous and destructive. These take place when after a thaw the snow becomes clumsy, and the single grains or flocks stick to one another, so as to unite into large hard pieces, which commonly take the form of balls. Such a ball, moved by its own weight, begins to descend the inclined plane, and all the snow it meets in its course downwards sticks firmly to it. This snow mass, increasing rapidly in its progress, and descending with great velocity, covers, destroys, or carries away, every thing that opposes its course—trees, forests, houses, and rocks. This is the most destructive of these avalanches, and causes great loss of life and property. In the year 1749, the whole village of Reuras, in the Canton of the Grisons, was covered, and, at the same time, removed from its site, by an avalanche of this description; but this change, which happened in the night time, was effected without the least noise, so that the inhabitants were not aware of it, and on awaking in the morning could not conceive why it did not grow day. A hundred persons were dug out of the snow, sixty of whom were still alive, the interstices between the snow containing sufficient air to support life. In 1806, an avalanche descended into Val Calanca, likewise in the Canton of the Grisons, transplanted a forest from one side of the valley to the other, and placed a fir tree on the roof of a parsonage house. In 1820, sixty-four persons were killed at Fettan, in the high valley of Engadin, in the country of the Grisons, and in the same year eighty-four persons and four hundred head of cattle, in Obergestelen, and twenty-three persons at Brieg, both situated in the Canton of Wallis. In the same country the village of Briel was almost entirely covered by an avalanche in 1827.

Many thousands of strong trees are destroyed by these avalanches, either by being broken off near the ground, or by being rooted up, strewed to pieces, and thus precipitated into the valley. Where these avalanches are of common occurrence, the inhabitants of the valleys know the places where they come down, and by observing the changes of the weather, they are able to foretel the time of their descent. The sliding avalanches originate on the lower and less steep declivities, when after a long thaw in spring, those layers of the snowy-covering which are nearest the ground, are dissolved into water, and thus the bond is loosened which unites the mass to its base. The whole snowy-covering of a declivity then begins to move slowly down the slippery slope, and to carry before it any thing which is too weak to withstand its pressure. When an object does not directly give way to the mass, it is either borne down by the snow accumulating behind it, or the whole mass divides and proceeds in its course on each side of it. The ice or glacier avalanches are nothing but pieces of ice, which formerly constituted a part of a glacier, but, loosened by the summer heat, are detached from the principal mass, and precipitated down with a noise like thunder. They are commonly broken into small pieces by the rocks which they meet with in their progress. When seen from a distance, they resemble the cataracts of a powerful stream. In the valley of Grindelwald, Bera, they may often be seen, and at the base of the Jungfrau, the thunder which accompanies their fall is almost continually heard. They are less destructive than the other avalanches, because they descend upon places which are not inhabited.

Occasionally the avalanches change their character in their progress. When the declivity is not too great, and the ground under it not too slippery, the mass of snow begins to slide, but arriving at a precipitous descent, its velocity and its masses are considerably increased, and it begins to roll. If in this stage of its course it meets a strong craggy rock, the mass is instantly divided into innumerable small pieces, and thus it appears at the end of its progress like a drift avalanche.

These phenomena are commonly known by the name of avalanches in France, but situate between the ranges of the Alps, they have the names of lids, lits or lydts. In Italy they are called Lavina; in Germany, Lähnen; in the neighbourhood of the Pyreness, Congeres; and in Norway, Snee Shred, and Snee Fond.

In the winter of 1837, there was an immense fall of snow at Lewes, in Sussex, which one might almost call an Avalanche. One of the streets of Lewes runs by the side of immense rocks or hills, and upon the setting in of a very sudden thaw, down came an enormous mass of snow. Cottages were overwhelmed, several persons perished, and numbers of cattle were destroyed. Fatal as this was, yet from it we can form but a very faint idea of those awful and terrific falls, witnessed in the Alps, where

> "Aghast, beneath it the pale victim sees
> The falling promontory—sees—and dies."

## CHAMOIS HUNTING IN THE ALPS.

With a full knowledge of the dangers to be encountered, the chase of the Chamois is, with the hunters, an insurmountable passion. Saussure relates, that he knew one who was on the point of marriage, but could not restrain his adventurous pursuit. "My father and grandfather were both killed following the sport," said he, to M. de S——, "and I am so certain that I shall be killed myself, that I call this bag, which I always carry with me when hunting, my *winding-sheet*. I am sure that I shall have no other, and yet if you were to offer to make my fortune, upon condition that I should renounce the chase of the Chamois, I should refuse your kindness." Our author adds, that he went several journeys on the Alps with this young man; that he possessed astonishing skill and strength, but his temerity was greater than either, and that two years after he met the fate which he anticipated, by his foot failing on the brink of a precipice to which he had leaped.

Death-bed scene of a Bear Hunter of the Pyrenees.—The father of the celebrated Fonda, himself y'clept, "le pere des Chasseurs de la vallie d' Ossau," was a most determined and successful bear hunter. He had killed, with his own hand, ninety-nine bears. When he was upon his death-bed, and after he had received absolution of his sins, he observed to the priest, that he had still one heavy cause of uneasiness and regret on his mind. "What can that be?" said the priest, "you have conducted yourself honourably in your transactions with your fellow men, and you die in the true faith, and pardoned for your sins." "What you say is very true," answered the dying man, "but would that I had killed my hundredth bear."

## THE PYRENEES

Are that chain of mountains which divide the Spanish peninsular from France, and which extend from the *Cap de Cevere* to the south-east of Colliouvre, or rather from the *Cap de Creus*, near Rosas, upon the shores of the Mediterranean, to the point of Figuier, near Fontarabia, on the Bay of Biscay. It is almost generally supposed that the Pyrenees are an isolated chain of mountains, from the fact, that their extremities drop into the sea, but a reference to their geographical position will determine that the Pyrenees form but a part of the same line of mountains both of France and Spain. In short, the Pyrenees appear to be attached on the east, to the great chain of the Alps, by the *Montagne Noire*, and to the west at the point of *Figuier*, and from thence to Cape Ortegal, in Galicia.

The length of the Pyrenees from east to west is about 200 miles, and their breadth very varied. It is greater in the centre, than towards the extremities of the chain, but may throughout be averaged at sixty miles. The Pyrenees are seen from a great distance, from whichever side they are regarded. One of the most favourable points from which to enjoy a view of this magnificent chain, is from the hills called *Pech David*, to the south of Toulouse. There the spectator is placed nearly in front of the centre of the range, sufficiently distant to admit of a vast horizon, and yet near enough to distinguish the most remarkable features.

From the Pech David the Pyrenees may be seen for more than 150 miles. The appearance they present is extremely imposing. They seem to form one single mountain, increasing in height towards the east, but broken into summits of various forms and characters. But the aspect of the mountains is not always the same, depending entirely on the state of the atmosphere, the hour of the day, and the season; and during the prevalence of the west and north winds, they are shrouded in mists.

Naturalists consider that the southern coasts of the Pyrenees are the most steep and rapid; and this is confirmed by modern travellers. On the Spanish sides, the ascents are invariably more steep and rugged, and consequently more difficult and fatiguing. Almost the whole of the French valleys either ascend gradually to the central ridge, or by a succession of basins. On the Spanish frontier this is seldom the case, and in the vicinity of the highest mountain, Mont Perdu, the summits decrease in altitude very suddenly, dwindling almost into insignificance at its base, while on the French side of that mountain, there are very many summits but little inferior in height to its own. The Pyrenees contain a great number of valleys. All the great ones are transversal. They begin at *a Col*, in the ridge of the central chain, and taking their course directly to the north or south, they form nearly a right angle with it.

There are few of the valleys of the Pyrenees, which, throughout their course, do not present a succession of basins. These basins are formed by the mountains which border the valley receding from the banks of the river, and leaving a circular hollow, where there is so slight an acclivity, that the stream indulates slowly, until at the extremity of the basin, where it resumes its original character, and runs through their gorges, and dashes over their precipices. These basins are in general considerably elevated above each other, and are joined together by narrow and deep ravines, rapidly inclined plains, or by a slope of rock, so very perpendicular, that the river dashing over forms a cataract from the basin above to that beneath. The climate of the two extremities of the Pyrenees is much warmer than that of their central districts. Their proximity to the sea, their comparatively slight elevation above the level of the ocean, and their distance from the great mountains, are the principal cause of this great difference of temperature. With the exception of the high valleys, the climate is in general very genial, the winter is very mild, the cold by no means severe, and the snow which falls very rarely remains beyond a day or two in the lower valleys; the summers are very warm, too warm for comfort, if the mountains were not near enough to fly to. Thunder storms are very frequent in the summer, but are seldom of long duration, and are accompanied with welcome rains, which greatly cool the atmosphere. The Pyrenees abound in mineral springs, which have acquired great celebrity from the wonderful cures that they are said to have effected.

The following will shew the estimated heights of the principal mountains of the Pyrenees. Mont Perdu, 11,283 feet; Maladitta, 10,857 feet; Le Pic Blanc, 10,205 feet; Tournavacas, 8,500 feet; Canigon, 9,290 feet; Pic d' Abizon, 8,344.

The most lofty mountains in general form parts of extensive chains; but there are many instances of great elevation being attained by isolated peaks. Instances of the former are familiar in the Alps, the Carpathians, the Himalaya, and the Andes; of the latter the towering summits of Ætna, Teneriffe, and Mouna Roa, in the Sandwich Islands. But such detached elevations are either active or extinct volcanoes.

# COMPARATIVE HEIGHT

## OF THE PRINCIPAL MOUNTAINS IN THE WORLD.

| | Names | Country where situate. | Height in English feet. |
|---|---|---|---|
| | | **Asia.** | |
| 1 | Dhawala Gira | Thibet | 26,462 |
| 2 | Jewahir | Jewahir. | 25,749 |
| 3 | Jamatura | Malown | 25,500 |
| 4 | Black Peak | Do. | 21,155 |
| 5 | Petcha | China | 21,000 |
| 6 | Moonakoah | Sandwich Isles | 18,000 |
| 7 | Lebanon | Asiatic Turkey | 9,520 |
| 8 | Ararat | Ditto | 9,500 |
| 9 | Carmel | Do. | 2,200 |
| 10 | Tabor | Do. | 2,000 |
| | | **America.** | |
| 11 | Chimboraco | Quito | 21,464 |
| 12 | Cotopaxi (Volcanic) | Ditto | 18,870 |
| 13 | Imbubara (ditto) | Ditto | 8,970 |
| 14 | Blue Mountain | Jamaica | 8,180 |
| 15 | Peaks of the Topian ridge | United States | 16,300 |
| 16 | Rocky Mountains | Do. | 12,500 |
| 17 | Allegany Mountains | Do. | 3,010 |
| 18 | Katskill | Do. | 3,000 |
| 19 | Mount St. Elie | Mexico | 18,222 |
| 20 | Popocatepetl | Do. | 16,365 |
| | | **Africa.** | |
| 12 | Geesh | Abyssinia | 15,050 |
| 22 | Peak of Teneriffe | Canary Isles | 12,358 |
| 23 | Nieuweldt | South Africa | 10,000 |
| 24 | Table Mountain | Do. | 3,582 |
| | | **Europe.** | |
| 25 | Mont Blanc | Alps | 15,735 |
| 26 | St. Bernard | Do. | 11,006 |
| 27 | Simplon | Do. | 11,000 |
| 28 | St. Gothard | Do. | 9,075 |


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EUROPE.

| | Names | Country where situate. | Height in English feet |
|---|---|---|---|
| 29 | Mount Perdu | Pyrenees | 11,209 |
| 30 | Etna (Volcanic) Sicily | Sicily | 10,963 |
| 31 | Olympus | Greece | 6,600 |
| 32 | Vesuvius (Volcanic) | Naples | 3,978 |
| 33 | Hecla (Do.) | Iceland | 3,690 |
| 34 | Stromboli | Lipari | 3,020 |
| 35 | Gibraltar | Andalusia | 1,439 |
| 36 | Montmartre | Paris | 400 |
| 37 | Ben Nevis | Invernesshire | 4,358 |
| 38 | Snowdon | Carnarvonshire | 3,571 |
| 39 | Ben Lomond | Stirlingshire | 3,240 |
| 40 | Skiddaw | Cumberland | 3,055 |

The great pyramids of Egypt and St. Paul's Cathedral are the lower figures.

## MODES OF ASCERTAINING THE HEIGHTS OF MOUNTAINS.

The height of mountains exercises an important influence on the climate and productions of the regions where they occur, and it becomes an important point to determine their respective altitudes. This has usually been attempted by two methods; by geodesical mensuration, and by marking the difference of the barometrical columns on their summits, and at their bases. The first is the most accurate, when we can obtain a level base at a moderate distance from the height to be ascertained, and when the measurements of the angles are carefully taken by expert operators, and with good trigonometrical instruments. The use of the barometer is confined to *accessible heights*, but it is much more easily managed under such circumstances, and requires little more than attention to the true height of the barometrical column, corrected for the temperature of the instrument, and of the ambient air. In variable climates, accuracy would require synchronous observations at the foot and on the summit of the height to be ascertained; but in tropical climates, or even in the South of Europe, the barometer scarcely varies throughout the year, at the level of the sea, and therefore such measurements are more easily made. An instrument invented by the Rev. F. Wollaston has been used to measure great elevations, by marking the temperature at which water boils at the base and the summit. This, though an ingenious instrument, is so liable to accidents in carriage, that it isseldom used.

# BURNING MOUNTAINS.

## MOUNT ÆTNA.

It takes its name either from *athuna*, a furnace, or *œtuna*, darkness. This mountain, famous from the remotest antiquity, both for its bulk and terrible eruptions, stands in the eastern part of the Island of Sicily in a very extensive plain, called *Val di demoni*, from the notion that it is inhabited by devils, who are supposed to torment the spirits of the condemned in the bowels of this volcano. There is much difference of opinion as to the height of this mountain, as also its circumference. Pindar, who lived 435 B. C., calls it the *Pillar of Heaven*, on account of its great height. The upper regions of Ætna are so cold, as scarcely to be available for the purposes of tillage and cultivation. Lower down commences the large woody regions, which consist of large forest trees. Below these lie the plains, which are mostly laid out in vineyards, the slope of them being very gradual; and here it is that, when the liquid fire arrives, there is most cause for alarm. At the very top it is perpetually covered with snow, from thence the whole is supplied with that article so necessary in a hot climate, and without which, the natives say, Sicily could not be inhabited.

In the middle of the snowy region stands the great crater, or mouth of Ætna; it is a little mountain, about a quarter of a mile perpendicular, and very steep, situate in the middle of a gently-inclining plain, of about nine miles in circumference. It is entirely formed of stones and ashes, in the middle of a hollow of about 2½ miles in circumference, but by some writers it is considered more: the inside is crusted over with salts and sulphur of different colours. It goes shelving down from the top like an inverted cone, the depth of which nearly corresponds to the height of the little mountain. From many parts of this place issue volcanoes of sulphureous smoke, which, being much heavier than the circumambient air, instead of ascending in it, roll down the side of the mountain, till, coming to a more dense atmosphere, it shoots off horizontally, and forms a large track in the air according to the direction of the wind. In the middle of this funnel is the tremendous and unfathomable gulf, so much celebrated in all ages, both as the terror of this life and the place of punishment in the next. From this gulf continually issue terrible and confused noises; which, in eruptions, are increased to such a degree, as to be heard at a prodigious distance.

Sir William Hamilton experienced a great difficulty of respiration, from the too great subtilty of the air, independent of that which arose from the sulphureous smoke of the mountain; but other visitors take no notice of this. Sir William Hamilton's barometer stood at 18 inches and 10 lines; Mr. Brydone's, at 19 inches 6½ lines. In these high regions, there is generally a very violent wind; which, as other travellers found blowing constantly from the south, is, perhaps, most frequently directed from that point. Here Mr. Brydone's thermometer fell to 27 degrees. The top of Ætna being above the common region of vapours, the heavens appear with exceeding great splendour. It was noticed by one who ascended at night, that the number of stars seemed to be infinitely increased, and the light of each of them appeared brighter than usual; the whiteness of the milky way was like a pure flame, which shot across the heavens, and with the naked eye they could observe clusters of stars, which were invisible from below. Those meteors called *falling stars*, appeared as much elevated as when seen from the plains below. To have a full and clear view from the summit of Ætna, it is necessary to be there before sunrise, as the vapours raised by the sun in the day time will obscure every object.

Here Sir William Hamilton had a view of Calabria, in Italy, with the sea beyond it, the Lipari Islands and Stromboli, (another volcano about 70 miles distant,) appeared just beneath their feet; the whole island of Sicily, with its rivers, towns, as seen on a map. Massa, a Sicilian author, affirms that the African coast, as well as that of Naples, can be seen from the summit of Ætna; this has been denied by modern writers. The visible horizon, however, can be no less than nine hundred miles in diameter. The pyramidal shadow of the mountain reaches across the whole island, and far into the sea on the other side, forming a visible track in the air; which, as the sun rises above the horizon, is shortened, and at last confined to the neighbourhood of Ætna.

This mountain is divided into three zones, called *Regione culta*, or fertile region; the *Sylvosa*, or woody region, and the *Regione deserta*, or desert zone. The form of Ætna is that of a cone, very broad at the base; which is more than forty miles in circumference. From the bottom, you ascend ten leagues, before reaching its summit; on the south side, and on any of the other sides, the way not being so straight, is considerable longer. Ætna is entirely composed of substances that have been discharged by the volcano, in its various explosions.

It appears, from the quantities of marine bodies deposited all over the lower part of Ætna, that it must have been once covered by the sea, to at least one half of its present height. It is the opinion of M. Houel, (who is acknowledged to have surveyed it with greater accuracy than any other traveller,) that the whole island of Sicily, and the greater part of Mount Ætna, have been formed under water. But the period when the eruptions from this volcano first commenced, the manner in which the sea subsided, and the precise time at which it fell so low as its present level, on the shores of Sicily, are facts concerning which we have no certain knowledge. The general principle, however, M. Houel thinks may be regarded as undeniable. When this mountain stood half under water, the currents of the ocean would gradually accumulate upon it large masses both of its own productions, such as shells and bones of fishes, and of various other matters, which would be intermixed with the other volcanic matters, discharged from the focus of the burning mount. In a long series of ages, these strata of heterogeneous matters would naturally become so considerable, as to form the enormous mass of mountains, with which the volcano is now surrounded. The current of the ocean might often convey the volcanic matters to a considerable distance from the volcanic focus: and there are mountains at no small distance from Ætna, which seem to have been produced in this manner. Those of Carlintini, at the distance of fifteen leagues, consist chiefly of a mixture of pozzolana, with calcareous matters. At Lintini, and in places around it, there are distinct beds of pozzolana, scoriæ, and real lava, as well as others, in which all these matters are blended together in a mass of calcareous matter. At Palazzolo, about twenty-four miles from the city of Syracuse, the sides of the hills having been cut by the streams, which run down them in many places to a considerable depth, display huge masses of lava, and extensive beds of pozzolana. In the neighbourhood of Noto, there are also volcanic productions to be found. At Pachimo, where the island of Sicily forms an angle, there is a range of hills, extending for several miles, which consist all of pozzolana. The woody region, especially the east side, called *Carpinetto*, abounds with large chesnut trees; the most remarkable of which has been called, from its size, the "chesnut tree of a hundred horse"—the circumference of which is said to have been two hundred and four feet. In Piedmontese, or *Regione culta*, is the river *Acis*, so much celebrated by the Poets, in the fable of Acis and Galatea. It bursts out of the earth, at once, in a large stream, runs with great rapidity, and about a mile from its source throws itself into the sea. Its water is remarkably clear, and so extremely cold, that it is reckoned dangerous to drink it, it is said, however, to have a poisonous quality, from being impregnated with vitriol, in consequence of which cattle have been killed by it. It never freezes, but is said often to contract a greater degree of cold than ice.

The majestic forests of Ætna afford a singular spectacle, and bear no resemblance to those of any other country; their verdure is more lively, and the trees of which they consist of a greater height. These advantages they owe to the soil on which they grow; for the soil produced by volcanos is particularly favourable to vegetation, and every species of plant grows here with great luxuriance. In several places, when we can view their interior parts, the most enchanting prospects are displayed. The hawthorn trees are of an immense size, and are cut fantastically, so as to represent orange trees; the beeches appear like so many ramified pillars, and the tufted branches of the oak like close bushes, impenetrable to the rays of the sun. The appearance of the woods in general is exceedingly picturesque, by reason of the great number and variety of the trees, and the inequality of the ground, which make them rise like seats in an amphitheatre, disposing them also in groups and glades, so that their appearance changes to the eye at every step; and this variety is augmented by accidental circumstances, as the situation of young trees among others venerable for their antiquity; the effects of storms, which have often overturned large trees; while stems, shooting from their roots, like the Lernœan hydra, show a number of heads, newly-sprung, to make up that which has been cut off.

There have been nearly forty eruptions of Ætna from the first which Diodorus Siculus speaks of (but does not fix the period at which it happened), until the last which occurred in November, 1832, the descriptions of which differ only in the extent of damage done. Having given one of these awful visitations in our account of Vesuvius, we do not deem it necessary further to notice them here, as it is scarcely more than a change of place and dates.

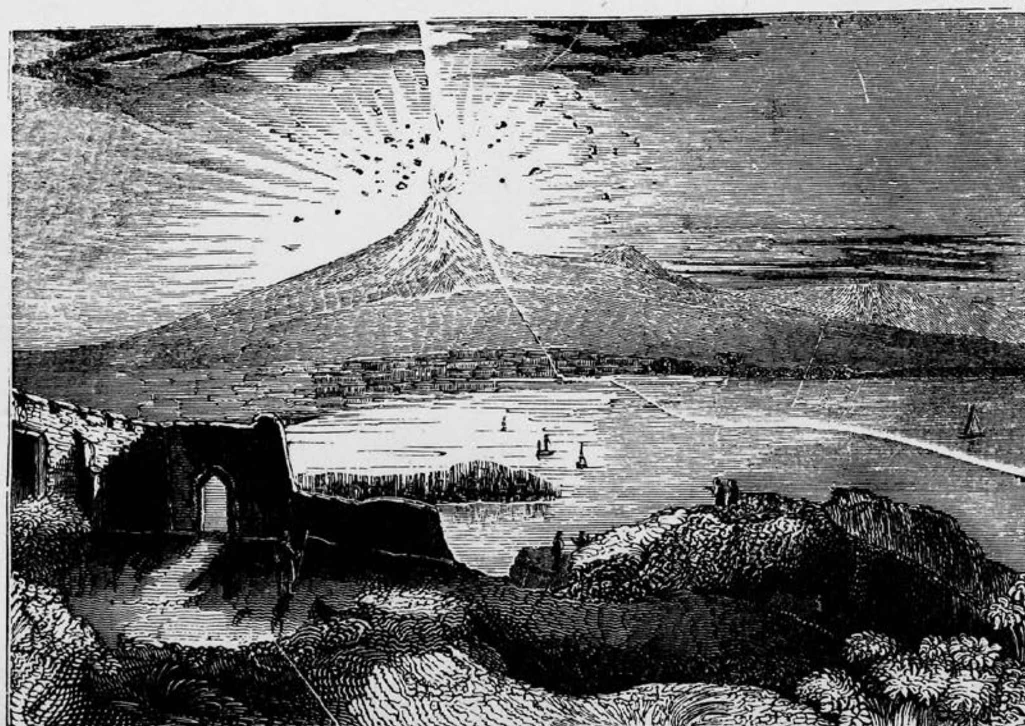
All travellers agree, that even in the height of summer, the cold of Ætna is the most piercing that they ever experienced, and a very recent one says, "The cold was so great that the wine had become quite thick, and on entering the stable, the guide found the mules trembling from its effects, notwithstanding that they had plenty to eat during our absence."

## MOUNT VESUVIUS.

This celebrated Volcano is situate on the shores of the Bay of Naples, to whose singularity and beauty it adds in a striking degree. A volcanic mountain might be considered as any thing but a pleasant neighbour, yet, except when it is in a state of violent eruption, the Neapolitans look upon it without dread. Though Herculaneum, Pompeii, Stabia, and other places of less note, lie buried by the lava and other matter thrown out by the volcano, still many beautiful towns and villages flourish around Vesuvius with numerous and happy populations. Some of these places are not only built over ancient interred cities, but have themselves in modern times experienced the violence of the Volcano, and been wholly or partially destroyed by vast rivers of lava. This is particularly the case with Torre del Greco, where the road is deeply cut through a bed of lava, and where other broad beds of the same material (which in some places have encroached far into the sea, forming little volcanic promontories) are found on every side of the town. The inhabitants however, in their attachment to the spot, have always persisted in building their houses above those that have been buried, thus keeping up, as it were, a struggle with one of the most fearful powers of nature.

The mountain is little more than four miles from the City of Naples, and, owing to the transparency of the atmosphere, seems even less. It rises quite alone from the plain, declining on one side to the shores of the sea, and on the other towards a chain of the Apennines.

Its base occupies an irregular space, said to be about twelve miles round, it rises conically to the height of somewhat more than three thousand feet, where it terminates in two mamillæ or breasts, one of which is called Somme, the other being that of the great Crator of the Volcano. From its form and entirely isolated situation, it looks like some tumulus or sepulchral barrow, except where broken by some chasms, and covered by courses of the lava, which have not yet had time to acquire a superficies of soil and vegetable matter. Mount Vesuvius is cultivated and inhabited for two thirds of its height. The soil that accumulates over (and is mainly produced by volcanic matter of different natures) is wonderfully firm and admirably adapted for vineyards. Here are produced the far famed Lacryma Christi, (tears of Christ) the Greco and other wines of superior quality.



Mount Vesuvius and City of Naples.

The ascent to the Mountain, though steep and very rugged, may be performed on mules or asses, as far as what is called the Hermitage of San Salvatore, a lonely little building on a flat, from which rises the crater or terminating cone of Vesuvius. But, hence, the remainder of the ascent, which may be about one fourth of the entire height of the mountain, is difficult and fatiguing in the extreme. The outer sides of the acute cone by which you have to climb, are nothing but a deep accumulation of cinders, ashes, and other yielding volcanic matter, into which your legs sink, and where you lose, at least, one out of every three steps you take. Even hardy and active men have been known to throw themselves down on the sides of the cone in a complete state of exhaustion, long before they could reach the top; but the summit once gained, fatigue is repaid by prospects of beauty, which are scarcely rivalled upon earth. Naples, and all the towns which we have mentioned, lie at your feet; before you flows the magnificent bay, studded with islands; and inland stretches the luxuriant plain of Campagna Felice, with cities and towns, and with villas and hamlets, almost too numerous to count, while the sweeping chain of the Appenines forms the extreme back ground to the picture.

We have noticed the views first, as they are of greater interest than the interior of the crater. This is nothing, in ordinary times, but a great funnel, shaped hollow, round the edges of which you can walk in perfect safety, and look down the curious depth. A modern writer, who descended into it in the summer of 1816, when the mountain had been inactive for some years, emitting only from time to time a little smoke, thus describes his progress:—Provided with ropes, which the ciceroni, or guides, held at the edge of the hollow, he and a friend went down the shelving side, for about 150 feet, when they landed on a circular flat, that sounded hollow beneath their feet, but presented nothing very remarkable, except a number of furmorali, or little holes, through which smoke ascended. The interior of the crater was coated with lapilla and sulphur, and in color a yellowish white. The fumes of the sulphur and the pungent smoke, from the little holes at the bottom of the crater, compelled a very speedy retreat, which was made with some difficulty, and without any addition to their knowledge of volcanos. It must be observed, that this principal crater on the summit of the mountain, is always considerably altered in its form and features when the eruption proceeds from it, and, moreover, that it is by no means the *sole vent* which the subterranean fire of Vesuvius finds. On the contrary, the fire and lava often issue from the sides of the mountain, far below, while the superior funnel only emits smoke. In the winter of 1820, a mouth was found at the foot of the superior cone, and nearly on a level with the Hermitage of San Salvatore. To use a homely comparison, this vent was not unlike the mouth of a baker's oven, but a considerable stream of lava, which, when in a state of perfect fusion, resembles molten iron, issued from it, and flowed down a chasm in the direction of the Torre del Greco, the place which has so often suffered from the eruptions. A singular and deliberate suicide was committed here. An unhappy Frenchman walked up the mountain, and threw himself in at the source of this terrific stream. The men who conducted him said afterwards, that he had a quantity of gunpowder about his person! He scarcely could have needed its agency, for the intense fire must have consumed him, skin, flesh, and bones, in a very few seconds. But though the eruptions of Mount Vesuvius do not always proceed from the grand crater, it must also be said, that those that do, are by far the most sublime in their effects, and that nothing can well be imagined more picturesque and striking, than to see, by night, the summit of that lofty cone, crowned by fire, as it frequently is, for many succeeding weeks. The finest view under those circumstances, is from the bay, over the waters of which it often happens that the moon throws a broad path of silvery light in one direction, and the volcano the blood-red reflection of its flames in another.

The earliest and one of the most fatal eruptions of Vesuvius that is mentioned in history, took place in 79, during the reign of Titus. All Campagnia was filled with consternation, and the country was overwhelmed with devastation in every direction,—towns, villages, palaces, and "all which they inherit," were consumed by molten lava, and hidden from the sight by showers of volcanic stones, cinders, and ashes. Pompeii had suffered severely from an earthquake sixteen years before the eruption of 79, and had been rebuilt and adorned with many a stately building, particularly a magnificent theatre, where thousands were congregated to see the gladiatorial shows, when this tremendous visitation burst upon the devoted city, and burying its site to a considerable depth with the fiery materials thrown from the crater. "Day was turned into night," says a classic author, "and night into darkness—an inexpressible quantity of dust and ashes was poured out, deluging land, sea, and air, and burying two entire cities, Herculaneum and Pompeii, while the people were sitting in the theatre."

It was during the eruption of 79, that Pliny, the Naturalist, fell a victim to suffocation, as did Agrippa. The particulars of the eruption of 1779 are known to every school-boy, and although vividly described by

Sir William Hamilton, (an eye witness,) it is unnecessary to quote, because their details, able as they are, would be but a repetition of the younger Pliny, and Dion Cassius, with modern dates. We shall close our article by an able description of the eruption of 1822, from the pen of the writer we have before quoted.

"The volcano had been unusually quiet for several months, without so much as a wreath of smoke proceeding from the great crater, or from any part of it, when suddenly, on a Sunday evening, late in the month of October, two columns of fire were seen to ascend from the summit of the great cone. The quantity of fire was inconsiderable. The burning stones and other ignited matter, seemed all to fall back into the broad crater, from which they were ejected, and there was no appearance that this would be any thing more than one of the frequent minor eruptions that cause neither mischief nor alarm. During the night the eruption continued as it had begun. On Monday the mountain offered only a small column of smoke. When the sun set, and darkness came on, the fire was again visible on the top of the cone, but during the whole of Monday night there was no increase, and on Tuesday morning the volume of smoke was as insignificant as on the preceding day. But about two hours after noon on Tuesday, all at once, a rumbling noise, of terrific loudness, was heard, and the next instant an immense column of fleecy smoke burst from the great crater, and towered slowly and majestically upward, until it attained an extreme elevation in the atmosphere, when it spread itself laterally, and for some time continued to present a consistent and defined form, like that of the Italian pine tree. In this it was an exceedingly beautiful object, its form being graceful, and its flaky white color relieved by the deep pure blue of an Italian sky. But soon other throbs and groans of the volcano were heard, smoke of a dark brown color burst from the crater, the head of the gigantic column swelled in size, and spreading in all directions, and becoming darker and darker, soon covered every part of the sky, and lost all shape. By this time alarm had struck not only the population in the immediate neighbourhood of the mountain, but the inhabitants of Naples itself.

"All thronged to the shores of the bay, or to the hills, or to the outside of the town, to gaze with terrified looks at Vesuvius. But it was not until the fall of night that the scene displayed all its terrors. Then an immense pillar of fire was seen to rise from the cone, and red-hot stones, and disrupted rocks, to ascend with it, and in their descent either to fall back into the crater, or to roll down the outside of the cone with fearful violence and rapidity. To this there was no pause. The pillar of fire never grew paler or less, and the burning stones and rocks succeeded each other without intermission or decrease. If our readers could imagine ten thousand pieces of ordnance, discharging red-hot shot in the air, in conjunction with ten thousand of the greatest rockets, still they would leave an inadequate idea of this mighty eruption, and of the noise that accompanied it.

"The column of fire threw a horrid blood glare over part of the bay, and a small portion of the sky, while from the dense clouds of smoke that continually increased, the most vivid forked lighning flashed at every second. The ghastly blue of these long zig-zag flashes contrasted strangely with the red color of the volcanic fire, and, as they darted on either side, and high above the head of the pillar, rising from the crater, they produced an effect which baffles all description of the pen, or the ingenuity of the pencil. To all this must be added, that a continuous issue of lava now came from the cone, and rolled down towards the sea, as a vast river of fire, whilst another stream of lava, scarcely less in magnitude, but not visible from Naples, flowed in the direction of the now disinterred city of Pompeii. Through the crowded city terror seemed to keep all eyes open, and numerous processions with figures of Madonnas and Saints, were seen hurrying to particular churches, and the suburbs facing Vesuvius, to implore the protection of Heaven. On the road to Portici the scene was still more melancholy—thousands and thousands of affrighted peasants from villages on the mountain's sides, and towns-people from Portici, Resina, the Torre del Greco, and other villages, were flying towards Naples, with such of their property as they could remove, or were lying out in the fields, or on the road near to the walls of the capital. The aged and the infirm, weeping women, and helpless children, were huddled together, with the conviction that their homes, their gardens, and their vineyards must inevitably be consumed and buried by the descending lava.

"The writer reached Resina, and thence walked up the Mountain to the Hermitage of San Salvatore, which is situated on a flat at the foot of the terminating cone, in which is the great crater. Here he found several English, and among them some ladies, whose anxiety to view this sublime spectacle near at hand had conquered their fears. From the Hermitage he advanced nearer to the cone, and then descended into a hollow, through which the great river of lava was flowing. As he approached it, he saw it come in contact with a fine large vineyard. The low dried vines were set on fire immediately, and, blazing all over in an instant, the destructive element spread to another and another vineyard until considerable mischief was done.

"The lava, as in every eruption he has seen, so far from being rapid, was exceedingly slow in its course, flowing only a few feet in a minute. At this time it seemed tending directly to the unfortunate town of Terre del Greco, which it threatened to overwhelm, but it afterwards turned aside, and following another hollow rolled into a wide and deep chasm of the mountain. He then attempted to ascend by the side of this burning river towards the cone, but its heat, which set fire to brushwood and little trees at several feet distance, became insupportable. At every throe of the volcano the mountain shook beneath his feet, and he was already so near that the lapilla from the crater fell upon him like hail. This sort of ash, which is called lapilla, is an exceedingly light and porous substance, resembling pumice stone; and though it fell so thickly, and in pieces as large as walnuts, it caused little annoyance. But the heat, as it has been said, was insupportable; and as the fumes of the sulphur became still more so, causing a most disagreeable sensation of suffocation, he returned to the hermitage. In a short time the quantity of smoke was so great, and was so black, that it obscured the lava that produced it. Nothing could now be seen distinctly, except the lightning flashing through a pitchy sky, and a part of a column of fire from the crater, looking a lurid red. The noise, tremendous even as far off as Naples, was at a spot so near the Hermitage utterly astounding. It should be noticed that this noise was produced by the passage through the air, of the matter which the volcano ejected, and then the fall of that matter; for the forked lightning was unaccompanied by thunder—it only played close round and above the crater, and seemed produced by electric fluid issuing thence, and to depend on the dense black clouds that flanked the ascending column of fire.

"The violence of this eruption was little abated for two days and nights. Fortunately, however, the lava, in the course it took, did not find any town or village to destroy, and the lapilla, and ashes or dust that fell in almost inconceivable quantities in every place in the neighbouhood, were not difficult to remove, and indeed (that being the rainy season) were mainly washed away by the heavy rains shortly after.

"When the smoke cleared away from the mountain, which it did not for many days, it was perceived that the eruption had carried away the edges or lips of the crater, and materially altered the shape, and lowered the cone of Vesuvius. The lava, by this time, though its outer coating had cooled to such a degree that you could walk over it, still burned beneath; and it was many days more before what had been rivers of liquid fire became cold.

"Solid ridges were then seen of what looked like hard, black, brittle stone, or rather like what smiths and iron founders call clinkers.

"The main stream of lava was about fifty feet wide on an average. It ran for more than a mile, and had not the eruption ceased and stopped at its fountain head, even in the direction it had taken, it would have soon destroyed a beautiful district between Vesuvius and the sea."

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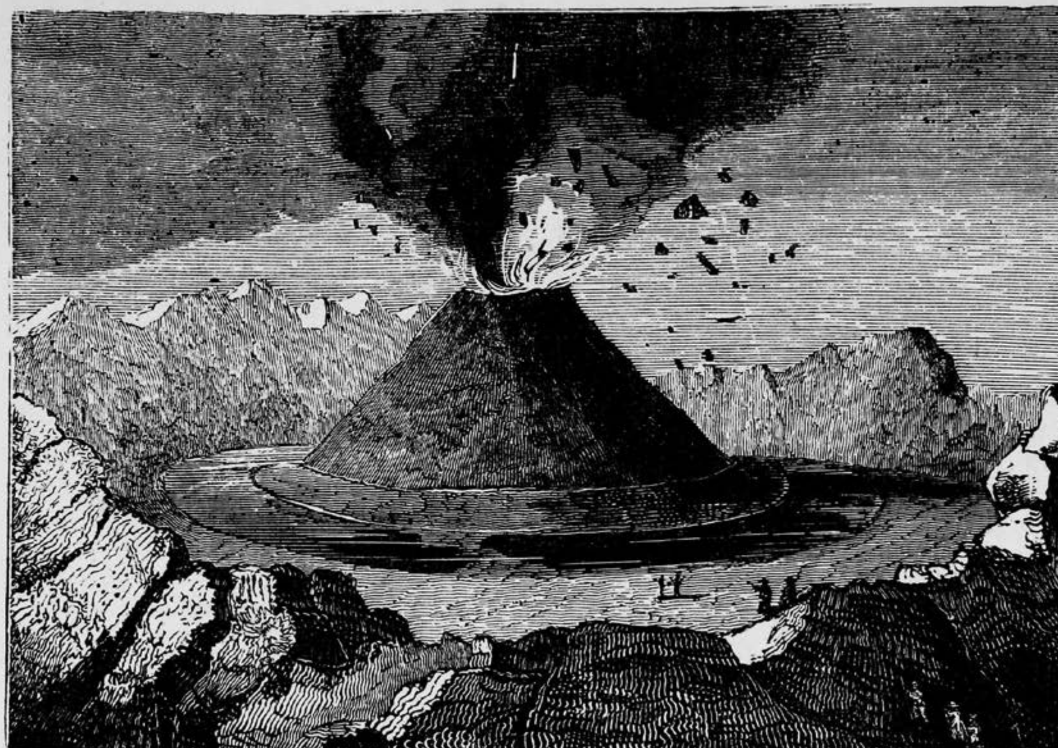
## MOUNT HECLA

Is situate on the southern side of the Island of Iceland, at a distance of a few miles from the sea coast; and though neither so grand as a mountain, nor so terrible as the centre of volcanic action, as some of its neighbours, Hecla has been more celebrated than any of them, because, from its position, it has been more frequently seen by strangers, and because it has been more frequently in a state of eruption, than any of the other volcanos. The height of Hecla, from the level of the sea, is between four and five thousand feet. From some points of view, its summit is divided into three peaks, of which the central peak is the loftiest and most acuminated: from other directions it seems to terminate in a single massy cone, like the volcano of Ætna.

One of the most singular features of Hecla, as compared with other volcanos, is the remarkable manner in which immense heaps of lava that have flowed from the mountain during different eruptions, are ranged round its base; so as to form a sort of rampart, from forty to seventy feet high. All travellers have been struck by the continuity and bright glazed appearance of these walls. Von Toil calls them "high glazed cliffs," "lofty glazed walls," not to be compared to any thing he had ever before seen; and they are described by another writer, as "immense rugged vitrified walls," going all round the base of the mountain. To explain part of this appearance, it may be necessary to say, that when the lava passes from its liquid state, and cools, it sometimes retains a shining vitreous coat, not unlike glazed bricks, or some of the refuse from the glass works. Beyond and above this immense rampart little more lava occurs; the rest of the mountain being composed almost entirely of sand and slags.

In 1772, the late Sir Joseph Banks, and another gentleman, ascended Mount Hecla; they found the whole country for more than two leagues, wholly destitute of vegetation, the soil consisting of red and black



The Crater of Mount Vesuvius.

cinders, scoriæ, pumice stone, and other volcanic results, whilst here and there it rose into little hills and eminences, which were of greater size in proportion to their vicinity to the base of the mountain. These eminences, which were hollow within, were craters through which the subterraneous fire had at different times run. The largest of them, called Raud-Oldur, was described by Sir Joseph Banks, as a crater, with an opening half a mile in circumference, and about one hundred and forty feet deep, having its western side destroyed; what remained being entirely composed of ashes, cinders, and pieces of lava, in various states. Near to this crater the party pitched their tents, in the midst of a scene of almost inconceivable horror and desolation.

When they continued their route, and came to the rampart already described as surrounding the base of Hecla, they experienced considerable difficulty in climbing and crossing it, for they frequently found the lava lying in detached masses, with deep holes between them. Having at length surmounted this difficulty, they found themselves on comparatively easy ground, and continued their ascent on their western side. Soon, however, they were somewhat alarmed, by hearing a cracking beneath their feet. On stooping to examine whence this proceeded, they discovered that the whole mountain was composed of loose materials, easily broken, of sand and pumice stone, lying in horizontal strata, every where full of fissures. Still continuing their ascent, they passed over a series of sloping terraces, and perceived that the sides of the mountain, from its summit to its base, were deeply scarred with ravines, formed originally by the descent of lava, but now serving as water courses and beds for the winter torrents. It was night when they gained the summit, and stood beside the great crater, on a spot covered with ice and snow. The snows are not, however, of the nature of glaciers, as, except such portions as lie in hollows and clefts, they generally melt in the course of the summer. The cold at this time (June) was so exceedingly severe, that the clothes of the travellers were covered wiih ice, and as stiff as buckram; the water which they carried with them, was all frozen. Here and there on the mountain top, they found great heat issuing from the ground, and melting the snow for a little space round its vent. One of these spaces was so hot, from steam and smoke, that they could not remain on it; but they nowhere saw traces of the dangerous bogs, the water-falls, the hot springs shooting in every direction, or the devouring flames which the natives had stated to exist.

The silence and the solitude of the spot were awful. It was midnight, but, in that northern latitude, as bright as day; the prospect was splendid. On one side (the east) they beheld an immense range of glaciers, beyond which the volcano of Hoerdabried shewed its peak, which had the semblance of a huge castle; on the north were lofty hills and lakes. The prospect seems to be the only thing which was interesting to our travellers. They descended on the western side by a deep ravine, which commenced at the top of the cone, and continued to the very foot of the mountain, and which appeared to be the bed of an immense stream of lava, and which is said, by the Native-chronicles, to have been formed by the great eruption of 1300, that rent the mountain in twain. Large masses of rock, seeming as cast from the crater, still hung over the edges of the ravine, and greater heaps of melted and burnt substances were found at the bottom of this singular and immense chasm. When this mountain was ascended in 1810, it was found to emit a much greater degree of heat. Hot vapours issued from several parts of the central peak, and the heat of the ground was so great, that on removing a few of the slags from those a little below, they were too hot to be handled. On placing a thermometer amongst them, it rose to 144 degrees. This last visit was made on the southern side, and the ascent was found tolerably easy, until the upper and steepest part of the cone was reached. This was covered with loose cinders; so loose, that the travellers frequently lost in one step the ground they had gained by several. During the ascent the mountain was for a while enveloped in dense clouds, which prevented their seeing the chasms in its sides, and they encountered some danger by crossing a narrow ridge of slags, that connected one of the lower peaks with the highest. This passage, during which they had a precipice on either side of them, they effected by balancing themselves like rope dancers. They found those superior craters very incompletely defined, their sides and lips being much shattered and broken away.

The last great eruption of Mount Hecla was in 1766. It broke out suddenly, and was attended at its commencement by an earthquake. It lasted, without intermission, from the 15th of April to the 7th of September, and did immense damage. The horses were so terrified, that they ran about wildly, till they dropped dead with fatigue. The people living near the mountain lost their cattle, which were either choked with the volcanic ashes, or starved before they could he removed to grass. A few lingered for a year, and on being opened, the stomachs of these were found to be loaded with ashes.

Other volcanos in Iceland, though less frequently in action, have caused much greater mischief than Hecla. In 1755, one of these threw out ashes that fell like rain on the Feroe Islands, at the distance of more than three hundred miles. But the last great eruption in 1783 was the most terrific on record. This proceeded from the Shaptaa Jokul. Many thousands of lives were destroyed; not absolutely by fire or ashes, but by starvation, the consequence of the burning up of all the vegetation on which the flocks and herds subsisted, and of the total disappearance of fish from the coasts. At that unhappy season, an enormous column of fire cast its glare over the entire island, and was seen from all sides at sea, and at the distance of many leagues. Issuing forth with the fire, an immense quantity of brimstone, sand, pumice stone, and ashes, were carried by the wind, and strewed over the devoted land. The continual smoke and steam darkened the sun, which in colour looked like blood. The whole face of the island has been changed by these terrific convulsions, and it is estimated that one continued surface of sixty thousand square miles has been subjected to the force of subterraneous fire in this part of the world.

## THE RIUKAND, OR SMOKING CATARACT OF NORWAY.

The Maane Elv (river) takes its course through the valley from west to east, and empties itself into a branch of the lake called Tindsjoen, which is 612 feet above the level of the sea. This river has its outlet from another lake, Mjos Vandet, considerably higher, at a short distance from which it rushes over perpendicular rocks, at the extremity of the valley, forming at its fall the celebrated *Rieukard* or *Smoking Cataract.* The valley is inclosed to the south by the mountain Gousta, one of the highest in Scandinavia, and by a lower ridge of mountains towards the north. The Gousta mountain is estimated, as being at least 6,000 feet above the level of the sea. At a distance of about five English miles up the valley, a smoke or vapour, rising up among the wild black grey mountainous country is now seen, which alternately rises and falls, denoting the nearer approach to the Riukand, and giving the first imposing impression of the stupendous dimensions of this magnificent cataract. Proceeding farther the traveller arrives at the commencement of the so called Maristein (Mary's Path), and has a distinct view of the fall, being then opposite to it, at the distance of less than half an English mile. From this spot the fall is seen to the greatest advantage. It precipitates itself down the rocks with a tremendous roar, through a cavity in the rocks not more than twelve feet wide, having the appearance of a vast quantity of foam, dividing and convulsing itself in a great variety of forms, as it dashes headlong towards the bed of the river, which to some considerable distance is completely covered with a kind of froth, the vapour of which rises like smoke, to a considerable height among the adjacent mountains. In the bottom of the valley, into which this cataract precipitates itself, is a basin or reservoir, in the form of a wedge between two high mountains, whose naked and apparently smooth sides seem to form an angle of 50 or 60 degrees with the horizon.

In order to come to the top of the fall, one is either obliged to go by a path four English miles round the mountain, or to pass up the Maristein, which runs in a zigzag direction in the side of the mountain, to a height of seven hundred or eight hundred feet; in some places so narrow, that one cannot place the feet side by side; and whence one false step would inevitably precipitate the traveller into the gulf below. Those who are apt to be giddy, crawl along this path on their hands and feet, but the mountaineers go up and down with the greatest facility. As it is almost impossible to get to the foot of the cataract, it is difficult to measure its perpendicular height, and on this subject authorities differ from between five hundred and six hundred to nine hundred feet. Some English travellers have given the latter height; truth may lie between, and we may call it seven hundred feet high. In winter the particles of water freeze, and form a curious natural filagree work, while a kind of tube forms itself around the fall, through which the water dashes with a fearful noise. The fountain of the Gousta, the rocks of the Riukard, and the other mountains, are of mica slate, chlorite slate, and the transition formation.

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## BEAR HUNTING IN THE PYRENEES.

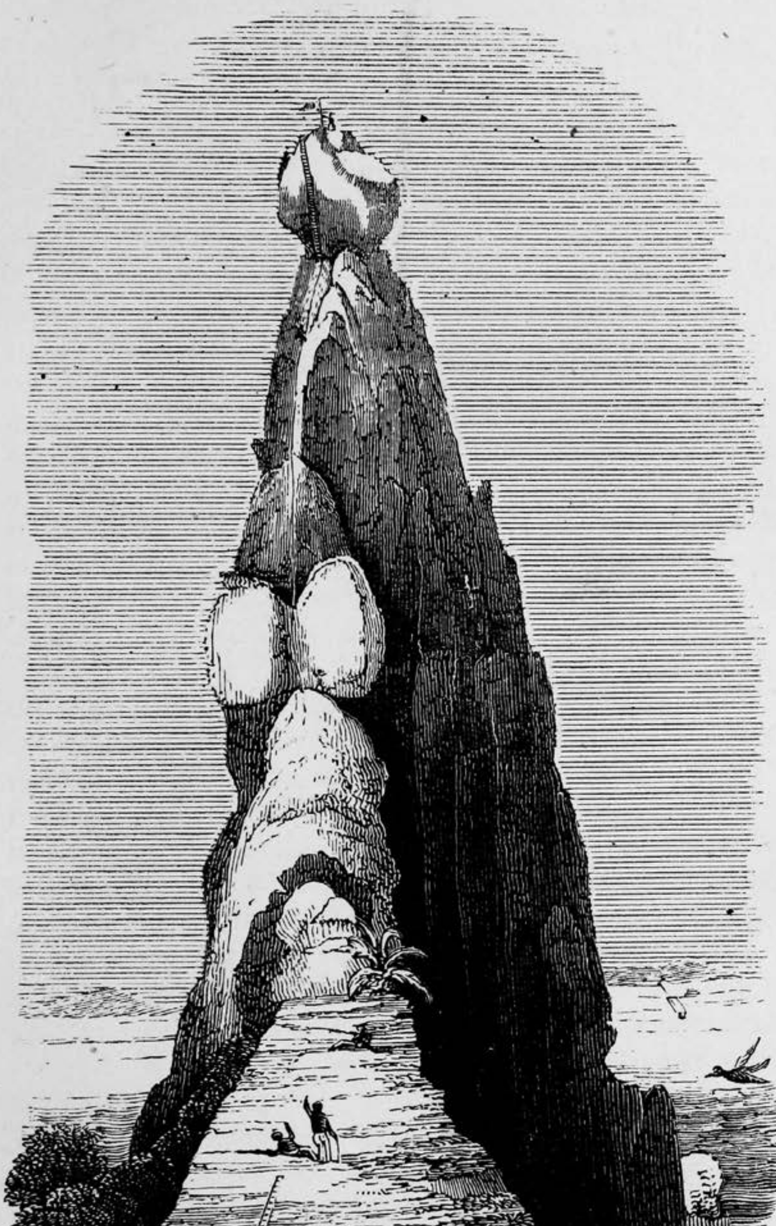
Barras, a celebrated Chesseur, related to Mr. Murray, the following, among many of his adventures. It seems that he had discovered a cavern, in which a bear had taken up his winter quarters, and from which he immediately determined to dislodge him. Single handed he did not dare to attempt this, and accordingly he chose one of his most hardy companions to join him in the attack. The place which the bear had chosen for his retreat, was an almost inaccessible cave, on the sides of the Pic du Midi, and among its darkest forests. When the two hunters arrived at the entrance of the cave, they consulted as to the best mode of rousing the animal, and getting him to leave it. Barras proposed that he should enter the cave and wake him, while his companion stood guard without. This extraordinary mode of disturbing the bear's slumbers was adopted, and the sentry having promised by the blessed Virgin to stand by his friend, the other prepared to enter the cave. For a considerable distance the cavity was large enough to permit cf the daring hunter walking upright, but decreasing in height, he had to grope his way on all fours. While proceeding in this manner, the bear, roused by the slight noise which the hunters had made at the entrance of his chamber, was heard approaching. To turn and run away was hopeless; the bear was too near to permit of this being attempted; so that to throw himself on his face, and take the chance of the animal's passing over him, was the only hope of escape. Barras did so, and the bear walked over him, without even saluting him with a growl. His companion at the mouth of the cave did not get off so easily; for expecting that he would certainly have some warning of the approach of the animal, he was not altogether prepared for the encounter when he appeared, and ere he had time to lift his gun to his shoulder, he was folded in the deadly embrace of the giant brute. Within a few yards of the cave, the precipice was several hundred feet in depth, and in the struggle, both bear and man rolled over it together. Barras, eager to aid his friend, followed the bear after it had passed over him, but reached the mouth of the cave just as the bear and his comrade were disappearing over the edge of the precipice. Horror-struck at the dreadful fate of his friend, and without the slightest hope of saving him, Barras rushed forward to decend the mountain side, and rescue, if possible, his mangled body; when the first glance into the gorge below, revealed to him his friend, dangling by his clothes among the branches of a thick shrub, which, growing out of a fissure in the precipice, had caught him in his fall, while the bear, less fortunate, had descended to the bottom. To release his friend from his precarious situation was no easy matter; but by the aid of the long sashes which the mountaineers almost always wear, he at last effected it, and drew him to the platform from which he had been so rudely hurled. The bear had lacerated him severely; but he was no sooner on his legs, than expressing his confidence that the bear had been killed by the fall, he proposed descending to the foot of the precipice, to ascertain the result. This, with much difficulty, they effected. and to their great satisfaction as well as profit, found, among the rocks below, the object of their search, in the last agonies of death. Sure of their prize, they returned to the Eux Chaudes, the wounded man greatly exhausted by loss of blood ; and Barras, returning next morning to the field of battle, accompanied by a band of villagers, triumphantly carried off the spoil.

## PETER BOTTE'S MOUNTAIN.

The island called the Mauritius and the Isle of Bourbon, lie near to each other, off the east coast of Africa, having, however, the great island of Madagascar between them and that continent. They were first discovered in the sixteenth century, by Pedro Mascarenhas, a Portuguese, from whom the group to which they belong is sometimes called that of the Mascarenhas. Its discoverer himself gave to the Mauritius the ame of Illa do Cerus. The Portuguese, however, never formed a settlement here, and in 1598, the island was taken possession of by the Dutch admiral, Van Nek, who called it by the name by which it is now commonly known, after Maurice, Prince of Orange. The Dutch finding it of little use, although they had began to colonize it in 1640, abandoned it altogether in 1712, and in 1721, the French, who had been already for some time in possession of the neighbouring Isle of Bourbon, began to colonize it. From them it received the name of the Isle of France, and they retained it until 1810, when it was taken from them by the English. It still remains a British Colony.

The Mauritius is extremely mountainous, and exhibits in every part of it the marks of volcanic action. Some of the mountains are between two and three thousand feet in height, and are covered with snow during a great part of the year. Among them are several that assume the most singular and fantastic shapes; but the most extraordinary of any in its appearance, is that which bears the name of *Peter Botte*, from a person, who is said, by tradition, to have climbed to its summit many years ago, and to have lost his life in coming down again. This, however, is mere rumour, and even if the attempt was actually made by the person in question, it is evident that the fate which overtook him must have rendered it impossible to say whether he succeeded or not.

In point of fact, the top of the mountain has been usually regarded as quite inaccessible, notwithstanding the boast of a Frenchman about forty years ago that he succeeded in reaching it. The attempt has also been several times made by our own countrymen, since the island became a British possession, but always in vain, until the period which we are about to describe, and which was accomplished in 1832. The account of it was read before the Geographical Society, by Mr. Barrow, and says, "From most points of view it seems to rise out of the range which runs nearly parallel to that part of the sea coast which forms the bay of



Peter Botte's Mountain.

Port Louis, (the capital situated on the west side of the island) but on arriving at its base, you find that it is actually separated from the rest of the range by a ravine, or cleft of a tremendous depth. The mountain appears to be about eighteen hundred feet high.

"Captain Lloyd, chief civil Engineer, accompanied by Mr. Dawkins, had made an attempt in 1831 to ascend the mountain, and had reached what is called the neck, when they planted a ladder, which did not, however, reach half-way up the perpendicular face of rock beyond. Still Captain Lloyd was convinced that with proper preparations the feat might be accomplished. Accordingly, on the morning of the 7th September, 1832, that gentleman, along with Lieut. Philpot, 29th Regt., Lieut. Keppel, R.N. and Lieut. Taylor, set out on the bold and perilous adventure. 'All our preparations being made' says Lieut. Taylor, who furnished Mr. Barrow with the account, 'we started, and a more picturesque line of march I have seldom seen. Our van was composed of about 15 or 20 Sepoys, in every variety of costume, together with a few negroes carrying our food, dry clothes, &c. Our path lay up a very steep ravine, formed by the rains in the wet season, which having loosened all the stones, made it any thing but pleasant; those below were obliged to keep a bright look out for trembling rocks, and one of these missed Keppel and myself by a miracle.' Along this path, which was not a foot broad, they picked their way for about four hundred yards, the negroes keeping their footing firm under their loads, by catching hold of the shrubs above them, as they proceeded. "On rising to the shoulder of the mountain," continues the narrative, "a view burst upon us which quite defies my descriptive powers. We stood on a little narrow ledge, or neck of land, about 20 yards in length, on the side which we mounted; we looked back into the deep wooded gorge we had passed up while on the opposite side of the neck, which was between six and seven feet broad, the precipice went sheer down fifteen hundred feet to the plain. One extremity of the neck was equally precipitous, and the other was bounded by what to me seemed the most magnificent sight I ever saw. A narrow, knife-like edge of rock, broken here and there by precipitous faces, ran up in comical form to about three hundred and fifty feet above us, and on the very pinnacle old Peter Botte frowned in all his glory.

"After a short rest we proceeded to work. A ladder had been left by Lloyd and Dawkins last year; it was about twelve feet high, and reached about half way up the face of the perpendicular rock. The foot which was spiked rested on a ledge, which was barely three inches on each side. A graphnel-line had been also left last year, but was not used. A negro of

Lloyd's clambered from the top of the ladder, by the cleft in the face of the rock, not trusting his weight to the old and rotten line. He carried a small cord round his middle, and it was fearful to see the cool, steady way in which he climbed, where a single loose stone, or false hold, must have sent him down into the abyss; however, he partially scrambled away, till at length we heard him halloo from under the rock "all right." These negroes use their feet exactly like monkeys, grasping with them every projection, almost as firmly as with their hands. The line which he carried up was made fast above, and up it we all four "shinned" in succession. It was, joking apart, awful work. In several places the ridge ran to an edge not a foot broad, and I could as I held on, half sitting, half kneeling, across the ridge, have kicked my right shoe down to the plain on one side, and my left into the bottom of the ravine on the other. The only thing which surprised me, was my own steadiness and freedom from all giddiness. I had been nervous in mounting the ravine in the morning, but gradually I got so excited and determined to succeed, that I could look down that dizzy height without the smallest sensation of swimming in the head; nevertheless, I held *uncommonly hard*, and felt very well satisfied when I was safe under the neck, and a more extraordinary situation I never was in. The head, which is an enormous mass of rock, about thirty-five feet in height, overhangs its base many feet on every side. A ledge of tolerably level rock, runs round three sides of the base, about six feet in width, bounded every where by the abrupt edge of the precipice, except in the spot where it is joined by the ridge, up which we climbed. In one spot, the head, though overhanging its base several feet, reaches only perpendicularly over the edge of the precipice, and most fortunately it was at the very spot where we mounted. Here it was that we reckoned on getting up; a communication being established with the shoulder by a double line of ropes, we proceeded to get up the necessary *materials*, Lloyd's portable additional coils of rope, crowbars, &c. But now the question, and a puzzler too, was, how to get the ladder up against the rock. Lloyd had prepared some iron arrows, with thongs, to fire over, and having got up a gun, he made a line fast round his body, which we all held on, and going over the edge of the precipice on the opposite side, he leaned back against the line, and fired over the least projecting part. Had the line broken, he would have fallen at least 1800 feet. Twice this failed, and then he had recourse to large stone with a lead line, which swung diagonally, and seemed to be a feasible plan. Several times he made beautifu heaves, but the provoking line would not catch, and away went the stone are below; till at length Æolus, pleased, I suppose, with his perseverance, gave us a shift of wind for about a minute, and over went the stone, and was eagerly seized on the opposite side. "Hurrah, my lads! steady's the word." Three lengths of the ladder were put together on the ledge, a large line attached to the one which was over the head and carefully drawn up, and finally, a two inch rope, to the extremity of which we lashed the top of the ladder, then lowered it gently over the precipice, till it hung perpendicularly, and was steadied by two negroes, on the ridge below. "All right, now hoist away," and up went the ladder, till it came to the edge of our ledge, when it was lashed in firmly to the rock. We then hauled away on the guy to steady it, and made it fast; a line was passed over by the lead line, to hold on, and up came Lloyd screeching and hallooing, and we all three scrambled after him. The union-jack and a boat-hook were passed up, and old England's flag waved freely and gallantly on the redoubted Peter Botte.

No sooner was it seen flying than the Undaunted frigate saluted in the harbour, and the guns of our saluting battery replied; for though our expedition had been kept secret till we started, it was made known the morning of our ascent, and all hands were on the look out, as we afterwards learnt. We then got a bottle of wine to the top of the rock, christened it "King William's Peak," and drank his Majesty's health hands round the Jack, and then hip, hip, hip, hurrah!

"I certainly never felt any thing like the excitement of that moment; even the negroes, down on the shoulder, took up our hurrahs, and we could hear far below the faint shouts of the astonished inhabitants of the plain. We were determined to do nothing by halves, and accordingly we made preparations for sleeping under the rock, by hauling up blankets, pea jackets, brandy, cigars, &c. Meanwhile, our dinner was preparing on the shoulder below, and about 4. p. m., we descended our ticklish path, to partake of the portable soup, preserved salmon, &c. Our party was now increased by Dawkins and his cousin, a Lieutenant of the Talbot, to whom we had written, informing them of our hopes of success; but their heads would not allow them to mount to the head or neck. After dinner, as it was getting dark, I screwed up my nerves, and climbed up to our queer little nest at top, followed by Keppel and a negro, who carried some dry wood, and made a fire in the clift under the rock. Lloyd and Phillpots soon came up, and we began to arrange ourselves for the night, each taking a glass of brandy, to begin with. I had on two pair of trousers, a shooting jacket, waistcoat, and a huge flushing jacket over that, a thick woollen sailor's cap, and two blankets, and each of us lighted a cigar, as we seated ourselves to wait for the appointed hour for our signal of success. It was a glorious sight, to look down from that giddy pinnacle, over the whole island, lying so calm and beautiful in the moonlight, except where the broad black shadows of the other mountains intercepted the light. Here and there we could see a light twinkling in the plains, or the fire of some sugar manufactory; but not a sound of any sort reached us, except an occasional shout from the party down on the shoulder (we four being the only ones above). At length, in the direction of Port Louis, a bright flash was seen, and after a long interval the sullen *boom* of the evening gun. We then prepared our pre-arranged signal, and whiz went a rocket from our nest, lighting up, for an instant, the peaks of the hills below us; and then leaving us in darkness. We next burnt a blue light, and nothing can be conceived more perfectly beautiful than the broad glare against the overhanging rock. The wild looking groups we made in our uncouth habiliments, and the narrow ledge on which we stood, were all distinctly shown, while many of the tropical birds, frightened at our vagaries, came glancing by the light, and then swooped away, screeching into the gloom below; for the gorge, on our left, was as dark as Erebus. We burnt another blue light, and threw up two more rockets, when our laboratory being exhausted, the patient-looking insulted moon had it all her own way again. We now rolled ourselves up in our blankets, and having lashed Phillpots, who is a determined sleep walker, to Keppel's leg, we tried to sleep, but it blew strong before the morning, and was very cold. We drank all our brandy, and kept tucking in our blankets the whole night, without success. At day-break we arose, stiff, cold, and hungry; and shall conclude briefly, by saying, that after about four or five hour's hard work, we got a hole mined in the rock, and sank the foot of our twelve foot ladder deep in this, lashing a water barrel as a land mark at the top, and, above all, a long staff, with a union-jack flying. We then, in turn, mounted to the top of the ladder, to take a last look at a view, such as we might never see again, and bidding adieu to the scene of our toil and our triumph, descended the ladder, to the neck, and casting off the guys and training lines, cut off all communication with the top."

The adventurous party descended in perfect safety from this perilous attempt, which was one of the most daring that ever was accomplished.

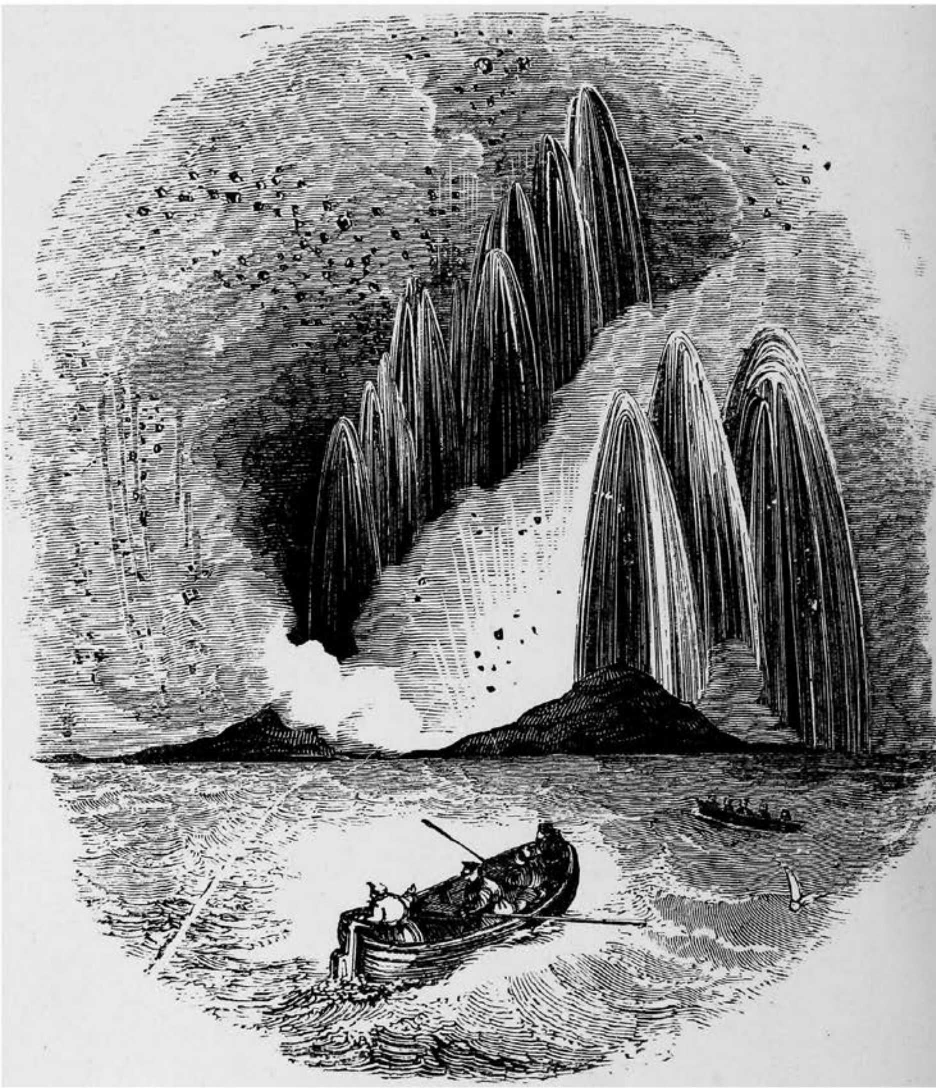
## VOLCANIC ISLANDS OFF THE AZORES.

Numerous islands of this description have, at various periods of the world, made their brief appearance, and then are in "the deep cavern of the ocean buried." In the night of the first of February, 1811, flames were observed issuing from the sea, at the distance of about a mile and a half from the west end of St. Michaels, and soon after a most awful and tremendous explosion took place, throwing up, from a depth of forty fathoms, cinders, ashes, and stones, of immense size.

Quantities of fish, as if boiled, floated on the surface of the sea towards the shore, and a dangerous shoal was thus formed. On the thirteenth of June, two columns of white smoke were seen rising from the sea at this spot, and the Sabrina, British sloop of war, supposing it to be the result of an engagement, made sail towards it. For two or three days previous, however, repeated shocks of an earthquake had been felt at St Michaels, which threw down several cottages, and portions of the cliff, towards the north west, but these ceased so soon as the volcano broke out. On the eighteenth it was still raging with unabated violence, throwing up, from under the water, large stones, cinders, ashes, &c., accompanied with several severe concussions. About noon on the same day, the mouth of the crater just showed itself above the surface of the sea, where there was formerly forty fathoms of water, at 3 p. m. it was about thirty feet above the water, and about a furlong in length. On the nineteenth it was about fifty feet high, and two thirds of a mile in length, still raging as before, and throwing up large quantities of stones, some of which fell a mile distant from the volcano. The smoke drew up several water spouts, which, spreading in the air, fell in heavy rain, accompanied with vast quantities of black sand. On the twentieth the Sabrina proceeded on a cruise, leaving the volcano about 150 feet high, still raging as formerly, and increasing in size; when she returned on the fourth of July, it was found quite quiet, and a complete island formed. The captain and several officers landed upon it, and found it very steep, and between 200 and 300 feet in height. It was with difficulty they were able to reach the top, which at last they effected in a quarter where there was a gentle declivity, but the ground, or rather ashes, composed of sulphureous matter, dross of iron, &c.; was so very hot to their feet that they were glad to return, after having taken possession of the island in the name of His Britanic Majesty, and left an English Union-Jack flying on it.

The circumference of the island, which was of a circular form, was at this time about a mile. In the middle was a large basin of boiling water, whence a stream, about six yards across, ran into the sea on the side facing St. Michael, and at the distance of fifty yards from the shore the water, although thirty fathoms deep, was too hot to hold the hand in. In short, the whole island appeared as a crater; the cliff on the outside as walls, steep within and without. The appearance of the volcano, prior to the crater showing itself above the surface, as seen from the nearest point of St. Michael, on a cliff about 400 feet above the sea, was that of an immense body of smoke, revolving in the water almost horizontally, in varied involutions, when suddenly would shoot up a column of the blackest cinders, ashes, and stones, in form like a spire, and rising to windward at an angle of 10 to 20 degrees from the perpendicular. The columns of ashes, &c., at their greatest height, formed into branches, resembling magnificent pines, and as they fell mixing with the festoons of white smoke, at one time assumed the appearance of plumes of black and white ostrich feathers, at another, that of light wavy branches of the weeping willow. These bursts were accompanied by explosions of the most vivid lightning, and a noise like the continual fire of cannon and musketry; and as the cloud of smoke rolled off to leeward, it drew up the water spouts above mentioned, which formed a beautiful, and striking addition to the scene.

Subsequently this islet sunk gradually into the sea, and in the middle of October no part was left above the water, but a dangerous shoal remained in the place, and exists to this day. In February, 1812, smoke was again discovered issuing out of the sea near the spot. Another of these volcanic islands suddenly rose from the bosom of the sea, opposite to Sicily, July 1831, and is thus described by a party of English gentlemen, who visited it. They left the shore of Sciacca at 9 o'clock in the evening. There was a beautiful bright moon, and they were further favored by a gentle breeze blowing from land in the direction of the island. A little before sunrise they were awakened by violent explosions, that warned them that they were near the volcano; and, rising, they saw at a short distance two hills surmounted by a column of smoke. The curious island of Pantellaria, which has evidently been thrown up in the same manner, by a sub-marine eruption, though it is now inhabited, and partially cultivated, was seen in the distance to the west. They calculated that they had sailed about 36 miles, and that the new island was



Volcano Island, off the Azores.

about equi-distant from Sciacca and Pantillaria. It had arisen from a sand bank, which was previously covered (though not with deep water) by the sea, and well known to mariners by the name of "Nerita." This sand bank itself, which extends for some distance, is probably the result of some anterior volcanic convulsion.

Just as they were within a few oars' length of the new island, the sun rose in all its glory behind the dark crater, revealing its form, and shining through the dense smoke with singular effect. They began their examination at the north west of the volcano, where it presented the form of a round hill, rising about 120 feet above the level of the sea. They were deterred from a closer approach by a thick cloud of white smoke, which issued from the side of the hill, on a level with the sea. They rowed the boat round the island, keeping about twenty feet from it, until they came to the north east point, where they found that the island was some feet higher than at the part previously examined, and that there was a piece of flat sandy shore, which seemed to afford a good landing place. As, however, nobody had hitherto set foot on this new production of nature, some apprehensions as to the safety of so doing, or whether they would not be swallowed up, were entertained by the Sicilians. After some minutes of hesitation, one of the sailors leaped ashore, and found tolerable firm footing. The English gentlemen followed him, but the sailor was still reluctant to proceed, or to ascend the side of the volcano. Mr. Wright (one of the party) advanced a few steps, and perceiving some bright yellow stones which had very much the appearance of gold, he picked up some of them, and cried out, "Run, run, my friends! here is gold, here is gold!" This temptation was irresistible; every man left the boat; or, to use the words of one of the party, "they all leaped on shore like so many devils careless of life, through the avidity to obtain part of the treasure;" but it is needless to say this was only a *ruse*. Finding that they nowhere sank much deeper than the ankle in the sandy soil, they readily followed Mr. Wright's example, and climbed up to the ridge of the island, at the part where it was lowest. Having reached this point with some difficulty, they stood on the edge of the crater, that was flanked on either side by a cone or peak, of superior elevation. The form of the crater was very irregular; within it, and 45 feet below its lip, or edge, on which they stood, and nearly on a level with the surface of the sea, they saw two small lakes of boiling water. One of these lakes was about 150 feet in circumference, the other not more than 30 feet. In the first, the color of the water was a light yellow, in the second a reddish yellow; they bubbled here and there, and emitted vapour. The master of the boat (a Maltese) boldly climbed to the top of the highest cone, an exploit not performed without danger, as on that part the island descended almost perpendicularly to the sea, whose waves had began already to destroy it, and occasionally carried away large masses at a time.

Mr. Wright and his party returned to the strip of beach where the boat was secured, and were amusing themselves by examining and collecting the curious ashes, lapilla, and stones, which were there deposited, when a rumbling noise, and smoke, accompanied by a most pungent sulphureous smell, arose from the crater, and compelled them to embark.

They rowed round to the south eastern point of the island, where they found a strip of beach like that which they had left, and lying on it, half dead and stupified, a fine large sword fish. This they secured, and carried back with them to Sciacca, where they found it weighed upwards of sixty pounds. The fate of the fish must have arisen from its coming too near the hot and contaminated water, which on all sides surrounded the island to a greater or less distance. Indeed, when the party started from this point to continue the circumnavigation of the island, they were obliged to keep nearly a mile at sea to steer clear of a new sub-marine crater, which was forming there, the eruption from which had changed the color of the waves from blue to deep yellow, and for the space of half a mile made them foam and roar in a fearful manner. Even at the distance at which they kept their boat, the air was so charged with sulphur, that it almost suffocated them. As they doubled this south eastern extremity, they saw immense clouds of smoke, now black, now white, rising as it were from a rent in the bosom of the sea, and attaining an elevation of 2,000 feet.

Having gone entirely round the island, they ascertained that its form was circular, and that it was then about two miles in circumference, but evidently diminishing every day. In October 1831, this island was visited again, and although only two months had elapsed, it had been reduced to one seventh of its former circumference. Peaks and elevations had sunk into the sea; there only remained one, which was much lowered and no longer retained the appearance of a volcanic crater. This rose in the centre of the island; it was an irregular cone in shape, and composed of fine, heavy, black sand, and very ficable scoriæ. All the rest of the island was a plain, whose level part, which, like the hill, was composed of black sand, and scoriæ, mixed here and there with fragments of lava, that seemed to contain a good deal of iron. No smoke then issued from any part of the island, but wherever the visitors dug a little in the plane a strong heat with smoke escaped. There remained, however, a small lake, the waters of which seemed, from the steam rising on the surface, to be still boiling; these waters had changed their color from yellow to a brownish black. In a few months this island had disappeared, and the sea between Sciacca and Pantellaria was perfectly clear.

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## THE GEYSERS, OR HOT SPRINGS OF ICELAND.

NEAR to the Volcanic Mountains of Iceland, the traveller frequently finds his course interrupted by frightful ruts in the earth, and deep fissures in the lava. He treads upon ground which sounds hollow beneath his feet, and then he frequently hears the rushing of water in the chasms over which he is walking, and at other times, where apertures occur on the thin crust of the earth, he sees steam issuing from the subterranean conduits, and towering in the air.

The volcanic fires which pour forth such terrific eruptions from Mount Hecla, the yokuls and other craters, though, generally speaking, they do not exert their fiery energies, except after intervals of years, are not yet extinct, but burning, unseen, extend far from the craters themselves, and convert the waters that flow near them into boiling fluid, and highly rarified vapour, which, at certain vents, maintain perennial eruptions. Instead of fire, smoke, liquid lava, lapilla and ashes, those vents, or aqueous craters, discharge columns of steam, and spouts of boiling water, and instead of years, in most cases, only a few hours intervene between the efforts. The most important of these issues is at Hankadal, considerably in the rear of Hecla, whose three snow clad summits, towering over a ridge of intervening hills, are, however, visible from the spot. Here, within a very limited space, are some dozens of Geysers; the clouds of vapour they are constantly emitting being visible at the distance of several miles. The term "Geyser" is derived from the Icelandic verb, "Geysa, to rage, to burst forth violently." The most important of the fountains at Hankadal, is called the "Great Geyser." It is surrounded by a large circular mound, formed by the earth and matter it has ejected and deposited during the course of ages. Internally this mound is hollow, presenting a basin of about one hundred and fifty feet in circumference, which is usually filled to the depth of about four feet with boiling water, beautifully clear and crystaline. In the middle of this basin, a pipe or funnel, about ten feet in diameter, but wider at the top, descends perpendicularly in the earth, to the depth of nearly eighty feet. It is this tube that is the vent of this subterranean action of fire and water. The bottom and sides of the basin, within the mound, are covered with whitish siliceous incrustations; rendered perfectly smooth by the constant action of boiling water. Two small channels from the sides of the basin open, and allow almost constant passage to some of the water. This water, still hot, and strongly impregnated with mineral matter, on leaving the mound through a turfy kind of soil, and by acting on the peat, mosses, and grass, gradually produces some of the most beautiful specimens of petrefaction; leaves of the birch, and other stinted trees, which grow in that inhospitable climate, are also found incrusted, so as to appear as of white stone, yet still preserving, not merely their general form, but their minutest fibres, unaltered.

The eruptions of the great Geyser occur at irregular intervals: low reports, and slight concussions of the ground, give the first signal of coming violence. These symptoms are succeeded by a few jets, thrown up by the pipe or funnel, in the centre of the basin; and then after a pause of a greater or less number of minutes, a rumbling noise is heard under ground; louder reports succeed, and concussions, strong enough to shake the whole mound; in the interior of which, the water boils with increased violence, and overflows the edges of the capacious basin. Other reports soon follow, being louder and more rapid than the preceding, and not unlike the discharge of a piece of artillery. Then, with an astounding roar, and immense velocity, the water rushes through the pipes, and rises into the air, in irregular jets, which are surrounded and almost concealed by accompanying volumes of steam. To these first jets, loftier and more defined ones succeed, and these are generally, a central or main jet, presenting a column of boiling water, from nine to twelve feet in diameter, from fifty to seventy feet in height, on an average. Sometimes the main jet exceeds a hundred feet in height, and other geysers are said to throw water, though not in such a volume, to a greater elevation. As the jets of the great geyser issue from the central pipe, the water in the basin, near the pipe, is raised about a foot and a half, and as the columns descend into the orifice, from whence they are ejected, the water every where overflows. Unlike the eruptions of fire, from the crater of a volcano, which often last for days, without any apparent diminution or pause, these boiling fountains seldom play longer than six or seven minutes at a time; then the action of the central pipe ceases, dense steam covers for a while the basin, and when that moves off, nothing is seen but a sheet of clear hot water, and all is quiet, until after an interval of some hours faint reports announce the approach of a fresh eruption. In August 1815, its eruption occurred pretty regularly every six hours, and some of the columns of water rose to the height of one hundred and fifty feet. Earthquakes, by intercepting the subterranean currents of waters, or by opening new channels, and giving other directions to those waters, by disrupting the earth, here, or by filling up former crevices—these, and by other processes, not easily detected, exercise an immediate and great influence over these fountains. During the dreadful earthquake that shook the island to its very centre in 1784, not only did the greater geysers shoot up with increased violence, but no fewer than thirty-five new boiling fountains made their appearance; many of these have since wholly subsided. There is one of these geysers, which is called "the Strockr," and D. Henderson says, that he discovered the key to its action, and by which he thought he could make it play whenever he had inclination to do so. He threw in a quantity of the largest stones which he could collect; presently it began to roar—he advanced his head, to look down the pipe or funnel, but had scarcely time to withdraw it, when the fountain shot up the jets of boiling water, carrying the stones with them, and attaining a height, which he calculated at two hundred feet. Jets surpassed jets, until the water in the subterranean cavern being spent, only columns of steam were emitted, and these continued to rise and to roar for nearly an hour. The next day he repeated the experiment, with the like success; and leaving the spot to go on his journey, he says, that he often looked back on the thundering column of steam, and reflected with amazement at his having given such an impulse to a body which no power on earth could control.

From the quantity of vapour emitted from these numerous vents, it often happens that the steam unites, and, forming a vast cloud, ascends, rolls and spreads itself, till it completely covers the confined horizon, and eclipses the mid-day sun. The effect produced by the reports and loud roaring of these fountains during the stillness of the night, is described as being peculiarlv impressive. On the brow of the neighbouring hill, nearly two hundred feet above the level of the great geyser, there are several holes of boiling clay, some of which produce sulphur and efflorescence of alum. On the reverse of the same hill, and at its base, are more than twenty other hot-springs. Near Rey Kium, there are some springs which do not erupt, but regularly contain water, at the temperature of 200 degrees of Fahrenheit, and are used by the Icelanders, for boiling, washing their clothes, and other domestic purposes. It has been calculated that, during an eruption, one of these geysers throws up 59,064 gallons of water every minute. Numerous hot-springs exist in the bed of a considerable river, and the quantity of boiling water they emit is so great, that it cannot be kept under by the cold water of the river, but forcing its way upwards, it bubbles and spouts above the surface of the stream. The mechanism of these geysers must be simple to have lasted for so many ages. They are mentioned by Saxo in his history of Denmark, and this shows that they must have existed for about six hundred years.

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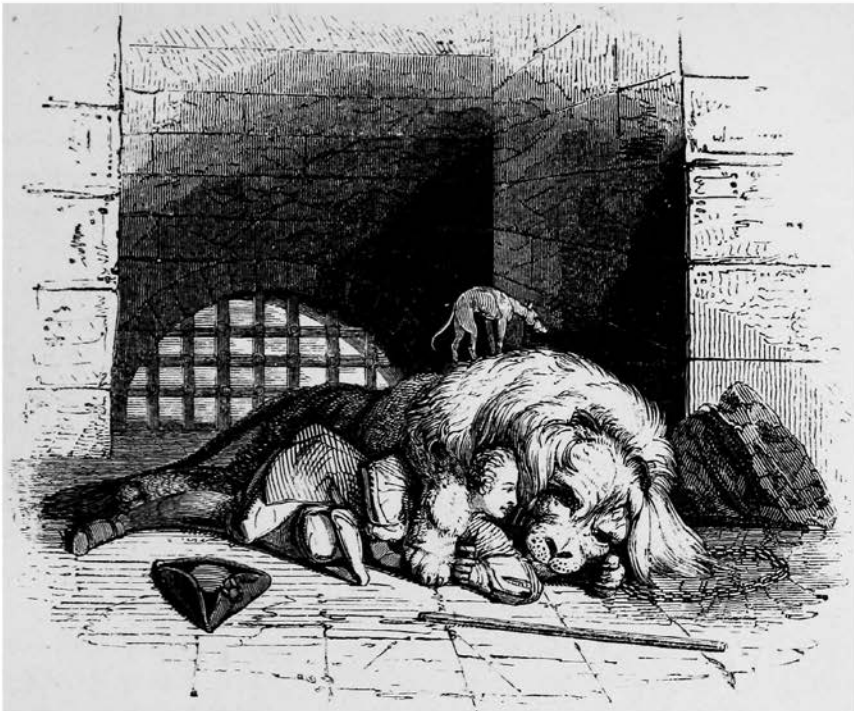
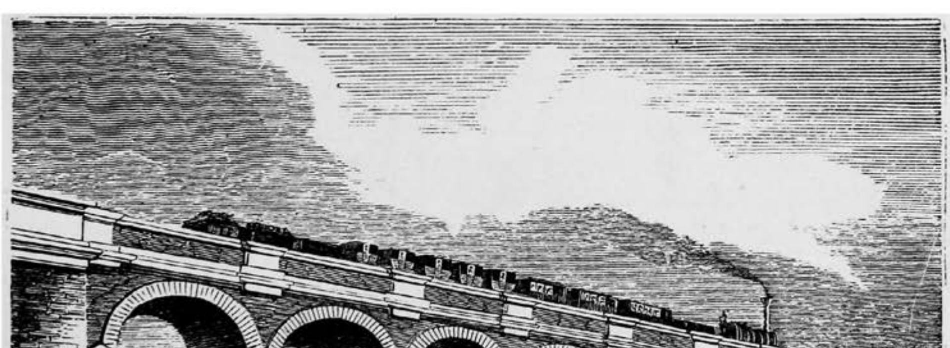
## GEOLOGY.

The name is derived from two Greek terms,—*gea*, the earth, and *logos*, a discourse; and its object is to investigate the nature and properties of the substances of which the solid crust of the earth is composed; the laws of their combination, as constituting the elements of rocks and other stony masses; the arrangement of these different masses, and their relation to each other; the changes which they appear to have undergone at various successive periods; and, finally, to establish a just theory of the construction of that solid crust. A large portion of the solid materials of the earth is arranged in beds, varying in extent and thickness, but everywhere indicating the operation of one common agent. These beds are sometimes slightly coherent, as when composed of clay or sand: but at other times they are consolidated stony bodies, arranged in parallel layers, which are often subdivided into thinner portions, by seams or joints, and preserve their parallelism for a great extent, whether their position be horizontal, or at different degrees of inclination. Such beds are termed *strata*, and the general fact is expressed by the term *stratification*. Sometimes we find a succession of strata of the same rock in juxta-position: at other times there are strata of different substances, interposed or alternating with the principal rock. The position of strata in plains is generally but little inclined towards the horizon; but as we ascend mountains, the strata are usually inclined, sometimes nearly or even absolutely vertical. When a mountain or chain of mountains is lofty, it is not unusual to find the strata inclined from the centre or axis of the chain towards either hand, and in such cases we generally find the strata reposing on a different kind of rock, which has no appearance of having a seamed or stratified structure. Hence the two great divisions of *stratified* and *unstratified*. Sometimes mineral bodies form irregular masses, entirely in the rocks in which they occur, varying in weight from a few grains to many tons, without any perceptible trace of the mode of their introduction. Occasionally long fissures occur, which are not filled up by any solid material; sometimes also cavities are left in the more solid species of rocks, the sides of which are lined with crystalline bodies, of various kinds. Sometimes these fissures and cavities are of enormous extent, forming vast caverns in the bowels of the earth, which are either empty, or filled with water. Such is the general structure of the solid crust of our earth. But when we examine the rocks more minutely, we find other striking peculiarities belonging to each, which, besides the order of their superposition, mark different eras in their formation. Minute examination of the organic remains, collected from several strata, has established the fact, that comparatively but few of the fossil animals are of the same species with those of the same families now living, and we cannot doubt but that they have wholly disappeared (genera and orders) from the face of the earth. It is only in the upper deposits that any species, identical with those now existing, have been detected. Where the organic bodies are completely fossilized, very few, if any, living species can be recognized; and, generally, the recent species most nearly allied to the fossil are now no longer to be found in the adjacent seas or regions. Thus the fossil shells and corallines of northern countries, in both continents, have their congeners (when such are known) generally in tropical climates, and the fossil trees of the British coal fields have a greater affinity to the *tree ferns* and *cyacadeæ* of southern regions, than to any sort of European vegetation. But it may be asked, how can Geologists fix so exact an order of succession? The answer to this is most complete, and they come to the conclusion from unerring data. Every stratum contains, within its own domain, records of its past history, written in characters intelligible to all nations, which no possible events can falsify or destroy, and which have enabled the Geologists to arrive at some conclusions, possessing all the certainty of mathematical demonstration. The following table will give a good general idea of the distribution of the strata, as regards the United Kingdom.

General outline of the order of succession of rocks, which compose the crust of the earth.

| Nature of various rocks and soils. | Situations where they are found. |
|---|---|
| **VEGETABLE SOIL.** | |
| Sand, clay, gravel, with bones of animals which now exist | Mouth of Thames and other rivers |
| Deep beds of gravel, large loose blocks, sand, all containing bones of animals, now extinct | Surface of many parts of England, and particularly the eastern and south eastern parts |
| **TERTIARY STRATA.** | |
| Sand, clay, pebbles, beds of hard, white, sand stone, many sea shells, bones of extinct species of animals | Hampstead Heath, Bagshot Heath, Coast of Suffolk and Norfolk, stones of which Windsor Castle is built |
| Alternations of lime stone, which contain fresh water shells, clays of different qualities, and limestones, containing marine shells | Isle of Wight |
| Thick beds of clay, with many sea shells, beds of limestone, remains of extinct species of plants and fruits, land and amphibious animals | Many places round London, great part of Essex and north-east of Kent, Isle of Sheppey, Woolwich, Cliffs at Harwich, Isle of Wight |
| **SECONDARY STRATA.** | |
| Chalk, with flints | Dover Cliffs, Brighton, Hertfordshire. |
| Chalk, without flints | Flamborough Head, in Yorkshire. |
| Chalk marl | Many parts of the south coast, Kentish rag |
| Green sand | Many parts of Kent and Sussex |
| Thick beds of clay | The Weald of Kent, Surrey, and Sussex |
| Yellow sand, with beds of iron ore | Neighbourhood of Hastings, Isle of Purbeck. |
| Argillaceous sandstone | Flat pavement of London, very often |
| Limestones of different qualities | Portland building stone. |





General outline of the order of succession of rocks, which compose the crust of the earth.

| Nature of various rocks and soils. | Situations where they are found. |
|---|---|
| Beds of clay | Kimmeridge, on coast of Dorsetshire |
| Limestones, with corals | Neighbourhood of Oxford |
| Beds of clay | Extensively in Lincolnshire fen clay |
| Thick beds of limestone | Bath building stone |
| Thin beds of limestone, and slaty clay | Whitby, Gloucester, Lyme Regis |
| Red Marly sandstone, often containing beds of alabaster or plaster stone, and beds of rock stone | Great part of East Yorkshire, Nottinghamshire, Stafford, Warwick, Worcester, Cheshire, and neighbourhood of Carlisle |
| Limestone, containing much magnesia. | Sunderland, Ferrybridge, in Yorkshire, Mansfield, Notts. |
| Coal, various seams of, beds of ironstone, clay, sandstones, and freestones, of various qualities | Newcastle, many parts of Yorkshire, Lancashire, Staffordshire, Somersetshire, vale in which Edinburgh and Glasgow are situate, South Wales |
| Coarse sand stone, and slaty clay | Millstones of Newcastle and Derbyshire |
| Thick beds of limestone and slaty clay, and sandstone, in many alternations | Deposits of the lead ore of Derbyshire, Yorkshire, Northumberland, Cumberland, high Peak of Derbyshire, mountains in Yorkshire, Mendip Hills, Somerset |
| Dark red sand stone, with many beds of pebbles. | Great part of Herefordshire, and south east part of South Wales, banks of the Wye, south part of Scotland |
| Thick beds of slate and sandstone, with sometimes impressions of shells, with thick beds of limestone | Cumberland and Westmoreland mountains, great part of Wales, north of Devon, South Devon and Cornwall, great part of Scotland. |
| PRIMARY STRATA. | |
| Slates and many hard rocks, lying in alternating beds, in which no trace of animal remains has been found, of great thickness, and the lowest that has been reached | Chief part of the Highlands of Scotland |

It has been truly observed, that "The Geologist may be considered as the historian of events relating to the animate or inanimate creation, previous to that period when *sacred* history begins, or the history of man, in relation to his highest destiny. Although it belongs to the geologist to study the events that have occurred within his province during the more modern ages of the world, as well as those which are in progress in our day, his especial object is to unfold the history of those revolutions by which the crust of the globe acquired its present form and structure. The solid earth, with its stores of organic remains which now rises above the surface of the sea, may be compared to a vast collection of authentic records, which will reveal to man, as soon as he is capable of rightly interpreting them, an unbroken narrative of events, commencing from a period indefinitely remote, and which, in all probability, succeeded each other after intervals of vast duration. Unlike the records of human transactions, they are liable to no suspicion that they have been falsified through intention or ignorance. In them we have neither to fear the dishonesty of crafty statesmen, nor the blunders of unlettered, or wearied transcribers. The Mummies of Egypt do not more certainly record the existence of a civilized people in remote ages, on the banks of the Nile, than do the shells entombed in solid stone, at the summit of the Alps and Pyrenees, attest that there was a time when the rocks of those mountains occupied the bottom of a sea, whose waters were as warm as those within the tropics, and which were peopled by numerous species of animals, of which there does not exist now one single descendant." With such objects in view, and the temptations so great to enter into detail upon this beautiful science, we are warned by our limits to confine ourselves to a brief description of the mineral kingdom, and particularly of Great Britain;—and first, of

COAL. If we examine a piece of this substance, particularly the Newcastle, we find it a compact, shining, stony body; but there are a few fragments even of a moderate size, in which we may not discover some parts very like *charcoal*, and very often with the distinct structure of wood, or other vegetable matter. Such appearances are most frequently observed in the slaty coal of Staffordshire, Scotland, and other parts. It is stated, that in all varieties of coal found at Newcastle coal-field, more or less of the fine, distinct net-like structure of the original vegetable texture can always be discovered. The vegetable origin of coal is further illustrated by the vast quantities of fossil plants found in the sand stones and shoals, which are interstratified with beds of coal. These are often in an extraordinary state of perfection, for the most delicate leaves are spread out on the stone like the dried plants on the paper in the herberium of a botanist. In the greater proportion of fossil plants of the coal measures, there is little appearance of woody matter; stems of a foot and a half in diameter have been found, with the external form perfectly preserved; but having only a coating of coaly matter of inconsiderable thickness, the interior part consisting of sand stone or clay, with now and then some more coaly matter, in the centre, indicating, as it were, the pith. But trunks of trees, in which the woody texture was preserved nearly throughout the whole stem, have often been met with: they have been seen in the coal mines of Westphalia sixty feet in length, and two remarkable fossil trees in the coal measures have occurred in Great Britain. In a bed of sand stone, near Gosforth, about five miles from Newcastle, a stem was found which measured 72 feet in length, and 4 feet in width at its lower end, and from which it tapered gradually. It was in a compressed state, as if flattened by great incumbent pressure, so that the above dimensions of the width are not the true diameter of the stem. There were no roots attached, but there were large knots, and other places where branches appear to have been broken off.

It is the general opinion of geologists, that our beds of coal have been produced by vast quantities of plants, carried down from the land, and accumulated at the bottom of the sea during the long succession of ages; the numerous alternations amounting to many hundreds, sometimes thousands, of sand stones, shales, and beds of coal, proving a long duration of the process of deposition. The character of the vegetation indicates not only a tropical, but also an insular climate; that is, the plants must have grown on islands in a very moist atmosphere, and in a heat as great or even greater than that of the West Indies. To account for the extraordinary luxuriance of the vegetation, Brongniart a (French naturalist, to whom society is indebted for most valuable and accurate information upon the subject of fossil botany) has suggested that there was probably a much larger proportion of carbonic acid gas in the atmosphere of that period than now exists; that gas, being one great source of vegetable matter in the growth of plants. As any great proportion of carbonic acid gas would render the air unfit to support animal life, the absence of the remains of land quadrupeds among such accumulations of terrestial plants certainly gives some countenance to the conjecture. This mode of accounting for the deposition of our coal beds is greatly in conformity with what must be now going forward in many parts of the earth, to prepare beds of coal for distant ages. Every river must carry down more or less of the trees, or other plants, which either fall accidentally into it, or are swept from the banks by the force or undermining action of the stream, and the accumulation of such vegetable matter at the mouth of the larger rivers must be very great.

It may be said, however, that granting this transportation of trees and plants by rivers, granting their sinking to the bottom of the sea, and their alternation there, in layers with beds of sand and clay, still their conversion into coal has to be accounted for; a substance not only different in appearance, but also in properties, from the substance of trees and plants. Here the researches of chemical science have come to our aid, for the conversion of vegetable matter into coal, has been proved by the observations of Dr. MacCulloch on peat-bogs, and by a series of experiments in the laboratory, instituted by that gentleman.

Coal, freed from its adventitious earthy matter, which is merely mechanically mixed with it, is resolvable into the same ultimate elements as wood, and MacCulloch ascertained that the action of water on turf or submerged wood, is sufficient to convert them into substances, capable of yielding *bitumen* on distillation, and black and brittle, like those varieties of coal called, by mineralogists, *legnite* and *jet*; and he is further of opinion, that great pressure, and long continued action, may have produced the other modifications. The coal so produced, differs, however, very materially in appearance and properties, as fuel, from the coal of our mines, and the last link of the chain between a lump of Newcastle coal, and a growing tree, is yet wanting.

There are in England and Wales 12 great coal fields, but as Northumberland and Derham supply almost exclusively London, we shall confine our observations to those great deposits. The length of the coal field from the Tees to the Coquet, is almost 55 miles; its greatest breadth between the mouth of the Tyne and western pits, about 22 miles. The coal measures are not spread horizontally over the area, but lie in an inclined position, and in different parts of it. The consequence of this is, that the same seams are formed at much greater depths from the surface in one colliery than in another. Nor will two distant parts of the field give the same sucession of strata, in a vertical section, either as regards the beds of stone or the seams of coal, in point of quality and thickness; the same seam of coal swells out in one place, and in another thins off so much as not to be worth the working, and the same thing occurs with the sand stone and shale; a bed of stone, or seam of coal, which in one pit is scarcely perceptible, will increase in another pit to several feet. Neither is it to be understood that these coal strata are continuous over the whole area; although that they were once so is more than probable.

This deep furrowing of the land, which is common more or less to every coal field in the island, has been ascribed by geologists to the action of great floods, at a period antecedent to all human records, carrying along with them gravel and blocks of stone, which have ploughed up the ground, and borne off the loosened materials, to be afterwards deposited in different parts, leaving behind them extensive valleys. The effect of this action has been called *denudation* by geologists, and the valleys so formed, which are not peculiar to coal fields, but exist in many parts of England, are called valleys of denudation. No bed of coal is uniformly good throughout any great extent; the high main coal is for many miles so deteriorated in quality, and so mixed up with stone, that it becomes worthless in many places. The coal-seams worked on these fields vary from 18 inches to 14 feet in thickness; but in the thick seams there is always a considerable portion of such bad quality as not to be saleable at a profit, and the best quality is seldom more than 6 or 7 feet thick. The best beds are those called by miners the high main and the low main; and, deep as the latter is, it is considered as quite a superior bed.

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## MODE OF WORKING COAL MINES.

No instances occur in this country of beds of coal lying so near the surface, that they can be worked in open day like stone quarries, nor are they often found on the side of a hill so that they can be worked horizontally. When a coal field is to be *won*, that is worked, the first step is to sink a perpendicular, circular shaft, like a great well, in order to get at the coal, and by which the miners or pit-men descend, and the coal is brought to the surface. The sum required for *winning* a bed of coal is so great, that it is usually done by a company of speculators. One of the difficulties in sinking a shaft is, passing through quick-sands; another is the immense quantities of water which are met with in certain parts of the stratification, generally within 40 or 50 fathoms of the surface, which is always damned back by a tub: the depths of the mines vary very much; in one place near Jarrow, five miles from the Tyne, he high main of coal is found 42 feet under the surface, while at Jarrow lake it is 1,200 feet from the ground. This great depth is not reached by one perpendicular shaft, but by a shaft and steam engine under ground, witn descending inclined planes (steam engines were first used in mines in 1804). The pit being sufficiently sunk to a seam of coal, the excavation begins by cutting out the coals literally into what are called galleries. One set of workmen is employed in digging out the coal and another in removing it to the bottom of the shaft, from whence it is drawn up by machinery to the surface. The work of the miners is very laborious, especially where the seams are so thin as to prevent their being in an erect posture.

The chief accidents to which collieries are exposed are inundations of water, and explosions of gas. The quantity of water which flows into the mines is sometimes quite enormous, and the expense of working it off by pumps of steam power, is one of the heaviest charges of a colliery. It very often happens that a man is drowned by an accidental opening into an old working, filled with water.

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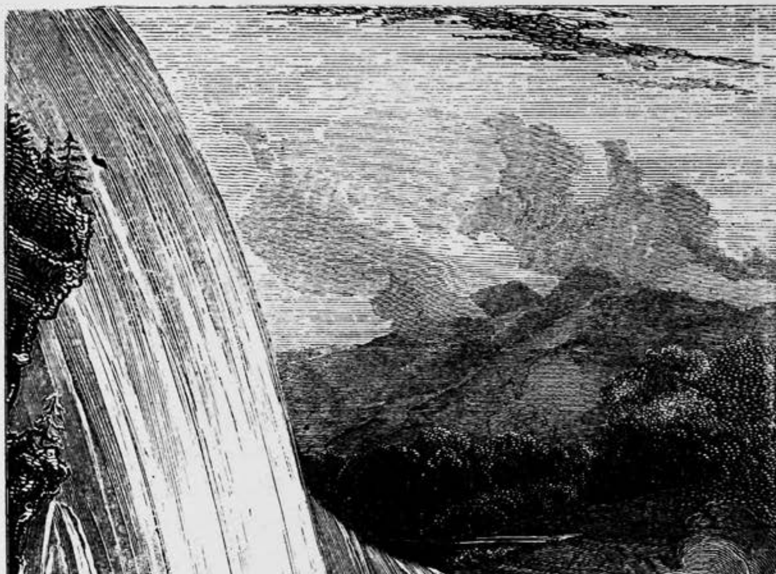
## HISTORY OF GAS.

The discovery of this beautiful means of light is not so modern as one is apt to believe from its recent adoption; for we find in the philosophical transactions of 1667, a paper by one Thomas Shirley, in which he speaks of the burning well near Wigan, in Lancashire, and confutes the opinion that the waters of that well were inflamable, as was then believed; and adds, that the flame produced, was by the combustion of bituminous fumes issuing from the water, and that it proceeded from the coal-bed which underlies all that part of the country.

The first published account of making coal gas was by Dr. Hales, in 1726, who produced 180 cubic inches of gas from 158 grain of Newcastle coal, and this only by way of experiment to prove the elasticity of the gas. A letter in the same publication, in 1739, lays claim to the discovery for one Robert Boyle much earlier, as that person died in 1691. Subsequently, the attention of many eminent chemists was constantly directed to this object, and to no one does it appear is the merit due of making it an economical means of light but to Mr. Murdoch, who first applied it for lighting his then residence at Redruth, in Cornwall. This was in 1792, and five years subsequently he made a similar use of gas in Ayrshire, and in 1798 he partially lighted with it the manufactory of Messrs. Boulton and Watt, at Soho, near Birmingham. In 1802, at the illumination for the peace of Amiens, the whole of the extensive premises at Soho was entirely lighted by gas. Mr. Murdoch in 1806 received the



Falls of Niagara.

gold medal from the Royal Society, for his successful erection of a gas apparatus for the manufactory of Mr. Lee, at Manchester. The public attention in London was shortly after called to it by a German named Windsor, who gave lectures on the subject at the Lyceum theatre in the Strand. Windsor, a man of enterprise, was but a very indifferent chemist, and although he succeeded in raising a company to prosecute his object, yet his views, and the expectations which he raised, were so extravagant that his scheme fell to the ground. It must be conceded to him, however, that he was the first who directed public attention to the introduction of gas in London, and that the first street lighted with it was Pall Mall, and its continuing exclusively so, for several years was by his sole influence. In 1809, the National Light and Heat Company applied for an Act of Parliament to establish a joint stock company, but they were strongly opposed by Mr. Murdoch, on the grounds of priority of invention, and the application was refused; they renewed their claim with better success the following year, and the Act was granted; this was the first of the chartered companies. A new charter, giving increased power and for raising more capital, was granted to this company in 1812, at which time the public became sensible of the advantage of gas as a brilliant and economical light, and applications for it came pouring in. Many of the parishes of the Metropolis discarded their ugly, uncouth looking lamps, which, as to giving light, did but "make darkness visible," and so successful was the original companies in 1823 (for by this time there were several) that, before a Parliamentary Committee, it was proved, the consumption of coal was 20,678 chaldrons annually, producing an average of 680,000 feet of gas every night, which was distributed through London by means of 122 miles of pipe; supplying upwards of 30,000 burners, and giving a light equal to 30,000lbs. of candles. Such has been the increase of gas lighting since, that this particular company have nearly quadrupled their supply, while the whole of the gas companies in London are estimated to consume more than 200,000 chaldrons of coal per annum, and to distribute through nearly 600 miles of pipe 7,000,000 of cubic feet of gas every 24 hours, on an average of the whole year, giving a light equal to what would be obtained from 300,000lbs. of candles! Although in London the progress of gas until 1813 was very slow, yet in the manufacturing districts it was making rapid strides, by Mr. Clegg at Halifax, and Mr. Pemberton at Birmingham, at both of which places the success of the experiment was equal to the talent with which it was carried on.

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## THE FALLS OF NIAGARA.

All travellers are agreed that this is the greatest of nature's wonders, and that language is incapable of conveying an adequate description of its beauties, its immensity—creating wonder, terror and delight to every eye that looks upon it, and defying delineation by pencil or pen. "It has, to me," says Mrs. Trollope, "something beyond its vastness: there is a shadowy mystery hanging about it, which neither the eye nor the imagination can picture; but I dare not dwell upon this; it is a dangerous subject, and any attempt to describe the sensations must lead to nonsense." The river Niagara takes its rise in the western extremity of lake Erie, and after flowing about 34 miles, it empties itself into lake Ontario. It is from half a mile to three miles broad, its course is very smooth, and its depth considerable. The sides above the cataract are nearly level, but below the falls the stream rushes between very lofty rocks, capped with gigantic trees, and this, forming such a contrast to the level shore above, gives reason to suppose that in some long by-gone time the level has been ploughed up by volcanic force. The great body of water, as may be supposed, does not precipitate itself in one complete sheet, but is separated by islands, and forms three distinct falls. One of these, called the *Great Fall*, or, from its shape, the great Horse Shoe fall, is on the Canadian side. Its beauty is considered to surpass that of the others, although its height is considerably less. Its exact dimensions can only be conjectural: its circumference is reckoned at 1,100 feet, with a perpendicular height of 165 feet. The chief points and features of this sublime scene are (besides the great Horse Shoe fall) the "Table Rock," "Goat Island," and the "American Fall," with a small section thereof separated at the top by a projecting rock, exclusive of other parts less remarkable or striking. "I will not attempt a general description," says a recent visitor, "of what nature never intended should be copied, for were I able to paint with human accuracy the different portions of this stupendous cataract, with its ever ascending column of misty spray, and give to the iris with which the morning and evening sun adorns the wild scene, all the beauty and loveliness of its primitive colors, yet would there be wanting the everlasting and deafening thunder, which nearly destroys the sense of hearing, as well as the superior interest which reality must ever possess over the most accurate and masterly copy

The distance from the inn where I lodged to the nearest part of the great Horse Shoe fall is about 300 yards, yet the concussion of air caused by the cataract is so great, that the window frames, and indeed the whole fabric, are continually in a tremulous motion, and in winter when the wind drives the spray in the direction of the buildings, the whole scene is coated with sheets of ice. Reason and imagination are alike confounded at the awfulness and grandeur of the scene, so completely does the first view of this mighty cataract absorb all human faculty, except to see and wonder! The first distinct view from the elevated Table land, or 'Mountain,' as it is called, is of a tolerably compact column of white mist, ascending perpendicularly to a vast height, when it apparently encountered a current of upper air, which broke it into small fleecy clouds that floated horizontally towards the sunny west, as far as the eye could reach. As I approached nearer, this column was truly beautiful, and before I had reached the immediate vicinity of the cataract, the sun had so far declined that his slanting rays were magically reflected in a beautiful bow thrown across the river, varying in its splendour according to the density of the ascending spray. The most interesting and beautiful point of view is from a cliff opposite to Fort Schloper cataract; although much less magnificent, yet it excites much more interest than any other station, having a delightful view of the steep and lofty cliffs composed of earth and rocks, which are generally quite perpendicular; here, however, one half of the Horse Shoe fall is concealed by the projecting cliff, but its partial view is beautiful in the extreme. The descent to the bottom of these falls is accomplished by very long pine trees formed in the shape of ladders, on which a visitor can descend to the bottom amidst a variety of huge rocks and pendant trees, which ever and anon seem to threaten him with destruction. The color of the water of these cataracts depends upon the state of the atmosphere, the force and height of the wind and sun; at times the spray rises above the falls, and seems to mingle with the clouds! The stream descends very rapidly for nearly eight miles below the falls, and is not safely navigable until it reaches Queen's Town, which is quite ten miles from the cataract. It is reckoned that the quantity of water which rushes over the falls is 674,000 tons per minute."

"Beyond the Horse Shoe is Goat Island," says the lady we have already quoted from, "and beyond Goat Island, the American fall, bold, straight, and chafed to snowy whiteness by the rocks which oppose its course, but it does not approach in sublimity or awful beauty to the wondrous crescent on the other shore. There the foam of the mighty cauldron, into which the deluge pours the hundred silvery torrents congregated round its verge, the smooth and solemn movement with which it rolls its massive volume over the rock, the liquid emerald of its long unbroken waters, the fantastic wreaths which spring to meet it, and then the shadowy mist that veils the horrors of its crash below, constitute a scene almost too enormous in its features for man to look upon; 'Angels might tremble as they gaze,' and I should deem the nerves obtuse, rather than strong, which did not quail at the first sight of this stupendous cataract."

Near Goat Island the river is 200 feet deep, and has at all points a fine view of the rapids of the American cataracts; it is a vast sheet, and has all the sublimity that height, and width, and uproar can give, but it has none of the magic of its rival about it. The furious velocity with which they rush onward to the abyss is terrific, and the throwing over a bridge was a work of noble daring. It has been attempted to establish, with some degree of accuracy, the precise distance to which the rumbling sound of the falls could be heard in a calm and still summer night; and one, who resided several years near the spot, asserts that eighteen or twenty miles is the extreme distance. After the American war three of our large ships, stationed on Lake Erie, were declared unfit for service and condemned. Permission was obtained to send them over the falls: the first was torn to shivers by the rapids, and went over in fragments; the second filled with water before she reached the falls, but the third, which was in better condition, took the leap gallantly, and retained her form till she was hid in the cloud of mist below. A reward of ten dollars was offered for the largest fragment of wood, which should be found from either wreck, five for the second, and so on. One morsel only was seen, and that, only about a foot long, was mashed as by a vice, and its edges notched like the teeth of a saw!

In 1827 a few individuals purchased a large schooner of 140 tons burden. This vessel was towed down the river, to within half a mile of the "rapids," when it was cut adrift and left to its fate. The rapids are caused by numerous ledges of rock from two to four feet high, extending wholly across the river, over which the water successively pitches, for about the distance of a mile immediately above the main cataract. The vessel got safely over the first ledge, but upon pitching over the second her masts went by the board, she sprang a leak and filled with water, but contrived, nevertheless, to float, though she changed her position to stern foremost, in which manner she took her last plunge over the main fall, her bowsprit being the last part that was visible of her: she, of course, never rose more, but numerous fragments of her timbers and planking were picked up some miles below in very small pieces, bruised, torn and shivered. There were two bears and some other animals on board of her, but the bears seem to have had misgivings of the safety of the voyage, and therefore when she sprang a leak and floated stern foremost they stepped overboard, and with much difficulty succeeded in swimming ashore, after having been carried half-way down towards the main cataract by the rapidity of the current. No trace of the smaller animals was ever discovered. It is the opinion of those who have been long resident near the cataract, that not even the different sorts of fish that happen to be forced down the falls ever escape with life, and in corroboration of this, numerous dead fish are daily seen below the gulf; wild fowl, too, unmindful of their danger, or floated down while they are asleep, never escape destruction if once driven within the verge of the main cataract.

## POLA-PHUCA CASCADE—COUNTY OF WICKLOW.

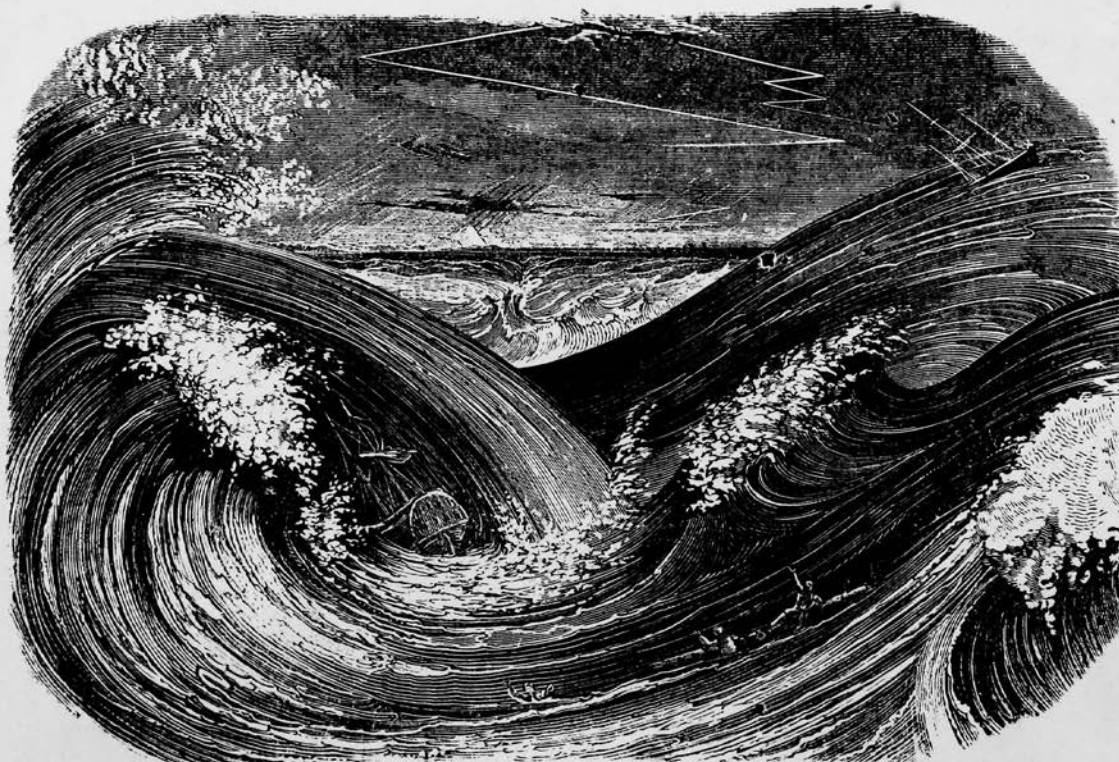
In no part of the United Kingdom is there so many beautiful objects of natural scenery in a small space as in the county of Wicklow, which adjoins the city of Dublin, and none more so than those of Bray, Inneskerry, the Dargle, and

"The vale of Avoca where the bright waters meet."

Of the three water falls, Pola-Phuca is the most striking and remarkable. The Dargle is not properly a water fall, though the citizens of Dublin are pleased to call it so. Powerscourt cascade descends from a vast height (and the view, with Grattan's house in the distance, is truly beautiful), but the stream of water is inconsiderable, except during or immediately after wet weather; in dry weather it has the appearance at a short distance, of a fine silver thread gliding down the face of a steep rock. Pola-Phuca, or, as it is sometimes written, *Poulia-Phouka*, is formed by the descent of the waters of the Liffey, a considerable stream, which in leaping down several progressive ledges of rocks, brawls and foams till the precipitated waters form a vortex below of great depth, and is supposed by the peasantry to be unfathomable. Pola-Phuca is understood to signify *Pucks* or the *Devil's hole*, a very expressive term, suggested by the whirpool. It is not far from Rossborough, on the left of the road leading from Blessington to Balymore, and is one of the great attractions of the good citizens of Dublin, and all visitors to that part of "Erin's green isle." There is a bridge higher up the river, which contrasts strongly with the masses of rock, and increases greatly the picturesque effect.

## FALLS OF THE CLYDE.

The river Clyde, near the town of Lanark, is, according to the opinion of all travellers, a situation of the most romantic and picturesque beauty of scenery unsurpassed in Europe. The falls of Clyde have been long celebrated; they are sometimes called "Linns," which comes from the Gaelic *Leum*, a fall of water. The first precipice over which the river rushes on its way from the hills, is situated about two miles above Lanark, and is known by the name of Bonnington Linn. It is a perpendicular rock of about 20 or 30 feet high, over which the water, after having approached its brink in a broad sheet, smooth as a mirror, and reflecting the forests that clothe its margin, tumbles impetuously into a deep hollow or basin, where it is instantly ground into froth. A dense mist continually hovers over this boiling cauldron. From this point downwards the channel of the river assumes a chaotic appearance; instead of the quiet and outspread waters above the fall we have now a confined and angry torrent, forcing its way with the noise of thunder between steep and meeting rocks, and over incessant impediments. The scenery on both sides, however, is exquisitely rich and beautiful. A walk of about half a mile, which may be said almost to overhang the river, leads to the second and most famous of the falls, that called *Corra Linn*, from the castle of Corra, now in ruins, which stands in its vicinage. The tremendous rocks around, the old castle on the opposite bank, a corn mill on the rock below, the furious and impatient stream foaming over the rock, the horrid chasm and abyss beneath the feet, heightened by the hollow murmur of the water and the screams of wild birds, form a spectacle at once tremendous and pleasing. A summer house is situated on a high rocky bank that overlooks the Linn. From its uppermost room it affords a very striking prospect of the fall; for all at once, on throwing your eyes towards a mirror on the opposite side of the room from the fall, you see the whole tremendous cataract pouring, as it were, upon your head. The Corra Linn, by measurement, is 84 feet in height. The river does not rush over it in one uniform sheet like Bonnington Linn, but in three different, though almost imperceptible, precipitate leaps. On the southern bank, and when the sun shines, a rainbow is perpetually seen forming itself upon the mist and fogs arising from the violent dashing of the waters. A short distance below Corra Linn is another fall called



The Maelstrom.

Dundaff Linn, the appearance of which is also very beautiful, though it is only about three and a half feet high. About three miles farther down, and a considerable way past the town of Lanark, is the last of the falls, called Stonebyres Linn. It is a precipice, or rather a succession of three precipices, making together a height of 64 feet. The same general features of rugged rocks, here appearing in all their dreary barrenness, there concealed by trees and shrubs, of wild birds winging their flight over the bounding cataract, and mingling their screams with its roar, and of cultivated nature in its most luxuriant beauty, contending all around with the sublimity of the ceaseless torrent, belong, in degree, as much to Stonebyres as to Corra Linn. There is a peculiar phenomenon to be seen here, that of the incessant endeavours of the salmon in spawning season, to mount the lofty barrier by which they find their migration from the sea opposed. It is needless to say, that their efforts are unavailing, the trout, however, have been noticed to spring up Dundaff Linn apparently without much difficulty.

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## THE MAELSTRÖM.

Whirlpools are occasioned by currents meeting with sub-marine obstacles, which throw them into gyration. When the movement is rapid, the centre is the most depressed portion of the rotating circle, and objects drawn within it are submerged at that point. The Maelström on the coast of Norway is a whirlpool of this kind, the perils of which are probably much exaggerated. The flood tide setting from the south west, amongst the Loffoden isles, especially when it meets with a strong gale from the northwest, produces a great agitation of the waves, and a whirpool is formed, the roaring of which is heard at the distance of many miles. Its agitated vortices are dangerous to vessels, and it is said that seals and whales, when caught with its eddies are unable to extricate themselves from destruction. It is now well ascertained that Charybdes, in the Strait of Messina, owes its terrors to the imagination of seamen in the infancy of navigation, and all its celebrity to poetic fancy. Such is the dry detail, which an eminent philosopher gives of this long famed whirlpool, stripping it by a few matter of facts of most of its highly poetic trappings; yet, plain and unvarnished as the truth may be, we cannot deny ourselves the pleasure of quoting a truly graphic description, from Fraser's Magazine, for September 1834, of the supposed situation of a doomed ship nearing the terrible Maelström. "And now the breeze, which had been long flagging, lulled into a calm, and soon a low continual hum, like that of an army of bees, which seemed to rise out of the stilled ocean, became audible to every ear; not a word was spoken, every one held his breath whilst he listened with an intensity of eagerness that betokened the awe that was fast filling the heart. 'It is the Moskoestrom,' cried the boatswain! 'The Moskoestrom!' echoed the crew. 'Away men!' shouted the mate, down to the hold, bring up the spare sails, clear the deck, set up a spar for a mast, away,—away!' The din of preparation drowned the stern hum of the distant whirlpool; there was, however, an anxious pause when the new sail was set into the air; and experienced sailors suffered themselves to be cheated with the hope, that there was still beeeze enough to make the good ship answer her helm. But, alas! the heavy canvas refused to expand its folds, and not a breath of wind ruffled the dull surface of the sullen waters. They had not another hope; the sailors looked on one another with blank dismay, and now they heard, with awful distinctness, the roar of the terrible Maelstrom, and the frowning rocks of Loffoden were but too plainly visible on the right. It became evident to all, that the ship, borne along by the tide, was fast approaching the dreadful whirlpool. The vessel continued slowly to approach, and the certainty of unavoidable death became every moment more overpowering and intense. At first the sailors stood together in a group, gazing gloomily upon one another, but as the roar of the whirlpool became louder and louder, and the conviction of inevitable destruction became stronger, they all dispersed to vàrious parts of the ship. * * * It was a beautiful day, the sun shone forth without a cloud to dim his lustre, the waves sparkled beneath his influence, and the white plumage of a thousand busy sea birds became more dazzling with his rays. The Isle of Moskoe was close at hand, and looked cheerful and inviting, but the ship was not to approach nearer to its shores,—the stream which bore her along never suffered any vessel to pause in its career. And now there arose at some distance ahead of the vessel, a horrible and dismal bellowing or howling, as some Leviathan in his agony, and when those on deck, who had still ears for exterior sounds, looked forward to ascertain its cause, they beheld a huge black monster upon the surface of the sea, struggling against the irresistible stream, and with his immense tail lashing the waters into foam, as he vainly strove to escape from destruction. They beheld him borne away by the might of his furious enemy; and they heard his last roar above the noise of the whirlpool, as he was sucked down into the never satisfied abyss, and disappeared from their eyes to be torn to atoms; for such is the fate of every thing that seeks the depths of the Maelström. The ship glides along faster and faster, she begins to toss and roll uneasily in the angry rapids that boiled around her,—her race is nearly run. Terrible, terrible moment! The ship hurries on to her doom with mad impetuosity. She is in the rapids! she hurries along swift as a flash of fire. She is in the whirl of water! round, round, round she goes.; her inmates catch hold of her bulwarks and of each other ,to steady themselves. And now her bowsprit is under the waves, and a wild shriek of despair rises into the sky! The whirlpool, with greedy jaws, has sucked her under."

The water of the whirlpool is said to be 40 fathom deep, and at ebb its noise is as loud as a cataract. In 1645 it was so violently agitated by a storm, that in Moskoe the houses were so shaken as to cause the stones to fall to the ground. Fragments of vessels wrecked in the Maelström are frequently seen on the coast, brought up by the return of the tide, their edges mashed and jagged as with a saw, which would induce the belief that the bottom is composed of sharp rocks.

## PEAK CAVERNS, DERBYSHIRE.

No county in England possesses a greater variety of scenery than Derbyshire, or presents more striking geographical contrasts, than its northern and southern portions. The latter is a beautiful fertile district, in no way distinguished from other midland counties, but the northern part abounds with hill and dale, and the scenery is always romantic and frequently even sublime. A chain of hills arises, which extends to the borders of Scotland. Those hills are at first of small elevation, but being in their progress piled on one another, they form very elevated ground in the tract called "the High Peak." The mountains of the peak, although inferior to those of Cumberland, constitute the loftiest and most considerable range in the midland regions of the kingdom. The highest points are Axe-edge, which is 2,100 feet above the level of Derby, and Kinder-scout, which is 1,000 feet higher than the level of Buxton. About 700 eminences and 50 rocky caverns, dells and valleys, have been enumerated in the region of the peak; the most celebrated is the "Peak Cavern," sometimes called "Devil's Cave," and more frequently "Auld Horney."

This is situate in Castleton Dale; the dale is six miles long and nearly two miles broad, and is calculated to be one thousand feet below the level of the surrounding country. It has been much celebrated, not because it is in that respect superior to many other valleys in Derbyshire, but from the lovely contrasts it presents to the sterile, bleak and desolate mountain tracts which surround it. The cavern itself is one of the most magnificent and extraordinary works of nature. It is almost impossible to conceive a scene more romantically beautiful, than the entrance to this cave. On each side the huge grey rocks rise almost perpendicularly to the height of nearly three hundred feet, having on the left the rivulet which issues from the cavern, and foams along over crags and broken limestone. The mouth of the cave is formed by a vast canopy of rock, which assumes the form of a depressed arch, nearly regular in its structure, and which extends in width one hundred and twenty feet, is forty-two feet in height, and above ninety feet in receding depth. This gloomy recess is inhabited by some poor people, who subsist by making pack-thread, and by selling candles, and officiating as guides to visitors. Their rude huts and twine-making machines produce a singular effect, in combination with the natural features of the scene. After penetrating about thirty yards into this recess, the roof becomes lower, and a gentle descent conducts by a detached rock to the immediate entrance to the interior, which is closed by a door kept locked by the guides. At this point the light of day, which had gradually softened into the obscurity of twilight, totally disappears, and torches are employed to illuminate the further progress through the darkness of the cavern. The passage then becomes low and confined, and the visitor is obliged to proceed twenty or thirty yards in a stooping posture, when he comes to another spacious opening, whence a path conducts to the margin of a small lake, called "First water;" this lake is about fourteen yards long, and in depth three or four feet: upon it is a small boat filled with straw, on which the visitor lies, and is thus conveyed into the interior of the cavern under a massive arch of rock, which is about five yards through, and in one place descends to within eighteen or twenty inches of water. Beyond the lake a spacious vacuity of two hundred and twenty feet in length, two hundred feet broad, and in some parts one hundred and twenty high, opens in the bosom of the rocks; but the absence of light precludes the spectator from seeing either the sides or the roof of this great cavern.

It is traversed by a path consisting of steps cut in the sand, conducting from the first to the "second water." Through this, visitors are generally conveyed upon the backs of the guides. Near the termination of this passage, before arriving at the water, there is a projecting pile of rocks, popularly called " Roger Rain's House," from the incessant fall of water through the crevices in the rocks. A little beyond this spot is the entrance of another hollow, called the " Chancel." At this point the rocks appear broken and dislocated, and the sides and prominent parts of the cavity are incrusted with large masses of stalectite. In the " Chancel" the stranger is much surprised and impressed by hearing the deathlike stillness of the place suddenly interrupted by a burst of vocal music, from the upper regions of the cavern. The tones are wild and discordant, but, heard in such a place, and under such circumstances, produce a powerful impression. At the conclusion of the performance, the singers display their torches, and eight or ten women and children—the inhabitants of the huts at the entrance—appear ranged on a hollow of the rock, about fifty or sixty feet from the ground. From the " Chancel" the path leads onwards to the " Devil's Cellar," and thence a gradual and somewhat rapid ascent of about one hundred and fifty feet conducts to a spot called the " Halfway House." Farther on, the way proceeds between three natural arches, to another vast cavity, which is denominated " Great Tom of Lincoln," from its resemblance to the form of a bell. A very pleasing effect is produced, when this place is illuminated by a strong light. The arrangement of the rocks, the spiracles of the roof, and the flowing stream, unite to form a scene of no common interest: the distance from this spot to the termination of the entire hollow is not considerable. The vault gradually descends, the passage contracts, and at last nearly closes, leaving only sufficient room for the passage of the water, which appears to have a communication with the distant mines of the Peak Forest. The entire length of this wonderful cavern is 750 yards, and its depth 207 yards. It is wholly formed of limestone strata, which abound in marine exuviæ, and occasionally exhibit an intermixture of chert. Some communications with other fissures open from different parts of the cavern, but none of them are comparable to it in extent and appearance. In general, the access to the cavern is easy, but in very wet weather it cannot be explored, as it is then nearly filled with water, which rises to a considerable height even at the entrance. In the inner part of the cavern a singular effect is produced by the explosion of a small quantity of gunpowder, when inserted in a crevice of the rock. The report seems to roll along the roof and sides, like a heavy and continuous peal of thunder.

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## SPECTRE OF THE BROCKEN.

Although the height of the Hartz Giant, the Brocken is only three thousand four hundred feet above the level of the sea; yet, it being isolated from its diminutive brethren, and no other mountains of equal altitude intervening to obstruct the view, we have consequently a more extensive prospect than from one of much greater height in the Tyrol or Switzerland; but those persons who tell us that the Baltic, the German Ocean, and the Vosges Mountains are visible, we may be assured are most imaginative tourists. However, Magdeburg, with the Elbe, Erfurt, Gotha, and Wilhelmshöhe at Cassel, may be distinctly seen, together with the towns of Brunswick and Wolfenbüttel. The surrounding country is also exceedingly interesting, as it affords numerous excursions, and at the same time a fund of amusement to the imaginative tourist, for he is now in the region of enchantment; and every hill, glen, and wood, has been the theatre of some supernatural legend. The Spectre of the Brocken is an aerial figure, which is sometimes seen among the Hartz Mountains in Hanover. This atmospherical phenomenon has been seen by many travellers, one of whom has described it as follows: "Having ascended the Brocken for the thirtieth time, I was at length so fortunate as to have the pleasure of seeing this phenomenon. The sun rose about four o'clock, and the atmosphere being quite serene towards the east, its rays could pass without any obstruction over the Heinrichpöke mountain. About a quarter past four I looked round to see whether the atmosphere would permit me to have a free prospect to the southwest, when I observed at a great distance, Achtermannshöue, a human figure of a monstrous size! A violent gust of wind having almost carried away my hat, I moved my hand towards my head, and the colossal figure did the same. The pleasure which I felt at this discovery can hardly be described; for I had already walked many a weary step in the hope of seeing this shadowy image without being able to gratify my curiosity. I made immediately another movement by bending my body, and the colossal figure before me repeated it. I was desirous of doing the same thing once more, but my colossus had vanished, I remained in the same position waiting to see whether it would return, and in a few minutes it again made its appearance on the Achtermannshöue. I then called the landlord of the neighbouring Inn, and having both taken the position which I had taken alone, we saw two colossal figures, which repeated

Spectre of the Brocken.

their compliments by bending their bodies as we did; after which they vanished. I particularly noticed that this phenomenon was frequently very weak and faint, but sometimes strong and well defined. The time to ascend the Brocken is in the month of September, that being the only month in the year when the fogs and steams of this northern clime will allow an uninterrupted view. It is not advisable to attempt an ascent to the Hartz without a guide, as these mountains abound with dangerous marshes.

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## EFFECTS OF A DREADFUL STORM IN THE PYRENEES.

THE storm came on towards the end of spring, 1836, and though it raged with unwonted violence, it was for the first three or four days almost disregarded. The peasantry believing that a limited period was assigned for this warring of the elements, never thought of the sufferings to which they would be subjected, should the period be unusually lengthened. Accordingly they adopted no precautionary measures, they collected no provisions; they did not conceive it necessary to withdraw the shepherds and their flocks from the mountains, and they felt no uneasiness as to their safety. The fourth day passed, then a week, and still no abatement in the violence of the storm. "It seemed," says an eye witness, "as if the mountains which surround our valley were fighting against each other, and their weapons, the thunders and the lightnings. The incessant peals, hurled from one summit to another, rolled back again with more stunning crashings, the lightning played around our cottages, and during the darkness of the nights illuminated the mountain tops, whose fantastic looking peaks every instant seemed shrouded in a blaze of light, while the rain descending in torrents, which no cottage roof could resist, and which threatened to sweep our dwellings from their foundations, and wash us into the river, whose swollen waters, rising far above the limits of their highest floods, were already robbing us of our property. Our thoughts were first directed to the dangers of our shepherds and their flocks, but to whom it was impossible to render assistance; the strongest man amongst us could not have braved the hurricane for an hour, so we were obliged to leave them to their fate! Weeks succeeded weeks, and still the terrible scene was the same. There was no abatement in the thunderings, no interval in the lightnings, no cessations in the rains; we gave ourselves up for lost, and believed that ' the end of all things was at hand.' It became apparent that death by famine or by perishing in the waters, which raged around us, was the fate which awaited upon all of us. Silent, stupified sorrow overwhelmed us, and our feelings were fast drying up; when, in the end of the sixth week, peace again reigned in the valley, and the clouds cleared away. The change which the first knowledge of the fact wrought upon our despairing minds may be conceived, but cannot be described."

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## DANGERS OF TRAVELLING IN THE PYRENEES.

" After quitting Quilan," says Murray, " the road begins rapidly to ascend the ridge of the Corbieres, which divide the department of the Aude from Roussillou. Upon reaching the summit of the ridge the road winds through a labyrinth of stony mounds; not a leaf or plant of any kind is to be seen; it seems as if some tremendous waterspout had created this scene of dessolation, and washed the whole soil into the plains. My companion (a lady), born in the plains of the north, had never seen hills or mountains in her life before, and as some of her friends at Perpignan had been kind enough to apprize her of the dangerous nature of the descent into Roussillou, she had ever since we left Quilan been incessantly talking about it, and as she approached it, became exceedingly alarmed and terrified. The summit of the ridge is quitted by a narrow passage, the entrance to which has in other times been guarded by a fort built upon the plains of Roussillou, and distinguish the road corkscrewing down the mountain into the valley many thousand feet below. Few roads, even, the higher Pyrenees, are more rapid in their descent than this, and none of them narrower or worse defended, without any parapet, and hanging like a shelf on the mountain side. Having passed the old fort and put the drag chains upon the wheels, the conductor set off at full gallop down the descent. The lady screamed, but, with the noise of the Dilligence, and the rain which fell in torrents, no one could hear her but myself; she shut her eyes, siezed hold of me, and, fortunately for herself, fainted. The rocks were almost over our heads when we were going down at this rate; an immense block of, perhaps, twenty or thirty tons weight, detached from its place by the rains of the preceding night, came over the mountain side, and dashing upon the narrow road a few hundred yards in advance of us, carried one half of it in the valley. Here was a pretty situation to be placed in, a fainting lady in my arms, with the knowledge that a few seconds would decide whether we were to pass the breach which had been made, or accompany the rock in its descent. To pull up was impossible, the rate at which we were going, and the impetus given to the carriage, totally precluded it, even had there been harness for the horses to hold back with, which there was not. As we approached, a cry of horror came from those in the "Blanquete" (the upper part of the Dilligence), who could see the danger, and I thanked God that the lady was insensible. What, if any of the leaders swerved from the path! what, if the conductor had not a steady head, and still steadier hand! were thoughts of the moment. I threw the lady upon the seat, and climbing through the window of the coupé to the side of the driver, urged him to keep the heads of the leaders well to the rock; so that they (if it was yet possible to pass) might not see the danger and start from it. Most fortunately he was a steady fellow; he did as he was desired, and we galloped over the remaining shelf, barely broad enough for the wheels to run upon; and, turning round, I could see an additional portion of the road roll down the precipice from the shock which the Dilligence had given it. The danger was seen and passed in the tenth part of the time which I have taken to relate it, and we arrived in safety at the bottom."

## FINGAL'S CAVE.

The island of Staffa is one of the Hebrides or western isles of Scotland, and lies a few miles to the west of Mull, within a sort of bay formed by the projecting extremities of the island. It is very small, being scarcely a mile in length from north to south, and about half that extent at its greatest breadth from east to west. The island is a mere mass of lava and basalt (from *basal*, iron; it is a heavy, hard stone, chiefly black or green, consisting of prismatic crystals, the number of whose sides is uncertain. English miners call it *cockle*, the German *schoerl*). The columns of the latter substance, which compose the chief part of it, are generally hidden between a thin layer of soil; but in many places, even of the surface of the island, they are to be found shooting out through this acquired covering, and the stone is every where come at on digging a few feet down. Around almost the whole circumference of the island the rock stands bare to view. The grassy top of the isle seems to be supported nearly all round on a range of pillars; in some places, indeed, so low as to be almost on a level with the surface of the water, but the greater part elevated far above it, and in some places rising into the air to the lofty height of 150 feet. The name of this extraordinary isle, accordingly, describes it by its most remarkable feature, Staffa, which is a Norse term for staffs or columns.

The highest part of the line of pillars is at the southern end of the island, and it is here that the celebrated natural excavation, called Fingal's cave, is situated. Its opening is very near the south east corner, and it extends nearly due north. The name by which it is commonly known in Gaelic, is the cave Fiuhn Mac Coul, or as Macpherson has called it in his Ossian, Fingal. This version, although it comes from a respectable source (Sir Joseph Banks), has been greatly doubted; and the name of the cavern is said to be called Uamh an Binn—Cave of Music; and there is a tradition attached, that it was the work of Fingal or Fion—macool.

The excavation is a vast opening, 42 feet in width at the mouth, extending 227 in depth, and gradually diminishing from nearly 100 feet to about 50 feet in height, supported throughout on both sides by perpendicular columns of extraordinary regularity. The opening is surmounted by a noble arch, and from this to the farther extremity of the cave, the roof extends in an unbroken surface, composed in some parts of smooth and unvariegated rock, in others of the ends of pillars stuck together in groups, or bunches, and with stalagmitic substance, which fills up the interstices, displaying a species of mosaic work of great regularity and beauty. On the west side the wall of pillars is 36 feet in height, but on the east, although the roof is of the same elevation, they spring from a much higher base, and are themselves only 18 feet in height. Along this side is a narrow foot-path raised above the water, which covers the floor, along which it is possible for an expert climber to make his way to the further end of the cave, although the attempt is rather hazardous. The proper and usual mode of viewing the cave, is by entering it in a boat, but even this can only be done with safety when the weather is tolerably calm. From the opening being so spacious there is abundance of light to the extremity, and from the same cause the waves, when there is a heavy sea, will come into it with great force. It is said, that there is, very far in the cave, a hole in the rock below the water, which makes a singularly agreeable sound on the flux and influx of the tide. It is this melodious murmur of the waters passing into it, which has doubtless given origin to its common name of the Cave of Music.

The basaltic pillars of this cave are of one ingredient only, which is a granular splintery material, resembling clinkstone, highly colored with iron, but a greenish black hue. Between the several pillars has exuded a yellowish substance, producing every where a deep contrast of two distinctly defined colors, which admirably relieves what would otherwise be the sombre aspect of the base.

The stone is in many places richly colored with light green, yellow and orange, produced by different species of lichen growing on it. "It would be no less presumptuous than useless (says a modern writer), to attempt a description of the picturesque effect of that to which the pencil itself is inadequate. But if this cave were even destitute of that order and symmetry, that richness arising from multiplicity of parts, combined with greatness of dimensions, and simplicity of style which it possesses; still the prolonged length, the twilight gloom, half concealing the playful and varying effects of reflected light, the echo of the measured surge as it rises and falls, the transparent green of the water, and the profound and fairy solitude of the whole scene, could not fail strongly to impress a mind gifted with any sense of beauty in art or in nature. If to those be added, that peculiar sentiment with which nature, perhaps, most impresses us, when she allows us to draw comparisons between her works and those of art, we shall be compelled to own it is not without cause, that celebrity has been conferred on the Cave of Fingal."

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EXTRAORDINARY NATURAL ARCH.—At Hirniskretschen in Bohemia, there is what is called, the *Prebischethor*. This extraordinary caprice of nature has all the appearance of a triumphal arch of the most colossal proportions; and, being situated in the midst of the wildest secenery, forms, as it were, a frame to the immense picture seen through it in the distance. The top of the arch is upwards of 1,400 feet above the level of the sea! Nearly adjoining, there is also an isolated rock in the shape of a cone, and an inaccessible chasm 1,200 feet in depth.

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# THE HUMAN FRAME.

## VENOUS SYSTEM,—ARTERIAL SYSTEM.

" What a piece of work is man."

" How noble in reason! how infinite in faculties! in form and moving how express and admirable! in action how like an angel! in apprehension how like a God! the beauty of the world! the paragon of animals!"

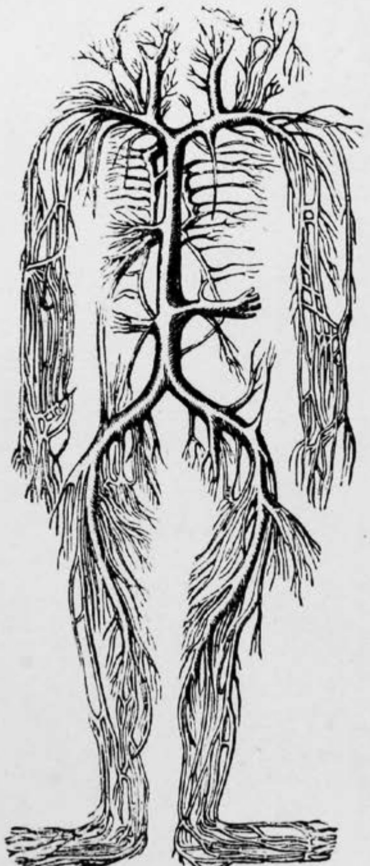
*Shakspeare.*

It is the too generally received opinion, that the study of the mechanism of the human body is dry and uninteresting, except to those who are intended for the medical profession; besides, too, the repulsive circumstances of the dissecting room are always conjured up in the mind, and the heart revolts from it, as if it were a science of blood and horrors. True it is, that to make a good surgeon, a man must be well acquainted with Anatomy; for one might as well expect a watchmaker to mend our watches or our clocks, without seeing the works, as to hope relief from the skill of the surgeon or the physician, who is ignorant of the complicated structure of the human body, the knowledge of which can *only be gained* by practical Anatomy. Second only to the beautiful sciences of Astronomy and Geology, is the knowledge of the mechanism of our own species; and one more calculated to give us the most sublime notions of the power and goodness of that Almighty Being,

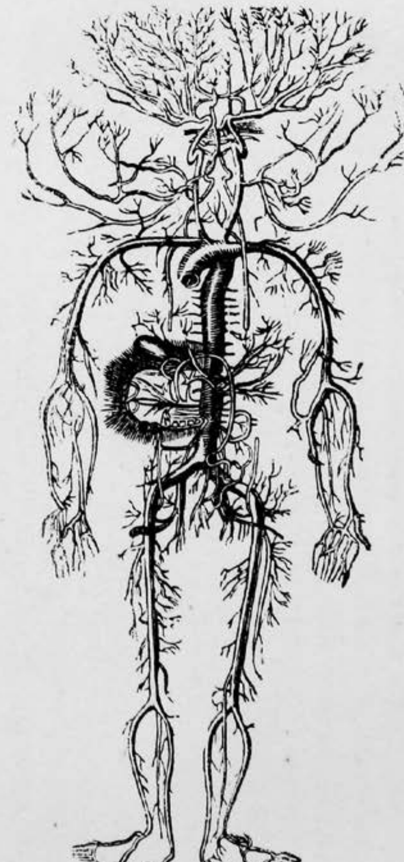
" Who formed, directs, and animates the whole,"

cannot be studied.

Well, indeed, might the great Poet of Nature, in his own beantiful terms of exalted admiration, exclaim, " What a piece of work is man!" Let the most ordinary observer look to the wonderful mechanism of the wrist; how great are the powers of motion, how admirably adapted for



Venous System.



Arterial System.

the purposes of action ;—the elbow, how powerful must be the muscles and tendons, to enable it to lift such heavy weights, and perform with such ease all its various and beautiful functions ;—the exquisite distribution of the nerves in the hands and feet, which give us the sense of feeling;—the delicate organs of the eye, the ear, the taste, the smell; all are calculated to feed the contemplative mind, from never-ending sources of wonder and admiration. So true is it, that

"The proper study of mankind—is man."

In the construction of the haman frame, and essential to life, are numerous bones for strength, hundreds of muscles and tendons for action, nerves spread every where for sensation, hundreds of arteries to *carry out the blood*, hundreds of veins to *bring it back again* into the system, and hundreds of glands performing all kinds of secretions, besides an infinite number of tubes to absorb and convey nutriment to the blood.

The heart is the centre of the system, from which the blood circulates through the frame by thousands of arteries, giving warmth, life and motion. The blood is driven from the heart of a human being in the form and force of water, forced by a common syringe; the blood in a man weighs about 30lbs., and our being depends upon its action, by the constant circulation from the heart. Until the discoveries of the great Harvey, this action was never perfectly understood. This stock of precious fluid is not allowed by nature to remain at the extremities of the arteries, but is instantly taken up by another set of tubes (the veins) and brought back again to the heart. The arteries into which the blood is forced, branch in every direction through the body, like the roots, branches, and leaves of a tree, running through the substance of the bones, and through every part of the animal system, till they are lost in such fine tubes, as to be wholly invisible.

In this manner they distribute nourishment, supply perspiration, and renew all waste of the skin; and by passing through the glands in every part of the body, all the animal secretions are elaborated. Four thousand times in every hour each cavity of the heart is called into action, and all the blood in the body passes through the heart fourteen times in every minute. In the parts where the arteries are lost to sight, the veins take their rise, and in their commencement are also imperceptible. The blood is then of a dark colour, and as it returns to the heart with less impetus, there is always twice as much blood in the veins as in the arteries. As the blood in this discolored state has lost some of its vital power, it is drawn through the lungs, and its color restored; but on its passage back to the heart, it also receives a supply of a new fluid, extracted from the food in the stomach and intestines: the process of digestion is not within our province to describe.

The bones are provided as a substantial frame for the body, giving firmness and shape, and acting as levers for the muscles, made of proportionate strength, as weight or other circumstances require. The bones in the legs of all animals are solid, and men's bodies being supported by two limbs only, the bones of those limbs are therefore more solid than those of quadrupeds. There are 248 separate bones in the human body, and they classed under those of the head, the trunk, and the extremities.

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## THE HUMAM LUNGS.

The human lungs, like those of the inferior animals, vulgarly called "the lights," are soft spongy substances, which, when healthy, will float in the water (this test, as a proof of life having once existed in the fœtus, is very doubtful). Their use is to assist in the purification of the blood. In fishes this duty is performed by the *gills*: and in insects, no air being admitted by the mouth, their blood is ventilated through the medium of small holes arranged along their sides. When "holding our breath," we soon experience a feeling of suffocation; this is merely a nervous impression, produced by the blood passing impure through the lungs to the left side of the heart; and it indicates the necessity of respiring fresh air to purify that fluid. The sensible change which the blood undergoes in passing through our lungs, is observed in its *colour*, characterised as *veinous* blood. It enters the lungs of a blackish or deep purple colour, but in leaving them it is of a bright vermillion red, and it is then called *arterial* blood. This change is owing to the action of the inhaled air. The lungs, with the exception of the air tubes (branches of the windpipe that perforate them in every direction), are one mass or net work of blood vessels. These, when approaching to the surface of the lungs, divide into an infinitude of small branches, the coats of which are so extremely thin, that the air we breathe readily acts through them, and makes the requisite changes. The circulation of the blood, from the time it leaves the lungs until it returns again, is very simple. The first stage of its progress is occupied in passing from the lungs to the left cavity of the heart; the left cavity of the heart then contracts and forces it along the *arteries* (the vessels that pulsate), and by them it is conveyed to every part of the body to bestow nourishment upon the different parts. All the demands of the system in the way of nutrition being supplied, the blood returns through the *veins* to the right cavity of the heart, and from thence to the lungs to be purified. When purified in the lungs it pursues the same route anew. By the preceding description it will be seen, that the colour of the blood becomes changed during its passage through the lungs, from a deep purple to a bright red. In the arteries it is always of the vermillion colour, and in the veins it is uniformly blackish or deep purple. One vessel excepted, professional men never let blood from an artery, for if once cut, an artery of any considerable size is not likely to stop bleeding unless it be tied at the point with a thread. The exception to this rule is a small artery which may be felt, and in many persons *seen*, pulsating on the temples. This vessel is sometimes opened in apoplexy, and in very dangerous cases of disease of the head. If an artery is punctured, the blood comes out in jets at intervals, but from a vein it flows in a continuous stream.

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## THE PULSE

In the new born infant is from 130 to 140 beats per minute, but decreases in frequency as life advances; so that in a middle-aged adult in perfect health, it is from 72 to 75. In the decline of life it is slower than this, and falls to about 60. It is obvious, that if a medical practitioner should be ignorant of this, he would commit the most awful blunders, and might be liable to imagine a boy of ten years of age to be labouring under some disease, because his pulse had not the slow sobriety of his grandfather's. A more likely error is to mistake the influence of some temporary cause for the presence of some permanent disease. Thus, in a nervous patient, the doctor's knock at the door will quicken the pulse between 15 or 20 beats a minute. Celsus named this eighteen centuries ago, (and its truth is acknowledged now), and recommends the careful physician not to be in a hurry to feel the pulse of his patient. But if these sources of error are avoided, yet the quickness of the pulse will afford the most important information. If in a person, for example, whose pulse is usually 72, the beats rise to 98, some alarming disease is certainly present; or, on the other hand, should it have permanently sunk to 50 beats, it is but too probable that the source of the circulation, the heart itself, is laboring under some incurable disease, or that some other of the springs of life is irremediably injured. Supposing, again, the pulse to be 72, each beat ought to occur at an interval of five-sixths of a second; but should any deviation of the rhythm be perceived, the pulse is said to be irregular. The varieties of the irregularity are infinite, but there is one so remarkable as to deserve particular mention. It will happen sometimes, that the interval between the two beats is so much longer than expected, that it would seem that one beat had been omitted; in this case the pulse is said to be an intermittent one. When the action of the heart is irregular, the beat of the pulse is so also; but it will occasionally happen, that the latter irregularity takes place without the former one, from some morbid cause existing between the heart and the wrist. Sometimes there is no pulsation at all perceptible at the wrist—this may proceed from so great a langour of the circulation, as not to be felt at the extremities, or from the radical artery (the one generally felt) being ossified, or from an irregular distribution of the arteries of the fore arm.

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## AVERAGE DURATION OF HUMAN LIFE.

Nothing is more proverbially uncertain than the duration of human life, where the maxim is applied to an individual; yet there are few things less subject to fluctuation than the average duration of a multitude of individuals. The number of deaths happening amongst persons of our own acquaintance is frequently very different in different years, and it is not an uncommon event that this number shall double, treble, or even be many times larger in one year than in the next succeeding. If we consider larger societies of individuals, as the inhabitants of a village or small town, the number of deaths is more uniform; and in still larger bodies, as among the inhabitants of a kingdom, the uniformity is such that the excess of deaths in any year above the average number seldom exceeds a fractional part of the whole. In the two periods, each of fifteen years, beginning at 1780, the number of deaths occurring in England and Wales in any year did not fall short of or exceed the average number of one thirteenth part of the whole, nor did the number dying in any year differ from the number of those dying in the next by a tenth part.

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## RIVERS.

The size and course of rivers are chiefly determined by the height and direction of the mountain chains, in which they originate. Thus the Rhine, the Danube, and the Rhone, the largest rivers in Europe, take their rise in the Swiss Alps. The great rivers of Asia have their origin in some of its lofty central chains. The northern rivers, the Irtish, Ob, Yenisei, and Lena may all be traced to the Altai; the Ho-yang-ho and Yangtse Kiang of China, arise in the mountains forming the eastern abutment of the central table land of Asia; whilst the southern ramparts of that table land contain the sources of the great river of Cambolia, the Irowaddy, the Brahmaputa, the Ganges, and the Scind or Indus. In Africa, the Nile has one of its sources in the lofty mountains of Abyssinia, and the other in the more distant central chain; the Niger rises in the western chain, runs eastward, is deflected in the kingdom of Houssa towards the south and west, and finally pours its waters into the Atlantic in the Gulf of Guinea. In America the Madalina and Maranon, spring directly from the Cordillera of the Andes, that

> ——————" Giant of the western star
> With meteor standard to the winds unfurl'd,
> Looks from his throne of clouds o'er half the world,"

which also contain the principal sources of the Orinoco; whilst the more sluggish streams of the Paraguay and Parana derive their waters from the lower transverse chain, stretching to the coast of Brazil. In North America the Arkansas, Red River and Missouri, the great feeders of the Mississippi, spring from the northern Andes, where also are the sources of the Columbia to the west, and of the Saskatchewan the principal stream, which flowing into Lake Winnipeg, becomes thus a part of that vast chain of lakes or seas, the outlet of which is the St. Lawrence. The channels of rivers are partly produced by the action of their own waters; but, undoubtedly, also by some cause which disturbs the original arrangements of the solid materials of the earth. Thus earthquakes have often opened passages for rivers, through barriers of rocks and mountain chains. Rivers occupy the lowest parts of valleys through which they flow, and when they are very large, their declivities are generally small. The surface of the Maranon, 3,000 miles from the sea, has only an elevation of

1,235 English feet, which would give less than five inches per mile for the mean declivity, but from the point to which the tides of the ocean reach the declivity, is considered not above 0.2 inch per mile. The Ganges from Hurwar, where it issues from the depths of the Himalaya, has a mean declivity of four inches per mile; that of the Volga is about five inches. The general form of the channels of rivers, however, especially in a champaign country, indicates that, if not wholly formed, they are greatly modified by the actions of their waters. In fact, their beds are usually proportional to the force of the stream; on the banks of many large rivers we can still trace the different heights, at which the waters have flowed formerly. Playfair mentions the existence of four or five successive terraces on the Rhine, each of which has evidently been formed in succession by the river; and, hence, he concludes that the Rhine once flowed 360 feet above its present level. Similar remarks were made on the upper Rhone, by Saussau. The general effect of the action of the water must be the erosion of the channels in the lapse of ages; and even in the rocky beds of rivers, this action of water is perceptible. Thus the waters of the Niagara have apparently worn away the limestone rock of the falls, and found a deep ravine through the stony bed, six miles in length from Queenstown, where the cliffs terminate abruptly to the present site of the falls. The undermining of the cliffs by this stupendous cataract, has caused a recession of the Falls, equal to about 18 feet in thirty years; but we cannot hence infer the length of time that this cataract has existed, because we have no certainty of the equability of the disintegration, nor of the other causes which may have aided or facilitated the process. The currents of large rivers may frequently be traced by their color to great distances in the ocean. Thus the Ganges, when in flood, discolors the sea in the Gulf of Bengal to the distance of sixty miles, and its mud covers the bottom at eighty miles from the land. The mud of the Orinoco is carried far into the Atlantic, and on examining water drawn from the sea, in latitude 8 degrees 20 minutes north, that is in the parallel of the Orinoco, and 200 miles from its embouchure, Traill ascertained that the specific gravity of the water suddenly fell below what it is was to the north and to the south of this parallel. The enormous mass of water discharged by the Maranon, according to Sabine, discolors the ocean, and has even considerable rapidity in a direction inclined to that of the equinoxial current, at the distance of 300 miles from the American coast. Fresh water may be obtained from the surface of this current, at a great distance from the shore. The periodical inundations of rivers depend on great falls of rain, in mountainous regions, or on the melting of snows in the neighbourhood of their sources. The period depends on the return of these seasons in different places. Within the tropics the rainy season is usually about the time when the sun passes the meridian towards the tropics, and continues until his return to the same place. The floods of the Maranon and La Plata, cover a vast extent of unexplored country. The rise of the Orinoco commences in May, its inundation begins in June, and the waters return to their channel in September; from which time they decrease until April of the succeeding year. The inundations of the Lower Mississippi begin in March, are at their height in June, and the river is lowest in October. The waters at their height, 1000 miles from the sea, attain a rise of 50 feet; at 300 miles, of 25 feet; and at 100 miles, of 12 feet. The western bank of the Mississippi forms a vast series of lakes, which are dried up in Autumn into arid plains, interspersed with swamps, but the delta below the juncture of Red River is a dismal swamp, scarcely elevated above the sea. In the Red River, the Arkausas, and the Lower Mississippi, are found those enormous rafts of drift wood formed during the river floods, which sometimes extend for ten or twelve miles in one mass, rise and fall with the stream, yet have a luxuriant vegetation on their summits. The inundations of the Ganges follow a nearly similar course; the waters begin to increase in April, when the rains commence in the mountains in which it has its sources; the rate of its increase is about three inches daily, until the month of July, when the rains descend in torrents in the plains. The increase of the river is then more rapid, being about five inches daily, and the country for 100 miles along its banks presents in the end of July the appearance of a vast lake, interspersed with isolated villages and woods. The general height of the inundation waters in Bengal is about twelve feet, but in some places they have a depth of more than thirty feet. The great rivers of Ava, the Indus, the Euphrates, and the Tigris, have all their periods of inundation depending on the circumstances determining the setting in of the rains, in which they originate.

The inundations of the Nile have long been celebrated; shortly after the commencement of the rains on the mountains of Abyssinia, in June, tne river begins to rise, and attains its greatest height in August. In Cairo, the greatest rise is 28 feet; at Rosetta it is no more than four about the middle of August, when the valley of Egypt, with a mean breadth of three or four leagues, and the greatest part of the Delta, are covered with one sheet of water. Its increase is irregular, and it decreases gradually until the following May. As soon as the waters are within their own channel, the soil, moistened and enriched by the sediment deposited from the inundation, is diligently cultivated by the natives; by such inundations the banks of rivers are usually elevated above the adjacent plains, and when the stream carries down much mud and gravel, the whole bed of the river may become considerably raised above the level of the country, through which it flows.

When river courses lie amongst mountains, they are subject to sudden breaks, which, according to their depth, give rise either to rapids or to cataracts. There are many picturesque waterfalls in Scotland, as the Cascade of Fyers, and that at Lochleven Head in Inverness-shire, Bruar Cascade, in Athole, the Devon Lynn, in Clackmannonshire, and the magnificent falls of the Clyde, near Lanark. The most stupendous cascade in Great Britain is the fall of Glomach, in the county of Ross. At the head of a wild and solitary glen, seven miles from the inn of Shealhouse, the river Girsac is precipitated in one unbroken fall of more than 300 feet. At the distance of about fifty feet from the bottom, the water impinges on a shelf, whence it falls into a dark pool, amidst naked perpendicular rocks. When the river is in flood, it descends in one unbroken sheet of above 380 feet in height. Wales and Cumberland can boast of many cascades on a smaller scale. The cataracts of Dahl in Sweden, of the Staubach in the Alps, of Tivoli and Terni in Italy, the less considerable cascades of Mavianeria, the far famed Styx (of Homer), in Arcadia, and the fall of the Rhine at Shauffhausen, are amongst the most celebrated in Europe. A cataract may exist in a comparatively flat country, from a sudden sinking in its level. The stupendous cataract of Niagara, in which a large and rapid river 1650 feet in width, precipitates itself by two channels in one vast leap of 160 feet perpendicular, is an instance of such an occurrence. The celebrated cataract of Tequendama, near Bogota, though found by Humbolt to be far less lofty than had been supposed by Bouguer, is still of stupendous height, and one of the most magnificent in the world; a river half the depth of the Seine at Paris is precipitated into a rocky gulf, at two bounds, to a depth of 540 feet. The cataract of the river *Shirawati*, in the Indian province of Canara, exceeds in beauty and sublimity every waterfall which has been hitherto made known in Europe. The country around the village of Haliali, about three miles north west of the fall, presents the richness of a tropical forest mingled with cultivation. The traveller comes suddenly on the river: a few steps more, over huge blocks of granite, is a fearful chasm, rocky, bare, and black, which is a thousand feet deep!—the bed of the river is a quarter of a mile broad, but the fall is elliptical with a sweep of

Overflowing of the Nile.

Comparative Magnitude of Rivers.

about half a mile. This body of water rushes at first for about 300 feet, over a slope at an angle of 45 degrees in a sheet of white foam, and is then precipitated to the depth of 850 feet more into a black abyss, with a thundering noise. It has, therefore, a depth of 1150 feet; in the rainy season the river appears to be about 30 feet in depth at the fall; in the dry season it is much lower, and it is divided into three cascades of varied beauty and astonishing grandeur, but the smaller streams are almost dissipated in vapour before they reach the bottom. The number of considerable rivers, which fall into the sea in different parts of the old continent, is 430, and those of the new continent 140; but this seeming disproportion is amply compensated by the vast dimensions of the latter. Several attempts have been made by philosophers, to compute the quantity of water which rivers discharge into the ocean, but it is a problem scarcely admitting of any solution, beyond a probable approximation. From the observations of Father Riccioli, on the discharge of the river Po, it has been calculated, that the water poured out by all the rivers of the globe is equal to 41 cubic miles daily, or 14,965 cubic miles annually; this computation is probably too high. The greatest estimate of the mean annual fall of rain, of dew, &c., is not above 34 inches for the whole earth, and the superfices of the globe being 196,816,658 square miles, this will afford a mass of water equal to 105,614 cubic miles, as the whole that is precipitated on the earth. But from this must be deducted all that falls on the ocean, which, if we consider the precipitation in the ratio of their surfaces, will give 38,271 cubic miles, as the water that falls on the land; of this quantity, however, at least two thrids are expended in irrigating the soil, or in sustaining vegetable life, and are restored to the atmosphere, by the process of evaporation; so that no more than 12,757 cubic miles will become the annual tribute of the rivers of the globe to the ocean. This estimate differs less from that founded on the tables of Cotte, than some later speculations on this subject, in which we suspect that the mean annual rain and the quantity returned by the rivers to the sea are considerably underrated. The length of the course of 22 of the principal rivers, and the area of their respective domains or basins, were calculated with much care, and given in a tabular form in the Essay on Physical Geography, in the last edition of the Encyclopædia Britannica.

# COMPARATIVE LENGTH

## OF THE PRINCIPAL RIVERS IN THE WORLD.

### EUROPE.

| | Rivers. | Locality. | Length in English miles. |
|---|---|---|---|
| 1 | Thames | Coswald Hills, Gloucestershire | 215 |
| 2 | Seine | France | 450 |
| 3 | Ebro | Spain | 400 |
| 4 | Rhone | France | 510 |
| 5 | Tagus | Spain and Portugal | 580 |
| 6 | Vistula | Poland | 650 |
| 7 | Elbe | Germany | 770 |
| 8 | Rhine | Do. | 840 |
| 9 | Dnieper | Russia | 13,90 |
| 10 | Danube | Germany | 1,833 |

### ASIA.

| | | | |
|---|---|---|---|
| 11 | Euphrates | Asiatic Turkey | 1,840 |
| 12 | Ganges | Hindoostan | 1,850 |
| 13 | Ho-yang-ho | China | 5,040 |
| 13 | Yang-tsi-Kiang | Do. | 3,290 |
| 15 | Enesia | Siberia | 2,890 |

### AFRICA.

| | | | |
|---|---|---|---|
| 16 | Gambia | Senegambia | 1,480 |
| 17 | Niger | Nigritia | 1,800 |
| 18 | Nile | Egypt and Abyssinia | 3,240 |

### AMERICA.

| | | | |
|---|---|---|---|
| 19 | Susqueharmah | United States | 600 |
| 20 | St. Lawrence | Canada | 1,180 |
| 21 | Orinoco | Columbia | 1,600 |
| 22 | La Plata | La Plata and Brazil | 2,400 |
| 23 | Amazon | Brazil | 3,350 |
| 24 | Mississippi | United States | 3,760 |

## OVERFLOWING OF THE NILE.

The swell of this river varies in different parts of its channel. In Upper Egypt it is from 28 to 30 feet, at Cairo it is about 23 feet, whilst in the northern part of the Delta it does not exceed 4 feet, which is owing to the artificial channels and the breadth of the inundation. Yet the four feet of increase is as necessary to the fertility of the Delta as the 23 or 30 elsewhere. The river begins to swell in June, but the rise is not rapid or remarkable until early in July; the greatest height is attained about the autumnal equinox, and the waters remain nearly level until the middle of October. After which the subsidence is very invisible, and the lowest point is reached in May. These phenomena, however striking, are by no means peculiar to the Nile; they are more or less common to all rivers whose volume is annually augmented by the periodical rains which fall within the tropics; but there is no river, the annual swelling of which is so replete with important consequences, or so essential to the existence of a nation. This is because Egypt depends wholly upon the Nile for its fertility, and wherever the influence of its inundation does not extend, there the soil is desert. Rain very seldom falls in Egypt. The irrigation which the land receives by the direct overflow of the Nile, and by the means of the canals which convey its waters where the inundation does not directly extend, is quite essential to that fertility for which Egypt has in all times been proverbial.

The inhabitants of Egypt have, with great labour, cut a vast number of canals and trenches through the whole extent of the land. These canals are not opened until the river has attained a certain height, nor yet all at the same time, as then the distribution of the water would be unequal. The sluices are closed when the water begins to subside, and are gradually opened again in autumn, allowing the waters to pass on to contribute to the irrigation of the Delta. The distribution of the Nile water has always been the subject of distinct and minute regulations, the necessity for which may be estimated from the common statement, that scarcely a tenth part of the water of the Nile reaches the sea in the first three months of the inundation. These regulations must be obviously necessary, where fertility so essential depends upon one great fertilizing power. Lower Mesopotamia, which in the time of Herodotus competed the palm of exuberant production with Egypt, is now a desert, in consequence of the abandonment of a system of irrigation, which is said to be nearly analogous to that which continues to fertilize the land of the Nile during the inundation, the whole level country appears like a series of ponds and reservoirs, and it is not merely the saturation of the ground, but the deposit of mould or soil, which takes place during the overflow, that is so favourable to the agriculture of Egypt. This mud contains principles so favourable to vegetation, that it is used as manure for those places which have not been adequately benefited by the inundation, and on the other hand, when the deposit has been complete the people are said to mingle sand with it to abate its strength. The cultivation of the ground commences as soon as the waters have returned, and where the soil has been sufficiently saturated the labors of agriculture are exceedingly light. The seed is sown in the moistened soil, and vegetation and harvest follow with such rapidity as to allow a succession of crops wherever water can be commanded. The influence of the river upon the condition and appearance of the country, can only be estimated by comparing its aspect in the season which immediately precedes, with that which follows the inundation. Volney has illustrated this, by observing, that the surface of the land successively assumes the appearance of an ocean of fresh water, of a miry morass, of a green level plain, and of a parched desert of sand and dust. It was the feeling generally entertained of their entire dependence upon the river, which led the Egyptians to deify their Nile, which had its appointed priests, festivals and sacrifices; and even now, under the Moslem religion, the reverence in which the Nile is held, as it is still called the "most holy river," and the ceremonies which take place on its yearly overflow, prove the value which the Egyptians set upon this bounty of nature, and their gratitude for it.

——————— "Glad to meet
The joyless desert, down the Nubian rocks,
From thundering steep to steep he pours his urn,
And Egypt joys beneath the spreading wave."

THOMSON.

Although the Nile is, almost without exception, the minister of good to Egypt, there are yet cases in which the excess of its waters have occasioned no small loss both of life and property. In September, 1818, Belzoni witnessed a deplorable scene, owing to the river having risen $3\frac{1}{2}$ feet above the highest mark left by the former inundation. Ascending with uncommon rapidity, it carried off several villages and some hundreds of their inhabitants. Excepting an unusual rise, in consequence of the scarcity of water the preceding season, the Arabs had recourse to their wonted expedient of erecting fences of earth and reeds round the villages, to keep the water from their houses. But on this occasion, the pressure of the flood baffled all their efforts. Their cottages built of earth, could not stand against the current, but were, as soon as the water touched them, levelled with the ground. The rapid stream carried off all that was before it; the inhabitants of all ages, with their corn and cattle, were washed away in an instant. In Upper Egypt, where the villages are not raised above the level even of the ordinary inundations, the natives depend for their safety upon artificial barriers. At Agalta, whither he went to procure the assistance of the camaikan or magistrate, he found the said functionary in great alarm, expecting every hour to be carried away by the Nile. "There was no boat in the village, and should the water break down their weak fences, the only chance of escape was by climbing the palm trees, till Providence sent some one to their relief. All the boats were employed in carrying away the corn from villages that were in danger. Both in Upper and Lower Egypt the men, women, and children, are left to be last assisted, as their lives are not so valuable as corn, which belongs to the pacha! As this village was four feet below the water, the poor Fellahs were on the watch day and night round their fences. They employed their skin machines or bags to throw out the water which rose from under the ground; but if their fences should be broken down, all would be lost." At another village described by the traveller, the distress of the people was very great; some of them had taken refuge on a spot where there were only a few feet of land uncovered; and the water, he adds, was to rise twelve days more, and after that to remain twelve days at its height, according to the usual term of the inundation. In a distance of 1,350 nautical miles from the mouth of the Tacazze to the Delta, the Nile does not receive a single tributary stream from either east or west, which, as remarked by Humboldt, is a solitary instance in the hydrographic history of the globe. The great canal which runs through Cairo, is cleaned periodically, and when the water in the Nile has risen to a certain height, it is opened with great ceremony; the day is kept as a holiday, a grand festival takes place, and the most extravagant joy animates the inhabitants. The other canals are then allowed to be opened.

## THE THAMES*

Has its source in the Cotswald Hills, Gloucestershire, and forms a stream near Lichlode, navigable for barges. The chief spring, or Thames head, is about three miles from Cheltenham, and from whence it runs its silvery course to Oxford, Henley, Staines, Kingston, Richmond, Brentford, Hammersmith, Battersea, Vauxhall; its broadest part in London is from Westminster bridge to that of Blackfriars; its course in the Metropolis is semicircular, and it falls into the sea at Shearness; it is one hundred and eighty miles in length, and is navigable for one hundred miles. It has fourteen bridges over it, and the flux of the tide reaches to Teddington locks; it flows up for four hours and a half, and its reflux occupies seven hours and a half, except at Neap tides, when it is five hours running up and seven hours down. Its greatness and its glories are to be found in the history of the country. Its commercial importance is felt in the remotest regions, where the enterprise of man has led him; the flags of all nations wave over its broad bosom, and the forests of masts ever seen on its flowing tides, bespeak the value it is to the civilized world. Its natural advantages are incalculable. So true it is, as the poet sung—

—————————Majestic Thames,
Rich river, richer than Pactolus streams,
Than those renowned of yore by poets, roll'd
O'er intermingled pearls and sands of gold;
How glorious thou, when from Old Ocean's urn,
Loaded with India's wealth, thy waves return.
Alive thy banks! along each bordering line
High culture blooms, inviting villas shine;
And while around ten thousand beauties glow,
These still on those redoubling lustre throw.

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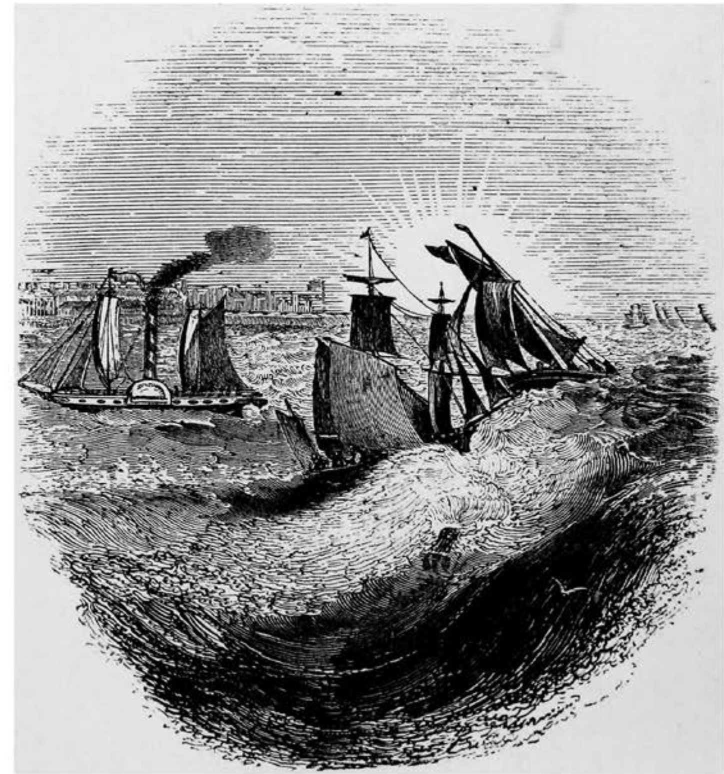
### COMING IN OF THE TIDE OF THE GANGES.

Of all the rivers of India the Ganges is the most sacred. It is, in the estimation of the natives, a god, and the most secure way to Heaven is through its waters. Hence, whenever it is possible, the Hindoo comes

* For a most interesting detailed historical account of this beautiful river,—see Tombleson's "Thames and Medway," illustrated with highly splendid steel plates, sold at *half its published price*, by Lacey, 76, St. Paul's Church Yard.

Source of the Thames.



The Thames at Sheerness.

to its banks to die, and piously drowns in it his parents and relations, to secure their eternal happiness. With the converse of the feeling of the Ghiber, who would consider the eternal fire the object of his worship, polluted by the touch of a corpse, the Hindoo casts the dead, naked, into the sacred stream; so that those who sail upon the Ganges, have often to make their way through shoals of livid corpses floating down to the sea, in various stages of corruption. This stream rises among the roots of the Hienalaya mountains, on the Indian side of the range. It very soon becomes of considerable depth, and navigable for the light barks of the country; but before the confluence with the Jumna, it is fordable in many places. The depth of the Ganges is not materially influenced by the melting of the snows, though, like all other tropical rivers, it overflows the surrounding plains in some places for more than one hundred miles in extent, at which time nothing is visible but the lofty palm trees, the villages, which are built on elevated sites, and a few mounds, the ruins of former hamlets. Travelling is, at this period, performed in boats, in which the Hindoo skims over his rice fields and gardens, which are then imbibing the moisture necessary to their fertility. The prospect is singular but monotonous, as every field is similar to the next, and the appearance of the country, upon the subsidence of the waters, is any thing but picturesque. At the distance of five hundred miles from the sea, the Ganges is thirty feet deep at low water, and never becomes shallow, until at its mouth, the bars and banks of sand, thrown up by the contending waters of the rivers and the sea, choke its channel, and render it unnavigable to large vessels. At the distance of two hundred miles from the sea, the river separates into two branches, the eastern, which flows towards the south east, retaining the original appellation, and the western branch assuming the name of the Hoogly. Except in the rainy season, the surface of the waters, rarely ruffled by the winds, is as smooth as a mirror. Towards the mouth this tranquillity is twice a day disturbed, by the tide rushing with indescribable violence against the stream, with what is called the *mascaret* or *bore*, and endangers the banks which encounter it; but words fail to convey an adequate idea of the awe and terror it inspires, when, bursting as thunder, it shakes the shores like an earthquake. Still less can the calculation of the number of cubic feet of water, which the streams hurl headlong every moment against the opposing waves of the ocean, give any conception of the magnificence of the struggle.

## THE VISTULA

Is the largest river in Poland proper. Its source is in Mount Crapach, on the borders of Silesia and Upper Hungary, crosses little Poland, a part of Masoria, of great Poland and of Prussia, and falls just below Dantzic, into the Baltic. In its course it passes by Cracow, Sandomir, Warsaw, Thorn and Culm; it is 650 miles in length.

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The far-famed

## TIBER,

With all its classic associations, is now shrunk into an inconsiderable stream, and "none so poor to do it reverence." Shorn of its former greatness, "its destiny," says a French author, "is altogether strange. It passes through a corner of Rome as if it did not exist. No one deigns to cast his eyes towards it; no one speaks of it, no one drinks its waters, and the women do not even use it for washing. It steals away between paltry houses, which conceal it, and hastens to precipitate tself into the sea, ashamed of its modern appellation—*Teveri.*"

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## THE RHINE

Is one of the noblest rivers in the world, and from the varied and beautiful scenery on its banks, is, perhaps, the most interesting. It rises in the Canton of the Grisons, from three principal sources; the first is in the mountain of Crispalt, north east of St. Gothard, and unites at Dissentis with the second, which comes from the Leumanian mountain; both unite with the third, which comes from a glacier in the Andula, abcut twenty leagues from Reecheman, where is the union of all the three streams; here it takes the name of the Rhine, and is 230 feet wide it is 840 miles long, and is navigable to the extent of 630 miles.

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## THE DANUBE

Is the second largest river in Europe, being inferior only to the Volga. Its rise is in the Black Forest, Germany, runs in an easterly direction through Austria, Hungary, part of Turkey in Europe, and discharges itself into the Black Sea, after a rapid course of 1,833 miles, previously having received thirty navigable rivers and ninety streams.

## THE RHONE

Is a large river in the south of Europe; it rises in the central and highest part of Switzerland, from the glacier of Furca, and runs across the Valais, to the lake and city of Geneva, after which it separates Bresse from Savoy and from Dauphiny as far as Lyons; then turning southward, it enters Lyonnois and Languedoc, which are on the west, and Dauphiny with Provence lying to the east, and thence proceeds into the Mediterranean. This river is computed to be 510 miles in length.

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## THE NEVA.

"This glorious river," says a modern traveller, "is, perhaps, the only object in St. Petersburg whose beauty and grandeur are wholly unmixed with meanness and bad taste. To drink the waters of the river, is worth a journey to Russia of itself. It is the most delicious draught imaginable, and has, besides, a medical property, favourable to most constitutions; it is found, on analysis, to contain much carbonic acid, without any metallic parts, except a scarcely perceptible quantity of common salt." The waters of the Neva are perfectly blue and transparent. The river at its broadest part is about three quarters of a mile wide, and is deep enough to bear ships of moderate bulk, but a bar across it prevents vessels, drawing more than 7 feet, from going higher up. On one side is a quay of granite, ten feet above the level of the water, and two miles and a half in length. The ice on the Neva seldom breaks up before the 25th of March, and never later than the 27th of April; the earliest period of its freezing is the 20th of October, and the latest the 1st of December. In its course it sends out two broad arms on the right shore, the former being called the Nevka, and the next, more westward, called the Little Neva. The Great Neva is traversed by two bridges of Pontoons, the largest is Isaak's bridge; it is 130 fathoms long, and rests on 120 barges, built expressly for this purpose, each being held in its place by a couple of anchors. To let ships through, two bridges are made, which are opened only at night. The mechanism of these bridges is so simple, that on the coming down of the floating ice in Autumn they can be taken to pieces in less than two hours, and the public is deprived of the use of them only a very short time before the freezing of the Neva. As soon as the ice is fixed, they are again put up, and remain till the spring, for the safety and convenience of the public. On the breaking up of the ice of the Neva, at that season of the year, they are a second time taken asunder, and only reinstated when the ice of the Ladoga has floated by, which frequently takes four or six weeks in passing.

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## THE NIGER.

It is not exactly known in what part of the Kong Mountains (Northern Africa), this river has its origin. It is here called, Joliba or D'joliba, that is, "the great water," or "the great river." Where the river descends from the mountain region it forms some cataracts, which interrupt the navigation near Bammakoo, not far from the western boundary of Bambarra. From this point it runs through the hilly country and the plain, commonly between extremely low banks, towards the east and north east. Numerous valleys, and some considerable places, stand upon this stream. Below Sego the river divides into two branches, which again unite at Isaca, a village situated at a considerable distance below. Afterwards it falls into the eastern part of a large lake called D'ebbee, or D'ebo, and issuing from it on the northern side passes to Timbuctoo. In this tract the river is navigated by vessels from 60 to 80 tons burden, and drawing 6 or 7 feet water.

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## CATARACT OF LAUFFEN ON THE RHINE.

Its greatest height is 75 feet; this is when, by the melting of the snow in the mountains, the lake and river are unusually swollen. At low water it is not more than 20 feet, but fifty is the general average. However, it is not the height of the fall, but the immense body of water broken into spray in the most picturesque manner over rocks, that constitute the great beauty of the cataract. It cannot bear the slightest comparison with that at Terni, which tumbles from a height of 800 feet, and forms three splendid and separate falls, neither with that at Staubach, in the valley of Lauterbrunn, which descends in a single leap 930 feet. The fall, however, is seen to the best advantage at Neuhausen, but in order to view the magnificent rainbow formed by the spray, the spectator must be on the spot before 9 o'clock in the morning.

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## HISTORY OF RAILWAYS.

The many advantages attendant upon this expeditious mode of travelling has been fully demonstrated; fourteen years of continued success (the Stockton and Darlington Railway was opened in the Autumn of 1825), and its general adoption throughout Europe and America, yield the most convincing proofs of its benefits to the civilized world. Greatly as travelling had improved within the last thirty years, in all parts of the United Kingdom; and, which, for speed and convenience was unequalled in the world; yet, the introduction of steam power, as a means of water conveyance had been so successful, that it opened a wide field for the application of it to land carriage, and of which, as was to be expected, our many clever Engineers did not fail to avail themselves.

Various were the machines and steam carriages which were invented, tried, and partially succeeded; Mr. Goldsworthy Gurney, Mr. Hancock, Colonel Masseroni, and many other ingenious men, had devoted their great talents to the accomplishment of so desirable an object; but without impugning, in the slightest degree, the merits of their several inventions, or detracting from the great ingenuity displayed by those gentlemen, it is sufficient here to say that they were all more or less unsuccessful.

The advantage of rail roads over the common roads, consists in the great diminution of friction which they occasion, whereby any given weight may be drawn through equal distances, at a much less expense of power. Many experiments have been made in order to ascertain the economy of power which they produce. The most moderate calculations estimate the resistance on a level turnpike road, to be more than seven times as great as that on a level railroad; while, by some experiments, it has been found, that the traction of the wheels on a level road, as to that on a good railroad, is twenty to one! It is thus evident that a smooth wheel will roll along a smooth plane of iron, much easier than it will roll along a plane covered with rough or loose stones; for, in the latter case, it has either to be lifted over the inequalities, or it has to push them on one side as it passes, or to crush them. But the crushing of the rough material, or the pushing it aside, is so much waste of power; hence the great advantages of a smooth surface. The late Mr. Telford, the eminent Engineer, made the following calculation of the draught upon various roads then in use:—

| | |
|---|---|
| " On well made pavement, the draught is . . . | 33 lbs. |
| On a broken stone surface, or old flint road . . | 65 " |
| On a gravel road . . . . . . | 147 " |
| On a broken stone road, upon a rough pavement foundation | 46 " |
| On a broken stone surface, upon a bottoming of concrete, formed of Parker's cement and gravel . . . | 46 " |

Although the *principle* of Railroads has been adopted from the year 1602, in the various collieries of the county of Northumberland, yet, the rails being composed of wood, and very rudely made, were imperfect and perishable; they were constantly out of repair, and the expense of keeping them useful was very considerable. The advantages even of these rude railways were still great, inasmuch as it was calculated that while a horse load upon a common road was 17 cwt., upon these wooden railroads it was more than double, or 42 cwt., and this advantage seems to have sufficed for the object in view, for no other attempts were made at improvement. Until within a very few years, railroads have been used as auxiliaries to canals, and then only for short distances, or where the nature of the ground precluded the application of inland navigation; and as the number of canals increased, and served the purposes for which they were intended, the ingenuity of man may almost be said to have slept on the farther improvement of railways by the addition of steam power. Between fifty and sixty years ago, iron was substituted for wood on railroads, and the tram road (sometimes called the plate railroad) was first adopted. It consisted of cast iron rails about four feet long, having a flange or upright ledge three inches high, to keep the wheel upon the horizontal part, which was about four inches wide, and another flange at the other side, projecting downwards to strengthen the rail; these rails were fixed together and fastened securely to stone supports. At first they were made to rest on transverse blocks, stretched across the whole breadth of the railroad, or upon short square wooden sleepers (stone blocks are now used). Since the close of the last century, railways have multiplied greatly in the immediate neighbourhood of the Collieries. In Glamorganshire alone it is estimated that there are three hundred miles of railways. These are, however, all detached, isolated, and private undertakings, appropriated only to the conveyance of the mineral produce to those points where water communication was already established. The Stockton and Darlington Railway was the first empowered by Parliament, to convey general marchandise and passengers; this was opened, as we have before stated, in 1825. It was about twenty-five miles in length, but consisted only of a "single railway," having at intervals of every quarter of a mile, "sidings" to allow of the carriages passing each other.

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## THE MANCHESTER AND LIVERPOOL RAILWAY.

THE project of a railway between these two great towns was first entertained in 1822, and a company formed, but from the great opposition to it in committee, it was not until 1826 that the Act of Parliament passed, upon which the company could proceed in their project. The railroad was commenced in June of that year, under the direction of Mr. George Stephenson. It was proposed to lay the railway as nearly as possible in a straight line, between the two places; the nature of the country rendered this undertaking a task of no ordinary difficulty. Tunnels were to be made, eminences were to be excavated, artificial mounds to be erected, and a moss (Chat Moss), four miles in extent, was to be drained, levelled in the centre, and embanked at each end; this Chat Moss was a huge bog, so soft and spungy that cattle could not walk over it: the bottom is composed of clay and sand, and above this, varying in depth from ten to thirty-five feet, is a mass of vegetable pulpy matter. This barren waste is in area about twelve square miles, according to the lowest calculation, contains sixty millions of tons of vegetable matter, and so spongy was it that men could only walk over it in the driest weather! We have thus alluded to some of the difficulties to be overcome; there were several others nearly as great, but the genius and perseverance of the Engineer, Mr. Stephenson, triumphed over all, and the whole line of thirty-one miles was completed. The rails are of wrought iron, and made in lengths of five yards each, weighing thirty-five pounds per yard; the blocks and sleepers are some of stone and some of wood; they are laid along about eighteen miles; the wood sleepers are made of oak or beech, and are principally laid across the embankments and across the districts of moss, wherever it is suspected the road may subside a little. The stone blocks are set firmly into the permanent road, which consists of a layer of broken rock and sand, about two feet thick, one foot of which is placed below the blocks, and one foot distributed between them, serving to keep them in their proper positions. They are placed at intervals of three feet; in each block two holes six inches deep, and one inch in diameter, are drilled, and into these are driven oak plugs. The rails are supported at every three feet on cast iron chairs or pedestals, into which they are immediately fitted and securely fastened; the chairs are placed on the blocks and firmly spiked down to the plugs, the whole forming a work of great solidity and strength: the rails are about two inches in breadth, and rise an inch above the surface; they are laid down with extreme correctness, and consist of four parallel rails about four feet eight inches apart, allowing two trains of carriages to pass in opposite directions with perfect safety. Under the warehouses at Liverpool there are four distinct railways, for the greater convenience and facility of loading and unloading the waggons. The principles followed on this railroad, were (after solidity) the making it as far as possible *level* and *straight*. With the exception of the two inclined planes at Rainhill, where the inclination is one in ninety-six, there is no greater inclination than in the ratio of one in 880. Along the whole extent there are no abrupt curves; the curvature rarely exceeds a deviation from a straight line of more than four inches in twenty yards.

Locomotive power being resolved upon, a premium of £500 was offered for the best engine; this was furnished by Mr. Booth, and the "Rocket" made the trial of 70 miles in less than six hours and three quarters, the engine weighing 4 tons 5 cwt., dragging a gross weight of three tons for every one of its own weight. The speed at which the Rocket travelled was frequently 18 miles an hour, and occasionally sometimes twenty. At length, after a little more than three years, this stupendous undertaking was completed, and it was opened on the 15th of September, 1830. The total cost of it was £820,000.

The railway was opened by the passage of eight locomotive engines, all built by Messrs. Stephenson and Co. To these were attached 28 carriages of different forms and capacities, containing altogether a company of six hundred persons. Preparations were made on a scale of great magnificence, to render this ceremony of no ordinary kind, and some of the most distinguished persons in the country were invited, and attended, to go first over that ground which has since become the scene of daily traffic. The Northumbrian, an engine of 14 horse power, took the lead, having in its train three carriages. The performance of the engines was extremely satisfactory, until they reached Parkfield, 17 miles from Liverpool, when they were stopped to renew the feeders and to take in a fresh supply of fuel. Here several of the company alighted from the different carriages; on again starting, that fatal accident happened to Mr. Huskinson, which, after a few hours of extreme suffering, terminated his life. On the following day the Northumbrian left Liverpool with 130 passengers, and arrived at Manchester in one hour and fifty minutes. In the evening it returned with 21 passengers and three tons of luggage, in one hour and forty eight minutes; and on Friday, the 7th of Sept., six carriages commenced running regularly between the towns, accomplishing the journey in much less than two hours. On the 20th of November, 1830, one of the engines went over the distance in the space of one hour! two minutes of which time was taken up in oiling and examining the machinery about midway. No carriages were attached to this engine, and it had only the additional weight of three persons. On the 4th of December following, the "Planet" locomotive engine took the first load of merchandize which passed along the railway between Liverpool and Manchester. Attached to the engine were 18 waggons, containing 200 barrels of flour, 34 sacks of malt, 63 bags of oatmeal, and 135 bags and bales of cotton. The gross weight drawn, including the waggons and engine tender, was about 80 tons. The speed over level ground was at the rate of 12 to 14 miles per hour. The train was assisted up the Whiston inclined plain by another engine, at the rate of nine miles an hour; it descended the Sutton inclined plain at the rate of 16½ miles per hour, and the average rate of the remaining part was 12½ miles an hour. The whole journey was performed in 2 hours and 54 minutes, including three stoppages of five minutes each, for oiling, watering, and taking in fuel. This was the greatest performance heretofore accomplished by any locomotive power, but it was only the commencement of much greater speed. The "Samson" engine, on the 25th of February, 1831, started with a train of thirty waggons from Liverpool, the gross weight of the whole being 164½ tons! and with this enormous weight it averaged a speed of 20 miles an hour, on level ground! It was assisted up the inclined plane by three other engines, and arrived in Manchester within 2 hours and 34 minutes from first starting; deducting 13 minutes for stoppages employed in taking in water, &c., the net time of travelling was 2 hours and 21 mile. The quantity of coke consumed by the engine in this journey was 1,376 lbs., being not quite one third of a pound per ton per mile. By taking the average speed throughout at 13 miles an hour, the same work would have required seventy good horses. The locomotive (or travelling) engines which are employed on this railway, are all what are called *high pressure engine*. One of

Watt's most ingenious contrivances was his condensing apparatus, by which, previous to every stroke of the piston, he created a vacuum in the part of the cylinder through which it had to be driven, and thereby enabled it to be sent forward through that space with a much inferior pressure of steam to what would otherwise have been required. But in the steam engines affixed to coaches, it is found convenient to dispense with this apparatus on account of its complexity, its weight, the room which it would occupy, and, above all, the constant supply of cold water which would be requisite to keep it in action. The consequence is, that in these engines, and others similarly constructed, a much greater force of steam is necessary to make the piston do its work; and they are on that account denominated *high pressure engines*. It is only within the last thirty years that they have been introduced, and the most remarkable proofs of their power have been afforded on the railways. The mail trains now go the whole distance from Liverpool to London in nine hours!

## THE GREENWICH RAILWAY.

This undertaking lays claim to early notice, in consequence of its being the first of the bold attempts to bring locomotive power so near to the populous parts of this great city, that has been completed. It was designed and executed under the personal superintendence of Lieutenant Colonel Landmann, R. E., ably assisted by the taste and skill of Mr. Mac Intosh, the Architect. It was begun in 1834, and was opened from the Spa Road to Deptford, 8th February, 1836—from London to Deptford, 14th December, 1836, and from London to Greenwich, 24th December, 1838. It commences at Duke Street, London Bridge, and terminates in London Street, Greenwich. This Railway is supported entirely upon arches (of which there are about 1,000), under these are shops, &c., from the letting of which the Company expect to derive great emolument. These arches are erected in the most substantial manner, and, for the purpose of additional security, cross walls are built between the arches, over which the rails are laid for the trains, and the intervals are filled with concrete. By this means the mass is rendered one solid piece, and the weight of the carriages is spread over a large space. The Railway is 25 feet wide, with 22 feet in the clear—that is to say, between the parapets which run from end to end, full breast high, so as to prevent accidents. The actual length of the Railway is three miles and a quarter, so that the absolute saving of distance is a mile and three quarters, and the time occupied in going to Greenwich, and back to the London Terminus, is exactly a quarter of an hour.

Mr. Herepath (no mean authority in these matters), although originally opposed to the design, thus pithily describes the Railway, in what has been aptly called his *amende honorable* to the Company;—"The prevailing character of the work may be summed up in uniform neatness, and strength without heaviness." The locomotive engines on this Railway are upon an entirely new construction; the frames are so formed that the wheels cannot deviate from the rails at any speed, and their revolving motion can be instantly changed to a sliding motion; thus the trains, being powerfully retarded by friction, are speedily brought to rest, and the risk of accident to the passengers is very materially diminished.

The trains start from each station every twenty minutes. An incident is said to have occurred (worth recording), upon an early trip, by Mr. I. Y. Akerman, the Secretary, and some of the Directors, in trying the Engines from Bermondsey Lane to Deptford, and back. On their return a splendid rainbow spread a vivid arch from one end of the road to the other, and such was the cheering effects on their minds, that, to commemorate so auspicious a circumstance, the Company adopted the sign on one of their banners (when the railway was first opened), with the motto, *in hoc signo vinces*—(in this sign is victory).

The undertaking has been eminently successful; and is now also the London Terminus of the Croydon Railway, to which it is joined at New Cross; and it will be the outlet for the Dover and Canterbury, Brighton, and other railways, when completed. As we have before said, it is intended to build shops and dwelling houses under the arches. At the Deptford end there are two neat dwelling houses already tenanted, which may be considered as specimens. These houses contain six rooms each, and, though small, appear to be very comfortable. The passing of the trains over is said to be only like the noise resembling thunder, but from the rapidity of the motion is away in an instant; others describe it as that of a heavy waggon, but not in a greater degree disturbing the tenants than the passing of waggons in a crowded street of London. The noise is less than may be supposed, in consequence of the solidity of the arches, and the smoothness of the railway, which materially decrease the vibration.

## LONDON AND BIRMINGHAM RAILWAY.

Although we cannot exactly pin our faith to *the flourish* of Mr. Arthur Freeling, in his very clever " Railway Companion," that this is a Roman work, conceived in a Roman spirit, and accomplished with Roman perseverance and determination," yet we join him in belief that it is destined to be " the great highway for the northern portions of the kingdom, to communicate with the Metropolis." Like all schemes for public advantage, the projectors of this railway had to combat with no ordinary degree of prejudice and opposing interests, and they deserve infinite credit for their spirit and resolution in accomplishing their great design, amidst such numerous difficulties ;—difficulties, which can only be estimated by a knowledge of the Parliamentary struggle to obtain their act of incorporation, and by many natural obstacles which they had to overcome. When these are considered, it is not surprising to find, that the expense of this railway nearly doubled the estimate, which was £2,400,456. The entrance at the London Terminus in Euston Square, is by an elegant archway having two wings; it is built of fine stone from the Fall Quarry, at Bromley, in Yorkshire ; it is of the Greek Doric order, and the portico is seventy-four feet in height. On either of the wings are booking offices, waiting rooms, &c. The whole front is three hundred and sixteen feet, and forms a truly elegant entrance, worthy the vastness of the work and the genius of the architect.

The first object which engages the attention at this front, is the immense tunnel, called the " grand excavation;" this is nearly a mile in length ; it is crossed by seven bridges, the sides are supported by walls about twenty feet high, surmounted by a neat iron railing, with brick piers, coped with stone; these walls are the internal segment of a curve, the inclination inwards being, perhaps, two inches to a foot of rise. At every interval of twenty feet is a pier, four feet six inches in width; the whole has a most massive and imposing effect. Through this excavation the carriages are drawn by means of an endless rope, connected with the stationary engine at Camden Town. This rope is 10,950 feet in length, seven inches in circumference, and weighs about 11 tons 12cwt.; it runs over hollowed iron sheaves, turning on an axle in an iron frame, placed at a distance of twenty-four feet; there are four lines of rails in this tunnel. The railway proceeds by the following places : Watford, Box-

Houses under Railway, near Deptford.

moor, Birkhamstead, Tring, Leighton Buzzard, Roade, Bilsworth, Weedon, Crick, Rugby, Brandon, Coventry, Hampton to Birmingham, at all of which places are principal stations, to receive passengers and merchandise.

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## THE GRAND JUNCTION RAILWAY

Continues the line of the London and Birmingham, by Wolverhampton, Stafford, Whitmore, Crave, Hartford, and Warrington, where, at the Newton bridge station, it unites itself with the Manchester and Liverpool lines of railway. The Grand Junction obtained their Act of Parliament in May, 1833, and in the following year they had an amended Act, which enabled them to purchase the Warrington and Newton railroad, and thus complete their original intention. The plan, estimates, &c., were laid down by Mr. Stephenson, but the railway was finished under the superintendence of Mr. Locke, and it was opened without any display (with well directed taste, as the recollection of the fatal accident to Mr. Huskisson on the same line of road, was yet green in the memory), on the 4th of July, 1837. The total expense being £l 512,150.0 : 4d. "On this railway," says Mr. Freeling, "there are 100 excavations and embankments. In the formation of which, 5,500,000 cubic yards of earth and stone have been cut and removed, three millions of which have been employed in the embankments; the remainder has been for the most part laid out for spoil. In the line there are about 109,000 distinct rails, which rest upon 436,000 chains, which are supported by four hundred and thirty-six thousand blocks of stone. The railway passes under 100 bridges, two aqueducts, and through two tunnels; it passes over 50 bridges and 5 viaducts; the latter are stupendous erections. In the formation of the line, upwards of 41,440,000lbs. of iron have been used for rails and chains, and upwards of 656,940 cubic yards of stone for blocks to support them." This account (immense as it is) is said to be rather under than over stated.

The next railway, which is calculated to be of the most beneficial advantage to the commerce of this country, is

## THE GREAT WESTERN.

The London Terminus of this great and important undertaking is situated near the end of Praed Street, Paddington. This railway was opened for passengers as far as Maidenhead on the 4th of June, 1838; its route is Uxbridge, West Drayton, Slough, Maidenhead; and it is intended to be continued by Wallingford, Chippenham to Bath, (with a branch to Bristol,) and from thence by Glastonbury, Bridgewater, Taunton, Tiverton and Exeter. By the report of the Parliamentary Committee on railways, it appears, that the cost of the locomotive engine on this line varies from £1,850 to £2,100!

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## THE SOUTHAMPTON RAILWAY.

This company obtained their Act of Incorporation on the 25th of July, 1834, and the railway was opened on the 1st of May, 1838. The estimated cost of the entire line, including locomotive engines, station houses, and every other item, is £1,700,000, being at the rate of £21,000 per mile, an outlay which (if not exceeded) will be infinitely below any other railway. The London Terminus is at the Nine Elms, near Vauxhall, and the line taken is, Wandsworth, Wimbledon, Kingston, Walton, Weybridge, Woking, Farnborough, Hartley Row, &c. to Southampton.

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The United Kingdom is intersected in every possible direction with railways, and much as we admire that species of expeditious travelling, still we cannot but regret that many of the well-appointed coaches have been taken off the road, because there were various conveniences and comforts belonging to them.

Now,

> "————————The abuse of greatness
> Is when it disjoins remorse from power,"

says the poet, and more than one of the railways is settling down into a very comfortable monopoly. We are glad, therefore, to find that the Committee of the House of Commons upon railways, have recommended some Legislative restriction, to prevent "the injurious effect of the railway system upon the poorer class of passengers, which will be more severely felt in proportion as other means of cheap travelling by stage coaches, carriers, carts and waggons, are graudally superseded." And it has been already shown, that the interests of private companies, and of the public, may be at variance; it is also doubtful, whether the same observations be not applicable to the cost of conveying goods by railroads."

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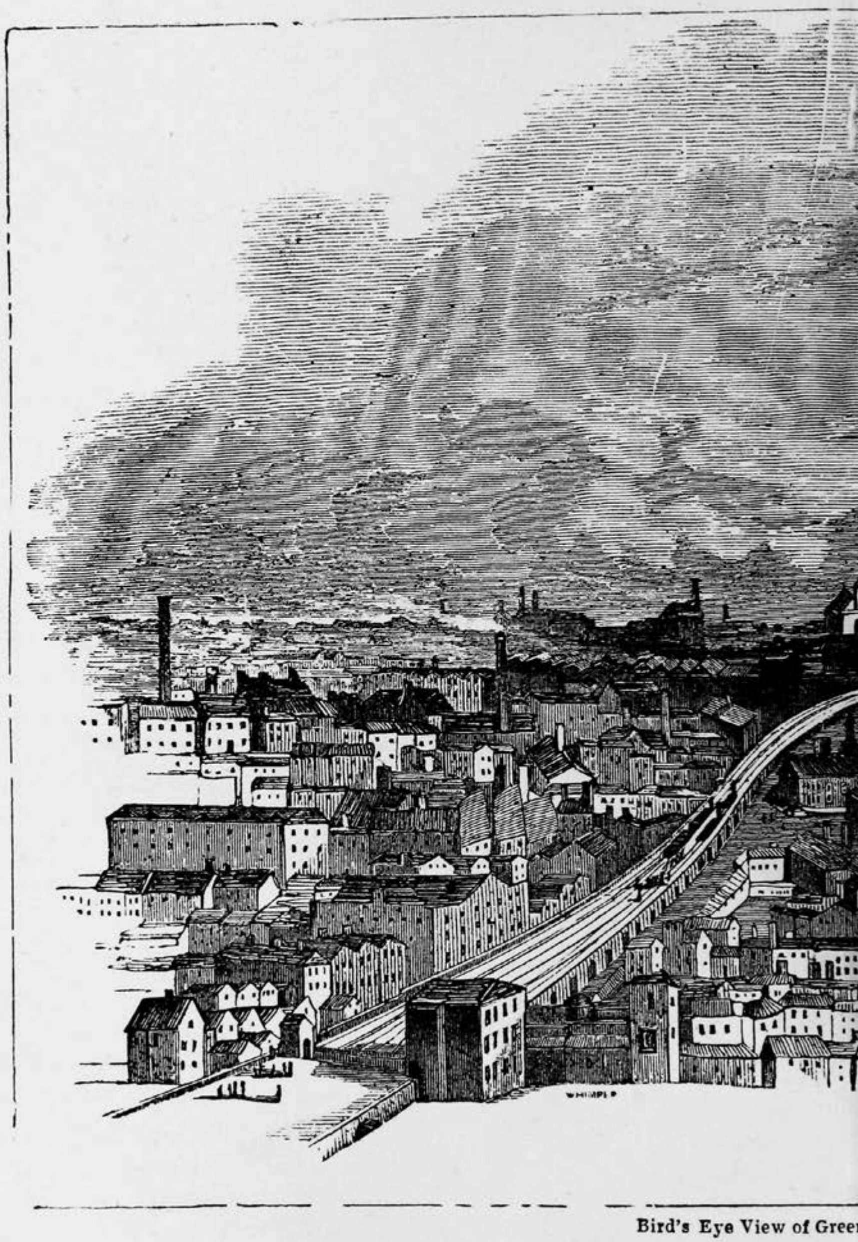

Bird's Eye View of Green

reenwich Railway.

## AN ENGLISHMAN'S OPINION OF RAILWAYS.

An intelligent writer of the present day thus describes his feelings:—"A pleasurable wonder takes possession of the mind as we glide along at a speed equal to the gallop of a race horse. It may be supposed that so great a speed would almost deprive the traveller of breath, and that he could not fail to be unpleasantly conscious of the velocity with which he cuts through the air. The reverse is, however, the case; the motion is so uniform, and so entirely free from the shaking occasioned by the inequality or friction of common roads, that the passenger can scarcely credit he is really passing over the ground at such a rapid pace; and it is only when meeting another train that he is fully aware of the velocity of his career. The novelty of the scene is delightful: now, where the natural surface of the ground is highest, we travel embosomed in deep recesses; and then, where the ordinary course of the road would lead through a valley, we "ride above the tops of the trees," and look down upon the surrounding country. The reflecting traveller probably falls into a pleasing vision, arising out of the triumph of human art. He sees the period fast approaching, when the remotest part of his own country shall be brought into easy and rapid communication; and he looks beyond this probable event of a few years, to the more distant day, when other nations shall emulate these gigantic works of peace. He sees the evils arising out of the difference of language, and soil, and climate, all vanishing before the desire of mankind for peaceful and commercial intercourse; and as he knows that the prejudices, and mistaken interests, which separate one district of the same nation from another, are broken down by such noble inventions as these; he feels that the same spirit of civilization which results from the exercise of our reason (which is bestowed by a beneficent Providence), will eventually render all men as brethren and children of one great Father."

And now for

A Yankee's Opinion of Railroads.—"I like railroads—any one can hate railroads, despise railroads, and rail at railroads—but I like railroads. I like to arrive at the railroad-office a quarter of an hour before starting: I like to be shewn into a nice warm room, where a quarter-of-an-hour passes quicker than five minutes in a dirty coach-office, or a coffee-room, where the waiters try to look you into a glass of brandy and water, for the sake of the house, or out of a sixpence for the sake of themselves. I like to go in at one door and out at the other—a thing you can never do in prison. I like to have my luggage and baggage taken from me where it is taken care of, and hate to have it wetted on the top of a coach, or stolen at a coach office while the book-keeper is looking at some lady at a crossing, who does not wish to wet the flounces of her gown. I like to have to do with porters who charge nothing for being civil, and cannot put their hands in their breeches-pockets, which is a vulgar and idle habit. I hate to wait for any thing. Men must wait, and horses must; and pretty women must wait, when agreeable young men, whom they admire, are engaged to charming young women (precisely my case); but steam-coaches know no dependence and are never in love. I like the ample room of a steam-coach, where there is no necessity for your neighbour, should she be old and ugly, to lay her soft head upon your soft shoulder. I like to travel fast. I dread vicious horses; I feel for distressed ones. I hate going down hill—drag-chain breaking, coach upsetting, coachman dying, leaving a wife and 12 children; myself with a broken leg going to married next week."

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That prince of punsters, Hood, has a funny story of a cockney lady, who, anxious to secure *her own place* in the Railway-train, from Liege to Bruges, travels three or four times over the same ground; and one of whose sage precautions is, to get farthest from the engine, because, as she gravely says, " it *must bust fust.*"

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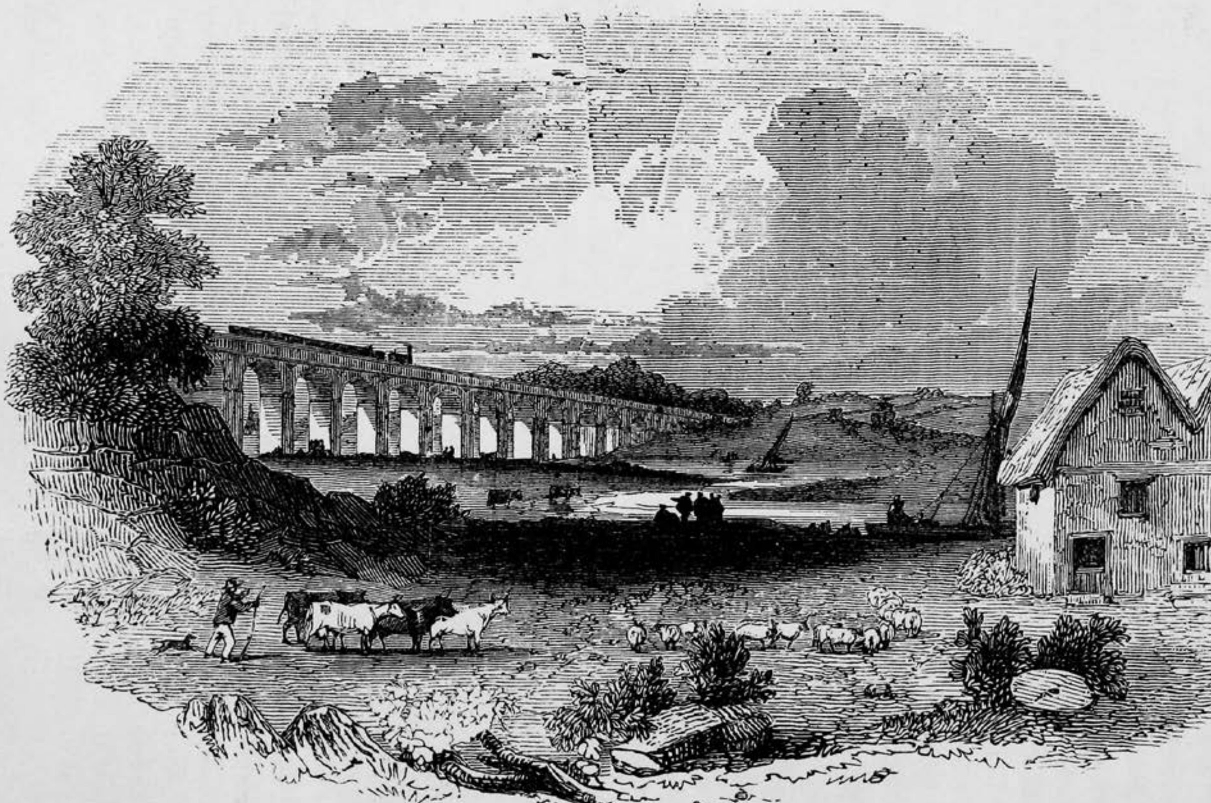
## INFLUENCE OF RAILWAY TRAVELLING UPON HEALTH.

An impression is current that this method of travelling is injurious to health. We cannot suppose that our readers are influenced by such prejudices; and we believe that it is a work of supererogation, to apply other than the language of ridicule to such an absurd notion; but should any timid person hesitate in such matter, we quote the opinion of Dr. James Johnson, a physician of first rate talent and deserved eminence, to cure any apprehensions which he may entertain. Contrasting Railway travelling with that by Coach, the Doctor says, " The former equalises the circulation, promotes digestion, tranquillises the nerves, and often causes sound sleep during the succeeding night; the exercise of this kind of travelling being unaccompanied by that lassitude, aching and fatigue, which, in weakly constitutions, is the invariable accompaniment



Railway Viaduct.

of ordinary travelling; and which so frequently, in such constitutions, produces sleepless nights."

"The Railroads bid fair to be a powerful remedial agent in many ailments to which the metropolitan and civic inhabitants are subject; and to thousands of valetudinarians in the Metropolis, the ride to Tring and back twice or three times a week, *would prove a means of preserving health, and prolonging life, more than all the Drugs in Apothecaries' Hall.*"

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## RAILWAY MILEAGE DUTIES.

The following duties were paid, as under, by the various companies—from July, 1837, to January, 1839, by Birmingham and London, £10,995, 12s. 1d ; the aggregate number of miles travelled during that period, being 24,111,560. The Grand Junction, from July 4, 1837, to January, 1839, £17,032, 19s. 10d.; number of miles, 32,702,384. The Liverpool and Manchester, from January, 1836, to January, 1839, £21,397, 2s. 8½d.; number of miles, 41,082,500. London and South Western, from May, 1838, to January, 1839, £1,524, 19s. 3d ; number of miles, 2,927,928. And the Great Western, from January 4, 1838, to January, 1839, £2,229, 10s. 1d ; number of miles, 4,280,048.

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## OPTICAL ILLUSIONS.

### THE MIRAGE.

Every traveller in the East has described in glowing terms this visual phenomenon, which really "please the eye but vex the heart;" and, while the body is suffering the most dreadful torture of thirst, when crossing the deserts of Egypt, Syria, or Persia, appears like a transparent lake, or flowing river, reflecting on its glassy bosom all surrounding objects. Conceive, if possible, the horror and disappointment, on finding it an optical illusion!

Thus speaks an eye witness of this "mockery of woe." "Conceive an European in those countries, travelling with

——————'Some great caravan, from well to well,
Winding as darkness o'er the desert fell,'

the ground beneath him like unto the hot ashes of a forge, and the air around glowing as the vapour of a furnace. No water of any kind has been seen for days, and the scanty supply of the skins reduced to such a small quantity, as to render what little is left as precious as gold. Every eye is dim, every tongue, swollen, parched and rent, cleaves to the roof of the mouth, and the Arabs begin to talk of killing the very camels for the sake of the water which these provident animals always keep in a large bag—the fifth stomach. In such circumstances it is easily to be imagined with what delight the traveller, in the very heat of the day, perceives before him one or more clear glassy lakes! He cannot utter the joyful cries of 'water, water,' but puts his beast to its utmost speed, and if he thinks of any thing but the instant means of allaying his burning throat, it is to wonder that none of the natives, whose wants are equal to his own, does not seem similarly excited by the appearance. But the traveller soon finds, to his cost, that he cannot reach the water for which he longs. The shore of the lake recedes as he approaches, and its dimensions are consequently contracted, until, if he proceeds, it disappears, and is frequently formed anew at a distance beyond him! Pausing to consider this phenomena, the traveller will easily perceive that it is the *Siraub* of which he has heard; but the most attentive consideration will not enable him to detect any difference in the exhibition from that which is presented by the appearance of real water! Often the clear, calm azure, reflects the surrounding objects with precision and distinctness, and frequently the whitish, vibratory volume, exhibits the contours of the reflected objects as badly terminated with that sort of indecision which always accompanies such representations in water slightly ruffled by the wind. Local circumstances sometimes contribute to give more striking effect to the illusion. In Lower Egypt, for instance, the villages, in order to avoid the effects of the inundations of the Nile, are built on small eminences, scattered through a plain of vast extent. Towards the middle of the day, when the ground was heated, each village often appeared to the French army, during the campaign in that country, as if surrounded to the distance of a league by a lake, in which, underneath the village, a distinct *reversed image of it* was represented. This illusion is altogether so perfect, and so strong, that, in our own case, after repeated experience, we always in the first instance took *the Siraub* for real water, unless, when from local knowledge, or the circumstances of the place, we knew its existence to be impossible or unlikely."

This phenomena is not confined to the land. It is more frequently observed at sea; hence the name (*Mirage*, sea vision), which the French sailors gave it.

We shall quote one or two remarkable cases of this optical illusion, and then endeavour to give a philosophical explanation of its causes.

At sea the mirage is usually noticed by the form, distinguished by the term "suspension;" the object is then represented as *above the water*, painted, as it were, on the sky. None more striking of which appears to be recorded, than that which was observed by Captain Scoresby, on the 28th of January, 1820, in the Greenland Seas. The sun was very brilliant, and his rays unusually ardent during the day. In the evening a light breeze sprung up, and most of the ships navigating at the distance of ten or fifteen miles (about eighteen or nineteen sail), appeared then to undergo a great change of magnitude and form, and when examined from the mast head with a telescope, exhibited some very extraordinary appearances, differing in almost every point of the compass. One ship had an inverted image above it, another two distinct images in the air, a third was distorted by elongation, the masts being nearly of twice the proper height, and others underwent contraction. All the images of the ships were accompanied by a reflection of the ice, in some places in two strata.

The images of the mirage are usually vertical; that is, presenting the appearance of one object above another, like a ship above its shadow in the water. Occasionally, but very rarely, they are lateral or horizontal, (viz.) one or more images are represented upon the same plane with the object. This form of the phenomena was seen by M. M. Jurine and Soret, onthe lake of Geneva, in September, 1818. A bark, near Bellerive, was seen approaching Geneva by the left bank of the lake, and at the same time an image of the sails was seen above the water, which, instead of following the direction of the bark, separated from it, and appeared to appraoch Geneva by the right bank of the lake; the image moving from east to west, while the vessel moved from north to south. When the image separated from the object, it was of the same dimensions as the bark, but it diminished as it receded, so that when the phenomena ceased it was reduced one half!

This remarkable class of *optical illusions* is thus accounted for: when a ray of light strikes obliquely, a medium less refracting than that in which it was previously moving, it is turned back into its original medium, and a direction is given to it precisely similar to that which would have been the result of a reflection taking place at the common surface of the two mediums. Now the sand of the desert, or the surface of the sea, being heated by the rays of the sun, communicates a portion of its warmth to the stratum of air immediately superposed, which then dilates and becomes consequently less dense, aud, therefore, less refracting than the superior. Thus, when an observer looks at an object above the horizon, the rays which, in coming to him, traverse a layer of air of uniform density, will exhibit it in the natural position, while the light directed obliquely towards the surface of the earth will be bent downward, and so come to the eye as if from an object placed inversely and below the former.

M. Monge, in Egypt, and Dr. Wollaston, in England, made experiments at the same time, and both came to the same conclusion.

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## THE FATA MORGANA,

*(Or Fairy Morgana)*, of the Bay of Riggio, in the Straits of Messina, Sicily, may be considered as of the same class of optical illusions. The inhabitants of this part of Sicily (Calabria) are exceedingly superstitious and ignorant; hence, when the "Fairy" makes her appearance (which, by the way, is very rare), the people hail it with exultation and joy, running down to the sea side, clapping their hands, and shouting out, "Morgana! Morgana! Fata Morgana!"

The most reasonable description of this phenomenon is from the pen of Manesi, a Dominican Friar, in 1773; who declares that *he saw it* three several times, and that its beauty surpassed every thing which he had ever seen or heard of in the world. Making allowance for his evidently exaggerated statement, still we must give the worthy father credit for something like fidelity of description, particulary, too, as he is confirmed in some of the main facts by writers of credit, and who are less imaginative; but let the friar speak for himself. "When the rising sun shines from a point, whence its insident ray forms an angle of 45 degrees on the sea of Riggio, and the bright surface of the water in the bay is not disturbed, either by the wind or the current, the spectator being placed on an eminence of the city, with his back to the sun and his face to the sea; on a sudden he sees appear in the water, as in a catoptric theatre, various multiplied objects, *i. e.* numberless series of pilasters, arches, castles, well delineated regular columns, lofty towers, superb palaces with balconies and windows, extended alleys of trees, delightful planes with herds and flocks, &c., all in their natural colors and proper action, and passing rapidly in succession along the surface of the sea, during the whole short period of time that the above mentioned causes remain. But if, in addition to the circumstances before described, the atmosphere be highly impregnated with vapour and exhalations, not dispersed by the wind nor rarefied by the sun, it then happens that in this vapour, as in a curtain extended along the channel to the height of about thirty palms, and nearly down to the sea, the observer will behold the scene of the same objects not only reflected from the surface of the sea, but likewise in the air, though not in so distinct or defined a manner as in the sea. And again, if the air be slightly hazy and opaque, and at the same time dewy and adapted to form the iris, then the objects will appear only at the surface of the sea, but they will be all vividly colored or fringed with red, green, blue, and other prismatic colors.' He adds (simply enough), that all the objects exhibited by the *Fata Morgana*, are derived from real objects on shore, reflected in all senses, magnified, mingled and multiplied. We shall pass over the friar's attempt at an explanation of this phenomenon, and quote a more recent and more philosophical author, who says, "that, by the form and situation of the Faro of Messina (the strait), the current from the south, at the expiration of which the phenomenon is most likely to appear, is so far impeded by the land, that a considerable portion of the water returns along shore, that it is probable the same coasts may have a tendency to modify the lower portion of air in a similar manner, during the southern breezes, or that a sort of basin is formed by the land, in which the lower air is disposed to become calm and motionless; that the Morgana presents inverted images beneath the real objects, and that these inverted images are multiplied, laterally as well as vertically; that in the aërial Morgana, the objects are *not inverted*, but more elevated than the original objects on the shore, and that the fringes of the prismatic colors are produced in falling vapours, and to be explained by the principles of refraction."

Although we have been "somewhat lengthy" in describing these phenomena, yet we are sure our readers will thank us, by briefly showing them how an imitation of them "in little" may be produced. Dr. Wollaston usually employed fluids, but the following is much more simple; take a red hot poker and look along the side of it, at a paper ten or twelve feet distant, a perceptible refraction will take place at three eighths of an inch from it. A letter more than three eighths of an inch distant will appear erect as usual; at a less distance will be a faint *reversed* image of it, and still nearer to the poker a second erect image !

Sir David Brewster has since produced a beautiful imitation of the phenomena of the *Mirage*, by the simple method of holding a heated iron over a mass of water. As the heat descends through the fluid, there is a regular variation of density, which gradually increases from the surface to the bottom. If the heated iron be withdrawn, and a cold body substituted in its place, or even if the air be allowed to act alone, the superior strata of water will give out their heat, so as to have an increase of density from the surface to a certain depth below it.

Through the medium thus constituted, all the phenomena of unusual refraction may be seen in the most beautiful manner, the variation of density being produced by heat alone. Brewster has also produced the same effects with plates of glass.

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## ADAM'S PEAK, CEYLON.

Few Europeans have reached the top of this extraordinary mountain; the last ascent was made in 1819, by Mr. Marshall and friend, from whose very interesting account we copy the following:—" Starting from the City of Kandy, and proceeding south west to the mountain, the travellers were three days performing thirty-nine miles, so rugged in parts, and in others covered with trees and low jungle, was the country they had to traverse. On the third day they saw the few huts of the natives, built on the extreme jagged points of the loftiest mountains, to escape the elephants. At the end of this day's journey, they were only eighteen miles from the foot of the peak, or the upper cone, yet it took them two days to perform that distance. On the fourth day there was a considerable degree of ascent in their road, and they found the trees covered with moss or lichen. For some distance their pathway lay along the ridge of a narrow hill, on each side of which flowed a river. These rivers at some places fall over stupendous precipices, forming cascades of great magnitude. From the height of one of these cascades, the whole mass of water which passed over the rock seemed to rise again in white vapour. Above these impetuous rivers rose lofty ranges of peaked mountains, the whole presenting one of the most magnificent pictures in the world.

The peak has always been considered by the natives as a Holy Mount, and pilgrimages were very often made to it. The returning Pilgrims, as an act of charity and duty, disposed of their walking staves on the face of the hill, so as to assist future travellers in their ascent. When Mr.

Marshall came to a very steep part of the road, he found a succession of these walking sticks stuck firmly in the earth, and bundles of rods laid horizontally behind them, by which means tolerable steps were formed. As, however, pilgrimages by the road they came had almost wholly ceased, since the dominion of the English, all these conveniences were rapidly going to decay. On the sixth day of their journey, when they were four days going about six miles, the guides were frequently at a loss to distinguish the path they ought to follow from the tracks of wild elephants through the jungle. On reaching the top of a very high hill, they had a near view of the peak, which rose before them like an immense acuminated or sharp pointed dome. The next morning our travellers approached a small river; from this the pathway went up a narrow rugged ravine: in the wet season, this is the bed of a torrent, and impassable. Thick jungle and lofty trees threw a wild gloom over this hollow, and intercepted the view. Their way was now more difficult than ever, as the superior portion of the peak consists of an immense cone of granitic rock, but very partially covered with vegetation. The track over several places of this cone is quite abrupt, and where the pathway leads over a bare declevitous rock (tending to some fearful precipice), there are steps cut in the stone, and iron chains so fixed as to lie along the steps, for the purpose of assisting passengers in ascending and descending. Mr. M. and his friend reached the top of the cone about two hours after they had begun to ascend at its base; they found that its narrow apex, which was only twenty-three paces long by eighteen broad, was surrounded by a wall, in which there were two distinct openings to admit pilgrims, corresponding with the two tracks, by which alone the mountain could be ascended. The elevation of this apex is 6,800 feet above the level of the sea; the granitic peak or cone resting upon a very high mountain, belonging to the chain which forms the rampart of the upper country. Nearly in the centre of the enclosed area they saw a large rock, one side of which is shelving, and can be easily ascended. On the top of this mass, which is of granite, there stands a small square wooden shed, fastened to the rock, as also to the outer walls, by means of heavy chains. This security is necessary, to prevent the edifice being hurled from its narrow base, by the violence of the winds. The roof and posts of this little building, which is used to cover the *Sri Pade*, or holy foot mark, was adorned with flowers and artificial figures, made of party colored cloth; this foot they found to have been made in part by the chisel, and partly by elevating its outer border with mortar; all the elevations which mark the spaces between the toes of the foot, have been made by lime and sand. The impression, which is five and a half feet broad, and nearly two feet deep, is encircled by a border of gilded copper, in which are set a few valueless gems. This foot mark is an object of deep reverence by the pilgrims, some of whom believe it to be that of their god Buddhoo; but the Arabs gave it to Adam our first father. Mr. Marshall found about fifty pilgrims here, who had ascended the peak in an opposite direction; they performed their devotions without taking any notice of the travellers, and then left the mountain suddenly, without looking on either hand. On the shelf of the rock on which the foot is traced, there is also a small temple, dedicated to Vishnu, whom the pilgrims propitiate with offerings of small sums of money. Mr. Marshall and his friend remained upon the peak all night, to watch the singular atmospheric effects, and the rising of the sun in the morning. "By midnight," says he, "the clouds had subsided to the lower strata of the atmosphere, and appeared to be all lying on the surface of the earth. The moon shone bright, by which means we had a magnificent view of the upper surface of a dense stratum of white fleecy cloud. It is impossible to convey in words the grandeur of the scene. The surface of the earth was overspread with a covering, resembling the finest white down, through which many dark colored mountains and cliffs projected. Could we conceive a white sea studded over with islands, extremely various in size and figure, a faint idea may be formed of the prospect from the peak during the night. The clouds continued to rest undisturbed on the bosom of the earth, until a little after six o'clock. For sometime before sunrise the sky towards the east had a bright flame colour, indicative of the approach of day. The sun burst forth suddenly in all his glory; not a cloud intervened to dim his splendour. Immediately after the rising of the sun, the shadow of the peak appeared like an immense cone or triangle, stretching to the edge of the western horizon. In a few minutes the base of the shadow approached the foot of the mountain. Soon after the appearance of the sun, light floating vapours began to rise from the upper surface of the clouds, which were qnickly dissolved in the superincumbent stratum of the transparent air. The travellers descended the cone by the opposite route, leading to Saffragam, which they found to be still more abrupt than the one by which they had ascended. In several places it led them across bare, slippery, precipitous rocks. There were no steps cut, as on the other side of the cone, but in the more difficult and dangerous places there were strong iron chains, fastened to the rock, to assist ascent and descent. At two or three turns the view downward was grand and awful in the extreme, the cone at these points seeming to overhang the lower mountain, by which means the eye plunged perpendicularly about the base of the peak. Meanwhile, the sun, shining brightly upon the space where the view terminated at the bottom of the mountain, increased thereby the sublimity of the prospect. It is impossible to describe the terrific grandeur of the scene; but, indeed, the prospect is so frightful, that I believe it is rarely contemplated with due composure.

## REMAINS OF STONEHENGE.

Stonehenge is the most remarkable ancient monument now remaining in this island; nor, indeed, is there known anywhere to exist so stupendous an erection of the same character. Even in its present half-ruined state, the venerable pile retains a majesty that strikes, at the first glance, both the most refined and the rudest eye; and the admiration of the beholder grows and expands as the more distinct conceptions of the original plan of the structure gradually unfolds itself from amidst the irregular and confused mixture of the standing and fallen portions, which, for a short time, perplexes the contemplation. Stonehenge stands at a short distance from Amesbury, Wiltshire, on the brow of one of those broad and gentle elevations which undulate the vast level of Salisbury Plain. The direction of the entrance, or avenue, is from north east to south west; and this appears to have been the only entrance to the enclosue in which the building stands; which is formed by a circular ditch, 369 yards in circumference, and having a slight rampart on the inner side. The building stands in the centre of this circular area. An outer circle of enormous upright blocks, having others upon them, as the lintel of a door is placed upon side posts so as to form a kind of architrave, has enclosed a space of 100 feet in diameter. The upright stones in this circle had been originally thirty in number; but only 17 of them are now standing. That portion of the circle which faces the north east is still tolerably entire, and the doorway at the termination of the avenue may be said to be in perfect preservation. It consists of two upright stones, each 13 feet in height, and between 6 and 7 feet in breadth, with a third block placed over them, of about 12 feet in length, and two feet eight inches in depth. The space between the two posts is five feet, which is rather a wider interval than occurs between any two other pillars. Through the circle the broad side of the stone is placed in the line of the circumference, so that there must have been more of wall than of open space, in the proportion of $6\frac{1}{2}$ to 5. The imposts are fixed upon the uprights throughout, by the contrivance called a tenon and mortise; the ends of the uprights being hewn into tenons or projections, and corresponding hollows being excavated in the imposts. They are oval or egg shaped. Of course, there are two tenons on each upright, and two mortises in each of the imposts, which are of the same number with the uprights. The principal workmanship must have been bestowed upon these fittings; for, although the marks of the hewer's tool are visible upon the other parts of the stones, their surface has been left, upon the whole, rude and irregular. They are made to taper a little towards the top; but even in this respect they are not uniform. Within this great circle there is another, formed by stones, not much smaller, but also much ruder in their outline; of these there had originally been 40, but only 20 of them can now be traced. This circle has never had any imposts; it is about 84 feet in diameter, and consequently the interval between it and the outer circle is 8 feet.

The next enclosure has been formed of only 10 stones; but they are of very majestic height, exceeding that of the outer circle. They have been disposed in five pairs, and in the form of a half-oval, or rather of a horseshoe; the upper part, facing the north end or great door; the two pairs, at the termination of the curve, which are distant from each other about 40 feet, are each sixteen feet three inches in height; but the height of the next two pairs, is 17 feet 2 inches; and that of the last pair, the station of which has been directly facing the opening, was twenty one feet and a half. A striking effect must have been produced by this ascending elevation. A variety and a lightness must also have been given to the structure, by the arrangement of the stones here, not at equal distances, as in the two exterior rows, but in pairs; the intervals between each two pairs being much greater than that between the two stones composing each pair. The uprights of this row have imposts over them, as in the outer circle. One of these imposts is 16 feet 3 inches long; of course the imposts here not forming a continuous architrave, are only five in number. Of the five pairs, or rather trilithons (that is, combinations of three stones), although some of the shafts have been injured and mutilated, all are still in their places, except the fifth, or that which faced the entrance: this trilithon fell down on the 3rd January, 1797, and the stones now encumber a flat one, of about 15 feet in length, which lay at their base. Lastly, there appears to have been a fourth enclosure, formed originally (as Stockely thinks) of 19 stones, but only 11 now remain entire or in fragments. These seem also to have been arranged in the shape of a half-oval, with the open part, as in the case of the other, to the north east. Although greatly inferior in height to those last described, they are still taller than those of the second circle. The most perfect, according to Sir R. C. Hoare (see his History of, South Wilts, London, 1812), is seven and a half feet high, and 23 inches wide at the base, and twelve at the top. Like the second circle this row has never had any imposts.

A variety of absurd legends are connected with the origin and purposes of this erection; but it is now universally admitted, that the view taken of its origin, by Stockely (1740), is the correct one, viz:—that it is a Druidical temple of the ancient Britons. It has also been the subject of wonder how the immense stones came there—this has been set at rest by Sir R. C. Hoare, who proves that those of the outer circle, and the five trilithons of the grand oval, are of the same kind with those which are found in different parts of the surface of the Wiltshire downs, and are there called *Sarsen Stones*, i. e., stones taken from their native quarry in their rude state—they being a fine grained species of silicious sandstone. Those forming the smaller circle and the smaller oval, are again quite different. Some are an aggregate of quartz, feldspar, chlorite, and horneblende; one is a silicious schist; others are hornstone, intermixed with small specks of feldspar and pyrites. What is called the altar, being the stone now covered by the centre trilithon, is a micaceous fine grained sandstone. It is still a matter of speculation by what mechanical power they were placed in their situations. At Averbury, in the same county, there are also some remains of what is supposed to have been the largest Celtic, or Druidical temple in Europe.

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THE RISENBERG, (GIANT'S CASTLE) IN FRANCONIA.—It is a rock of most stupendous height, and the number of recesses, windows, arches, rooms, &c. in its interior is truly astonishing. But the attention is forcibly struck with a most singular freak of nature, the form of a human being of gigantic dimensions, in the rocky roof of one of the halls—the head, limbs, and ribs are distinctly developed. The castle derives its name from this figure.

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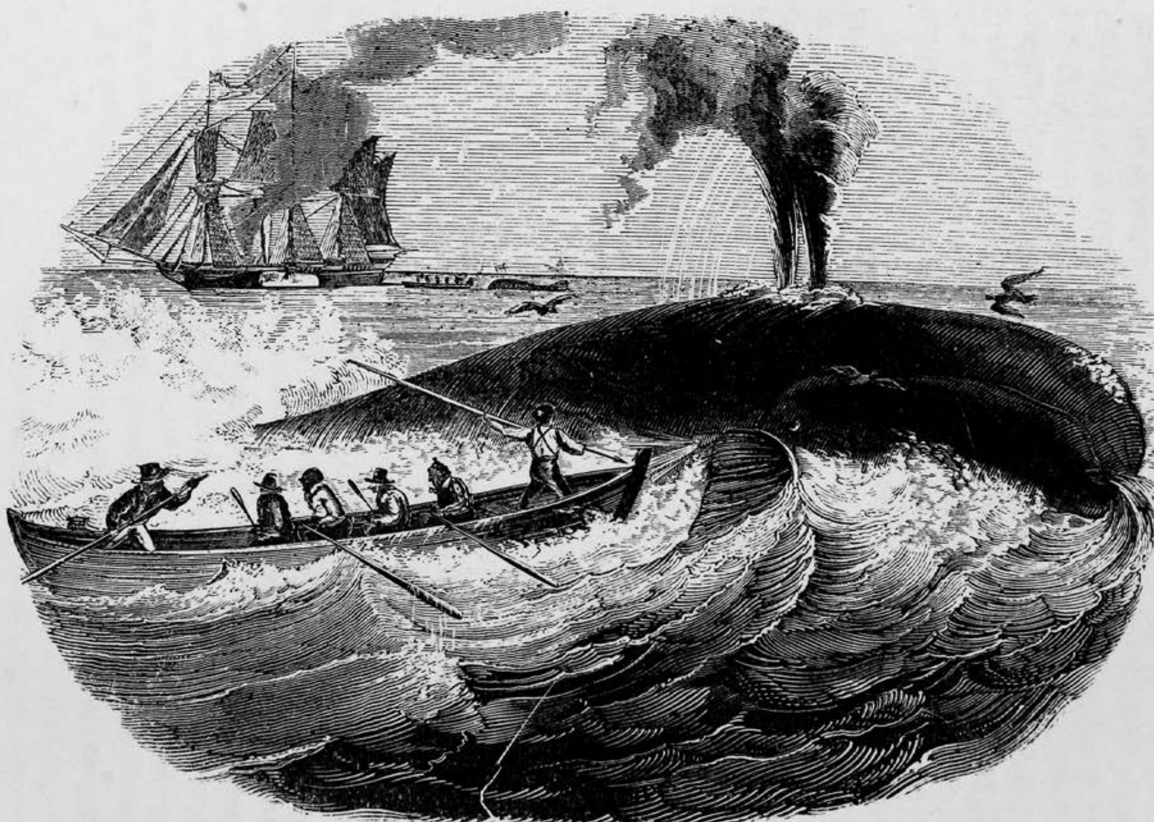
## WHALE FISHERY.

Although there is little doubt that the Norwegians were the first who engaged in the catching of these Monsters of the deep, yet it is certain that the inhabitants of the coast on the Bay of Biscay were the first who followed Whale fishing in a systematic manner, and for commercial purposes. The Bay being soon thinned of fish, the whalers removed their trade to the coasts farther north, and, by degees, carried on their enterprises on the shores of Iceland, Greenland, and Newfoundland. Thus began the northern whale fishery about the middle of the sixteenth century.

The earliest Whaling Voyage made by the English, was by some merchants of Hull, in 1598, who fitted out some ships expressly for that purpose. The Dutch, French, Danes, &c. quickly followed,—both in England and Holland the fishery was carried on exclusively by chartered companies, till about a century ago, when the trade was thrown open in both countries, previous to which it was anything but a source of profit even to the monopolists.

In 1732 the British Parliament adopted a scale of premiums, to give encouragement to the fishery. Thus a bounty was offered of 20 shillings per ton, and, in 1749, it was doubled; but as this was found to lead to great fraud, it was first reduced to 30s. per ton, and altogether withdrawn in 1824. The only competitors to the British in the fiishery now are the Americans, Hamburghers, and Russians.

The whale ships are strongly-made vessels, of from 3 to 400 tons burden; and they leave the country in time to reach Shetland by the first of April, where they complete their ballast and get thence to the ice, about the end of May. This rule is not so strictly observed as formerly, fish being now frequently sought with success, as early as April, and as late as September or October. Their scene of action too is changed; instead of the Arctic Ocean on the east coast of Greenland being chosen as formerly, the whalers now proceed directly through Davis' Straits, to the great inland sea, called Baffin's Bay, which lies on the other side of Greenland. In those high latitudes whales still exist in very large numbers; but, from the prevalence of ice bergs, the fishery in Baffin's Bay is more perilous than that which used to be carried on in the animal's more ancient haunt.



Whale Fishery.

Since the year 1790, the trade from London, and the other parts of the kingdom, and the number of whale ships have been greatly reduced. So great was the consumption of whalebone in England, that it is said that more than £100,000 annually was paid to the Dutch for several years. The first blow to the trade was abolishing the fashion of wearing those frightful looking things, called "Hooped Petticoats," the users of which Pope ridiculed as

"Stiff with hoops, and armed with ribs of whale;"

the use of gas lights still further depressed the trade in oil.

The crew of a whaler consists of a Master, Surgeon, and forty or fifty men, who are divided into several classes, as, harpooners, boat steerers, line managers, carpenters, coopers, &c. She is commonly provided with six or seven boats, which, as affording the principal means by which the fishery is to be carried on, are hung round her in such a manner, as to admit of being detached and launched with the greatest possible expedition. After the whale is killed and cut up, the bone and blubber are stowed in the ship, but the attack upon the animal, and all the operations of its capture and destruction, are carried on in the boat. The chief instruments with which every boat is provided, are two harpoons, and six or eight lances. The harpoon is made wholly of iron, and is about three feet in length; it consists of a shank, with a barbed head, each barb, or wither as it is called, having an inner or smaller barb in a reverse position. This instrument is attached by the shank to a line or rope of about two inches and a quarter in circumference, and 120 fathoms in length. Each boat is furnished with six of these lines, making in all 720 fathoms, or 4320 feet. The use of the harpoon, which is commonly projected from the hand, but sometimes forms a sort of gun, is merely to strike or hook the fish: it is by the lance that its destruction is accomplished. This is a spear of the length of six feet, consisting principally of a stock or handle of fir, fitted with a steel head, which is made very thin, and exceedingly sharp.

The lance is not flung from the hand like a harpoon, but held fast, as it is thrust into the body of the animal.

The common Greenland whale *(Balæna mysticetus)* is not unusually 58 or 60 feet in length, by 30 or 40 in circumference: this gives a weight of about 70 tons, equal to 200 fat oxen. Captain Scoresby (Journal of a voyage to the Northern Whale Fishery, 1820) says, that of 322 whales, in the capture of which he was personally connected, no one, he believes, exceeded 60 feet in length. A few instances, he adds, may have occurred, in which eight or ten feet more had been attained; but there is no evidence that the animal has ever been seen of a greater length than 70 feet. There is, however, another species (called by Linnæus *(Balæna physalis)*, known by the name of "razor back" among the whalers, which reaches a larger size, being sometimes 100 or 150 feet long. It is, most probably, the most bulky and powerful of created beings: the name of razor back, which is given to it, is from a small horny fin, or protuberance, running along the ridge of the back, and is no great favourite with the whalers, being more active and difficult to capture than the common, or what they call the *right fish*, and very far from being so valuable a prize when caught. The whale is popularly considered as a fish, but, except that it lives in the water, it has little or no similarity to the class of animals properly so denominated. It is viviparous, i.e. brings forth its young, not enclosed in an egg, but alive and full-formed, it has usually but one at a time, which it suckles with milk drawn from its teats. It is considered as belonging to the class of the Mammals, the same under which man is comprehended. It is also like man, a warm blooded animal; the blood, however, being of considerably higher temperature than of the human species; finally, it is provided with lungs like the human species; and can only breathe by putting its head out of water. The skin of the whale is dark colored, smooth, and without scales. Its form in the middle is cylindrical, from which it gradually tapers to the tail. This part of the animal is only five or six feet long, but its width or extent from right to left, its position being horizontal or flat upon the water, is sometimes twenty-five feet long; the power of this bony fan is prodigious. It is the instrument by which the animal principally makes its way through the water, and is also its most effective weapon of defence. Towards the head it likewise possesses two fins or swimming paws, as they have been termed, attached to the under part of the belly; but the chief use of these seems to be to balance it or keep it steady as it moves along. About a third part of its whole length is occupied by its enormous head, which is cleft in two by a mouth, the opening of which extends to the neck; the head of the whale is the most peculiar and remarkable part of its structure; this species has no teeth, but in their room two fringes, as they may be called, consisting of a series of blades of an elastic substance, covered on the interior edges with hair attached to the upper gum; this is the substance known by the name of whalebone. The blades are broadest at the upper extremity, where they are inserted in the gum, and are of the greatest length in the middle of the series or row, on each side of the mouth; the greatest length varies from ten to fifteen feet, and the breadth of the gum is usually in a full grown fish from ten to twelve inches. There are upwards of three hundred blades in each series or side of bone, as the whale fishers term it. The use of this part of its structure to the animal is to serve as a net or sieve, in which to collect its food. As it proceeds with distended jaws through the ocean, the water rushes through this sieve; but even the minutest living creatures are detained by it, and are made, in so many successive accumulations, to form mouthful after mouthful to this mighty destroyer. The eyes of the whale are placed immediately above the corners of the mouth; they are singularly disproportionate to the size of the animal, being scarcely larger than those of an ox. No trace of an ear is to be discerned till after the removal of the skin, and the hearing of the whale is accordingly very imperfect. On the most elevated part of the head are the nostrils or blow-holes, being two longitudinal apertures of six or eight inches in length; through these, when the creature breathes, a jet of moist vapour is snorted forth to the height of eighteen or twenty feet, and with a noise which may be sometimes heard at the distance of several miles.

The open mouth of a whale is a capacious cavern, capable of containing a ship's jolly boat full of men. Captain Scoresby describes its dimensions as being commonly six or eight feet wide, ten or twelve feet high in front, and fifteen or sixteen feet long; the throat, however, is very narrow.

The part of the whale which gives the chief value to the fish, is what is called its *blubber*, being that substance from which train oil is obtained; this substance, which is really the fat of the animal, lies immediately under the skin, encompassing the whole body, fins and tail. "His color," says the author, from which we have quoted largely, "is yellowish-white, yellow or red. In the very young animal it is always yellowish-white. In some old animals it resembles the color of the salmon; it swims in water; its thickness all round the body is eight or ten or twenty inches, varying in different parts as in different individuals; the lips are composed almost entirely of blubber, and yield from one to two tons of oil each; the tongue is chiefly composed of a soft kind of fat, that affords less oil than any other blubber. * * * The blubber in its fresh state is without any unpleasant smell, and it is not until after the termination of the voyage, when the cargo is unstowed, that a Greenland ship becomes disagreeable."

The only operation performed upon the whale in its native region after its capture, is the process called "*flensing*," that is, the clearing the carcase of its bone and blubber. This is effected by bringing the dead animal alongside the ship, and after it has been secured, then sending down the men upon it, having their feet secured with spurs to prevent them from slipping, who, by means of knives and other proper instruments, cut off the blubber in slips.

After one side has been cleared there is a contrivance for turning the fish over upon the other. The blubber is received from the flencers by the boat-steerers and line-managers, who, after dividing it into smaller pieces, hand it over to two men, called *Kings*, by whom it is finally deposited in the ship's hold. While the process is going on, various birds of prey attend in great numbers, and bears and sharks are at no great distance, ready to fall upon the remainder of the carcase before it sinks into the deep. The operation of flencing is commonly performed by British fishers in about four hours. Even this part of the business is far from being free from its perils; "Flensing in a swell," says Captain Scoresby, "is a most difficult and dangerous undertaking, and when the swell is at all considerable it is commonly impracticable. No ropes nor blocks are capable of bearing the jerk of the sea. The harpooners are annoyed by the surf, and repeatedly drenched with water, and are likewise subject to be wounded by the breaking of ropes or hooks of tackles, and even by strokes from each other's knives. Hence, accidents in this kind of flensing in particular are not uncommon. The harpooners not unfrequently fall into the fish's mouth, when it is exposed by the removal of a surface of blubber; where they might easily be drowned, but for the prompt assistance which is always at hand. Some years ago I was witness of a circumstance in which a harpooner was exposed to the most imminent risk of his life at the conclusion of a flensing process, by a very curious accident. This harpooner stood on one of the jaw bones of the fish with a boat by his side. In this situation, while he was in the act of cutting the kreng (the skeleton) adrift, a boy inadvertently struck the point of the boat hook, with which he usually held the boat, through the ring of the harpooner's spur, and, in the same act, seized the jaw bone of the fish with the hook of the same instrument. Before this was discovered the kreng was set at liberty, and began instantly to sink. The harpooner then threw himself towards the boat; but, being firmly entangled by the foot, he fell into the water. Providentially he caught the gunwale of the boat with his hands, but, overpowered by the force of the sinking kreng, he was on the point of relinquishing his grasp, when some of his companions got hold of his hands, while others threw a rope round his body. The carcase of the fish was now suspended entirely by the poor fellow's body, which was consequently so dreadfully extended that there was some danger of his being drawn asunder. But such was his terror of being taken under water, and not indeed without cause, for he never could have risen again, that notwithstanding the excruciating pain he suffered, he constantly cried out to his companions to 'haul away the rope.' He remained in this dreadful state until means were adopted for hooking the kreng with a grapnel, and drawing it back to the surface of the water. His escape was singularly providential, for had he not caught hold of the boat as he was sinking, and met with such prompt assistance, he must infallibly have perished."

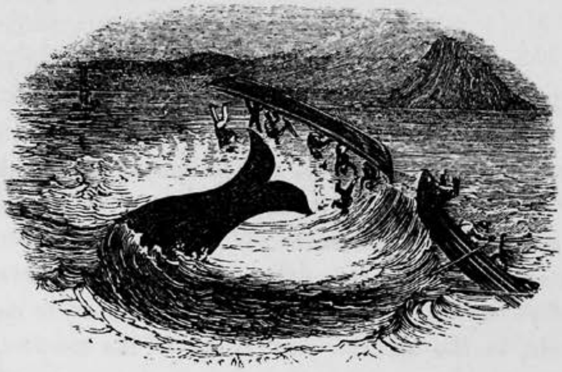
## CACHELOT FISHERY.

The Cachelot, or as it is more usually called, the Spermaceti Whale, is more slender and possesses much greater activity than the common whale; it remains a much longer time under water when struck by the harpoon; but is an object of greater anxiety to catch, because of its greater value, from it possessing those two precious drugs, spermaceti and ambergris. The whole oil of the fish is easily converted into the former, and the ambergris is formed in a bag three or four feet long, in round lumps from one to twenty pounds weight; but it is only in the oldest and largest Cachelots, *that these drugs* can be extracted.

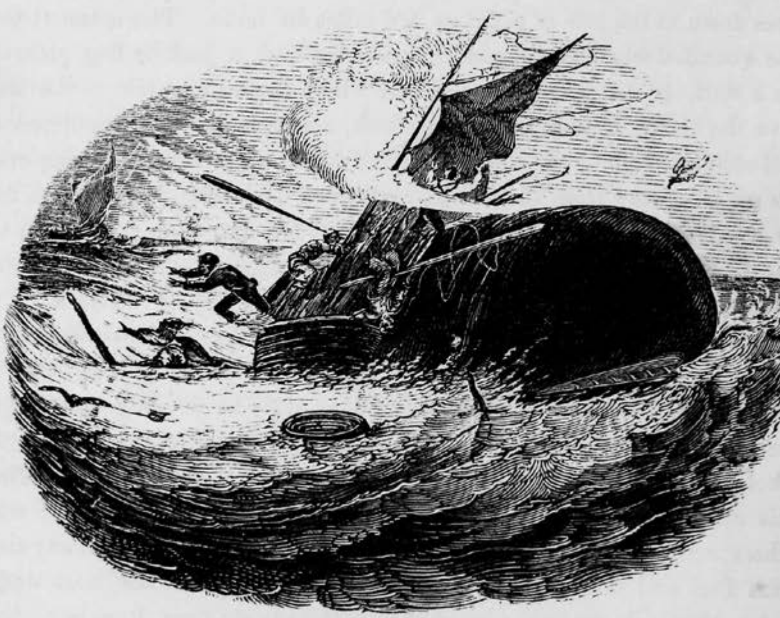
## HABITS OF THE WHALE.

With all its enormous physical strength, the whale is singularly gentle and harmless; so remarkably so indeed, that it has been characterized by those who have had the best opportunities of observing it, as a stupid animal. The absence of ferocity is, however, no proof of this, and, indeed they are indicative of a great degree of sagacity. It exhibits the usual instinctive sense of danger when it perceives the approach of its natural enemy—man; and both before and after it has been struck with the harpoon, it most commonly adopts the very best expedients open to it for a chance of escape. If a field of ice be near, for instance, it makes for the water under it, whither it cannot be followed by the boat, and even when it tries to release itself merely by a precipitate plunge downwards into the sea, it would be difficult to say how it could act more wisely, with a view to snap the line to which it has got attached. If these efforts were not met on the part of the crew in the boat with the most energetic application of those resources of art, dexterity and decision, which are peculiarly at the command of man, it would probably be in every case successful; but if the whale be not allowed to be a very intellectual animal, its affections, at least towards its own kind, appear to be deep seated and strong. The fishers, indeed, are in the habit of taking advantage of the love of the old whale for its offspring to entice it into their snares, and the artifice often succeeds when probably no other would. The cub, though of little value in itself, is struck to induce the mother to come to its assistance. "In this case," says Captain Scoresby, "she joins it on the surface of the water whenever it has occasion to rise for respiration, encourages it to swim off, assists its flight by taking it under her fin, and seldom deserts it while life remains. She is then dangerous to approach; but affords frequent opportunities for attack. She loses all regard for her own safety in anxiety for the preservation of her young, dashes through the midst of her enemies, despises the dangers which threaten her, and even voluntarily remains with her offspring after various attacks on herself from the harpoons of the fishers.

"In June 1811, one of my harpooners struck a sucker, with the hope of its leading to the capture of the mother. Presently she arose close by the 'fast boat,' and seizing the young one, dragged about one hundred fathoms of the line out of the boat with remarkable force and velocity. Again she arose to the surface; darted furiously to and fro; frequently stopped short or suddenly changed her direction, and gave every possible intimation of extreme agony. For a length of time she continued thus to act though closely pursued by the boats, and, inspired with courage and resolution by her concern for her offspring, seemed regardless of the danger which surrounded her. At length one of the boats approached so near that a harpoon was hove at her. It hit, but did not attach itself. A second harpoon was struck; this also failed to penetrate: but a third was more effectual and held. Still she did not attempt to escape, but allowed other boats to approach; so that in a few minutes three more harpoons were fastened, and in the course of an hour afterwards she was killed."



Dangers of the Whale Fishery.



Cachelot Fishery.

## DANGERS OF THE WHALE FISHERY.

We shall now proceed to describe the process of whale catching and its *pleasant* accompaniments, in the words of Captain Scoresby. " Whenever a whale lies on the surface of the water, unconscious of the approach of its enemies, the hardy fisher rows directly towards it, and in an instant, before the boat touches it, buries the harpoon in its back; the wounded whale, in the surprise and agony of the moment, makes a convulsive effort to escape; this is the moment of danger. The boat is subjected to the most violent blows from its head or its fins; but particularly from its ponderous tail, which sometimes sweeps the air with such tremendous fury that boat and men are exposed to one common destruction. The whale on being struck dives into the water with great violence. It appears, from the line which it draws out, that it goes down at the rate of eight or ten miles an hour. The moment that the wounded whale disappears or leaves the boat, a jack or flag, elevated on a staff, is displayed; on sight of which those on watch in the ship give the alarm by stamping on the deck, accompanied by a simultaneous and continued shout of 'a fall.' At the sound of this the sleeping crew are roused, jump from their beds, rush upon deck with their clothes tied by a string in their hands. The cry of 'a fall' has a singular effect on the feelings of a sleeping person unaccustomed to the whale fishing business, and has often been mistaken for a cry of distress. The rapidity with which the line is drawn out by the whale occasions so much friction as it passes over the edge of the boat, as frequently to invelope the harpooner in smoke, and it is only by pouring water upon the wood that it is prevented from catching fire. Frequently also, the whole line in the first boat is run out before another has arrived. When this result seems approaching, the crew raise first one oar and then others, according to the exigency of the case. If the line at any time runs foul and cannot be instantly cleared, it will draw the boat under water, on which the only chance of the crew saving their lives is each to catch hold of an oar and leap into the sea; the utmost care is necessary in the boat to avoid being entangled in the line as it is drawn out. Scoresby relates a case, in which a man, having chanced to slip his foot through a coil, the line drew him forward to the boat's stem, and then snapped off his foot at the ankle. Another anecdote is related of a harpooner, who, when engaged in lancing a whale into which he had previously struck a harpoon, incautiously cast a little line under his feet that he had just hauled into his boat, after it had been drawn out by the fish. A painful stroke of his lance induced the whale to dart suddenly downwards; his line began to run out from beneath his feet, and in an instant caught him by a turn round his body. He had just time to cry out, "clear away the line; oh! dear," when he was almost cut asunder, dragged over board and never seen afterwards. The line was cut at the moment, but without avail.

The fish generally remains about half an hour, but sometimes a great deal longer, under water after being struck; and then it often rises at a considerable distance from the spot where it had made its descent. Immediately that it reappears, the assisting boats make for the place with the utmost speed, and, as they reach it, each harpooner plunges his harpoon into its back, to the amount of three or four, or more, as circumstances direct, and according to the size of the whale. Most frequently, however, it descends for a few minutes after receiving the second harpoon, and obliges the other boats to wait its return to the surface before any further attack can be made. It is afterwards actively plied with lances, which are thrust into its body, aiming at its vitals. At length, when exhausted by numerous wounds and the loss of blood, which flows from the huge animal in copious streams, it indicates the approach of its dissolution by discharging from its blow-holes a mixture of blood along with air and mucus, and finally of blood alone. The sea to a great extent around is dyed with its blood, and the ice, boats and men, are sometimes drenched with the same. Its track is likewise marked by a broad pellicle of oil, which exudes from its wounds, and appears on the surface of the sea. Its final capture is sometimes preceded by a convulsive and energetic struggle, in which its tail, reared, whirled, and violently jerked in the air, resounds to the distance of miles. In dying it turns on its back or on its side, which joyful circumstance is announced by the captors with the striking of their flags, accompanied with three lively huzzas. The exhaustion which the whale exhibits on returning to the surface after its first plunge, is to be attributed to the immense pressure it has sustained from the water, from the great depth to which it had descended. At the depth of eight hundred fathoms, as Captain Scoresby calculates, this pressure must be equal to 211,200 tons. "This," he adds, "is a degree of pressure of which we can have but an imperfect conception. It may assist our comprehension, however, to be informed that it exceeds in weight, sixty of the largest ships of the British Navy when manned, provisioned, and fitted for a six month's cruise."

A whale has been sometimes captured and killed in little more than a quarter of an hour, and instances, on the other hand, have occurred in which the contest has lasted from forty to fifty hours; the average time under all circumstances is from two to three hours. There is a remarkable case related, of one vigorous whale who broke away from its pursuers with a boat and twenty-eight lines of cord, the united length of which was 6,720 yards, or upwards of three and a half English miles; he was attacked again, and before he was captured he took the enormous quantity of 10,440 yards of line, or nearly six miles.

We have described the immense power in the tail of these monsters; we shall now quote two remarkable instances of the exercise of this tremendous organ. "A large whale harpooned from a boat of the Resolution of Whitby, became the subject of a general chase on the 23rd of June, 1809. Being myself in the first boat which approached the fish, I struck my harpoon at arm's length, by which we fortunately evaded a blow which appeared to be aimed at the boat. Another boat then advanced, and another harpoon was struck, but not with the same result; for the stroke was immediately returned by a tremendous blow from the fish's tail. The boat was sunk by the shock, and at the same time whirled round with such velocity that the boat-steerer was precipitated into the water on the side next to the fish, and was accidentally carried down to a considerable depth by its tail. After a minute or two he arose to the surface of the water, and was taken up along with his companions into my boat." In some instances the boat, instead of being struck into the water, has met with the equally alarming fate of being projected by a stroke of the powerful animal's head or tail. "Captain Lyons, of the Raith of Leith," says our author, "while prosecuting the whale fishery on the coast of Labrador, in the season of 1802, discovered a large whale at a short distance from the ship. Four boats were dispatched in pursuit, and two of them succeeded in approaching it so closely together that two harpoons were struck at the same moment. The fish descended a few fathoms in the direction of another of the boats, which was on the advance, rose accidentally beneath it, struck it with its head, and threw the boatmen and apparatus about fifteen feet in the air! It was inverted by the stroke, and fell into the water with its keel upwards. All the people were picked up alive, except one man, who got entangled in the boat, fell beneath it, and was unfortunately drowned:—the whale was afterwards killed." The annals of the whale fishery abound with fearful narratives of the dangers from icebergs closing upon the ships or dashing them to pieces, many of which are of absorbing interest; but which our limits will not allow us to detail.

## THE SWORD FISH.

Next to the harpooners, the whale may be said to fear the attack of this little but very active enemy, at the sight of which, the huge animal seems to be frightened and agitated in a most extraordinary degree, and attempts to fly from his pursuer, whose active exertions quickly overtakes his monster prey—"I have been a spectator," says Anderson, "of these attacks. The whale has no instrument of defence but his tail, and with that it endeavours to strike its enemy, and a single blow taking place would annihilate its adversary; but the sword fish is as active as the whale is strong, and easily avoids the stroke; then bounding into the air, it falls upon its enemy, and endeavours not to pierce it with its pointed beak, but to cut with its toothed edges. Succeeding in this, the sea is all round dyed with blood, proceeding from the wounds of the whale; while, the enormous animal vainly endeavouring to reach its invader, he strikes with his tail the surface of the water, making at each blow a noise louder than the report of a piece of ordnance. The whale has still another enemy, which is called the 'Biller.'" Those fish are armed with strong and powerful teeth—they attack the whale in a body, completely surrounding it, in the same style that dogs attack a bull, until at last their huge enemy is torn down.—It is said that the "Billing," eat the tongue only of the whale which they have thus conquered.

## WHALE FISHERY ON THE COAST OF IRELAND.

The following account appears in the report of the Committee on Public Works in Ireland, and is therefore worthy of credit. It is an extract of a letter from the Commander of the Coast Guard. "It is very extraordinary, but still very true, that this coast (one of the best coasts in Europe, abounding from the most productive whales, both Spermaceti and Greenland, to the common herring) posseses the worst and most ignorant race of fisherman, and (with few exceptions) very indifferent boatsmen. But the cause of these remarks may be easily accounted for; their poverty, which prevents them from procuring proper stout vessels for so dangerous coast, and almost total absence of all patronage and support, to follow up with energy and spirit the unbounded sources of wealth, which nature has thrown within their grasp. It may appear still more extraordinary to those connected so extensively in the Greenland and South Sea whale fishery, that they should so long have remained in ignorance, that those fish abound on the coast which I have described. In order to give proof of so bold an assertion, I shall state some circumstances which came under my immediate observatlon, in my own vessels, and at a subsequent period, in command of a revenue cutter. On a visit, in company with the Rev. Mr. Mahon to the Sun Fishery at Bofin's Island, we strayed on a blustry day to observe the coast and breakers; at a short distance from the shore we saw several large fish, which I supposed to be grampusses, or finners, that had taken shelter under the lee of the island; still looking closely at them, they advanced towards the rocks immediately under the cliffs, where we had a perfect view of them, at a distance of 500 yards, with a spy glass, their double tufted heads quite conspicuous, and no intervening back fins, I decided at once on their species. In the month of July, after the sun fishery, a large spermaceti whale was drifted on shore dead, at the Bay of Bunowen, in Connemara, about two leagues from Cliffden or Ardbear Harbour; in cousequence of the ignorance of the peasantry and the boatmen, and their continual squabbling and fighting, three fourth's of the oil was lost; the surface of the bay was dyed with a rainbow tinge, from the floating particles of oil. Shortly after, an immense fish was towed into the island of Teuk, by three of the island fishing boats; the monster was observed floating about a mile from the island, and had been very recently killed, but how, could not be ascertained: this fish completely filled up the small and only inlet in the island, and measured in length thirty three yards; it was claimed by the proprietor, I believe, the Archbishop of Tuam, who, I had been informed, gave it up to the islanders. A small village near the place where they had towed it, shortly became deserted, the inhabitants never calculating on the fœtid air caused by their imprudence. The islanders were two months employed in cutting up and launching over the cliffs the bones and remains of their prize. About the beginning of August, in beating down Blacksod Bay, with light airs, and near the island of Inniskeas, two large whales came alongside the cutter; the day very fine, and making but little way, I ordered the gig and jolly boat out, and pursued them and had the men been sufficiently acquainted with the art, I shonld have succeeded in killing them; they allowed me to go alongside them, and I was only prevented from striking them by the bowman, who intercepted me at the moment by panic, being fearful of the event, by a lash of the tail. What the result might have been I know not, but nothing could have been easier accomplished than striking them, and only in fifteen fathoms water. I had been after these whales three hours, and they never went above 300 yards from our boats, and at that distance turned their huge heads towards the boats, and got away. I gave up following them towards evening; had I struck them at the commencement of our chase, when they were perfectly tame, I might have succeeded, even with the sun fish spear and line, owing to the small depth of water."

## THE BLOCK MACHINERY, PORTSMOUTH DOCK-YARD.

These unparalleled machines were the invention of Mr. Brunel, sen., the celebrated Engineer, who took out a patent for them in 1802, and in 1804 Government resolved to erect a set of them: this was accordingly done, and forty-four machines were set to work by a steam engine of thirty-two horse power, erected by Boulton and Watt. The manual labor required is simply to supply the wood as it is wanted, and to remove the blocks from one machine to another till they are completely finished. In order to convey some idea of these machines, and the effects they produce, we shall trace the whole process, from the rough timber to the finished blocks. By means of four sawing machines, distinguished for the ingenuity of their construction, (viz.) the straight cross-cutting saw, the circular cross-cutting saw, the reciprocating ripping saw, and the circular ripping saw, the timber is cut into parallelopipeds of the proper size for the blocks. The blocks in this rude state are taken to the boring machines, of which five are used for the purpose of boring a hole for the centre pin, and another at right angles of this at the same time for the commencement of the mortice which is to contain the sheave. From this machine, the blocks are taken to the morticing machines, of which three are used. These beautiful machines give motion to one or more chisels in a vertical direction, which mortice out the cavities for the reception of the sheaves. A chip of the thickness of a piece of pasteboard is cut out with the most wonderful accuracy, and these chips are prevented from accumulating by means of a piece of steel at the back part of each chisel, which drives them out. The chisels make from one hundred and ten to one hundred and fifteen strokes every minute. When the cavities are morticed out, the blocks are taken to the corner saws, of which there are three, by which the angles are cut off in succession, by means of a circular saw fixed on a maundril. When the blocks are thus sawn into a polygonal figure they are carried to the shaping engine; the object of which is to shape them to the segment of a large circle. For this purpose ten blocks are fixed by their extreme ends between the rims of two equal wheels, fastened upon the same axis. These wheels are then made to turn with amazing rapidity, so as to bring the blocks successively against the edge of a fixed gouge, which thus cuts them to the proper curvature.

A progressive motion is also given to the gouge, in order to give the blocks their proper curvature, in a direction at right angles to the planes in the wheels, between which they are fixed. When one side of the blocks is thus shaped, all the ten are, by an instantaneous movement, turned a quarter round, so as to expose another side to the gouge, which shapes them as before; and in this way the third and fourth sides are formed of the proper shape. Three of these engines are used for blocks of different sizes.

The blocks are now taken to the scoring engine, which is intended to form the score or groove round the largest diameter, for the reception of the ropes or straps of the blocks. By the above machines the shells of the blocks are formed. The next part of the operation is the formation of the sheaves, which are made of lignum vitæ. By means of two saws, the straight saw and the circular saw, the tree of lignum vitæ is cut into pieces approaching to a circular shape, and nearly of the intended sheave. These pieces are taken to the crown or trepan-saw, with a centre bit in its axis. When the wood is properly fixed, the saw is applied against it, and cuts it into a circular form with great rapidity, while it, at the same time, forms a hole exactly in the centre.

The sheaves are now taken to the coaking engine; a machine of splendid ingenuity. It is employed to form in the centre of the sheave a cavity of the shape of three small semicircles, arranged at equal intervals round the centre hole formed by the crown saw. This cavity is intended for the reception of the coak or metal bush, which is made of copper, zinc and tin, and cast of the same shape as the cavity now formed. When the coaks are inserted into the sheave, the drilling machine is employed to perforate the three semicircular projections of the coaks and the wood beneath, in order to fasten the coaks by copper pins put in these holes. The pins being placed into the holes, then drilled, are rivetted by means of the rivetting hammers, which are made to strike a heavier blow at the end of the operation. The sheave is now carried to the broaching engine, and fixed to an axis revolving vertically. A broach or cutter is inserted in the hole in the centre of the coak, for the purpose of enlarging it and making it truly cylindrical. The sheaves are then finished by the face-turning lathe, which has a sliding rest that supports the turning tool, and moves it slowly across the face of the sheave. As the face of the sheave which is thus turned is composed partly of the metal coak and partly of wood, and as it has been found by experience that different velocities are required for turning wood and metal, the machine has a very ingenious contrivance for changing the velocity when the tool passes from the wood to the metal.

Besides the machines already mentioned, there are five others, (viz.) the turning lathe, by which the iron pins are cut to their proper diameter; the polishing engine, by which they are polished, and which is sure to detect those that have flaws in them; the machine for boring very large holes in any position, which is used for the largest size of blocks; the machine for making dead-eyes, and the other for making tree-nails, used in fastening the planks to the timbers of ships.

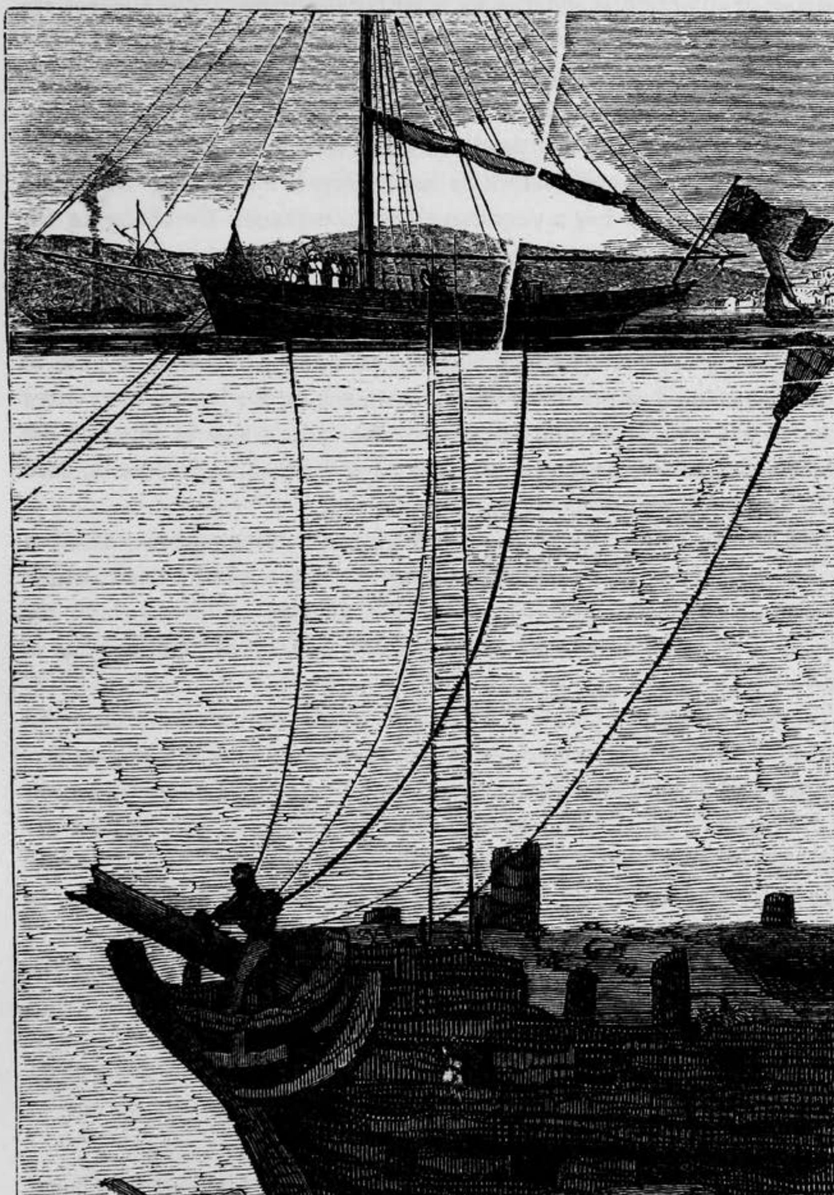
By this machinery the blocks are made with the nicest precision; a quality which was always found wanting in those made by hand, which oftentimes rendered them unserviceable at the moment when the quickness of their movement was intimately connected with the fate of the ship.

To give a pretty accurate idea of the expedition of these beautiful works, we will state the number of blocks that can be made per day. The first set of machines make those from four to seven inches in length at the rate of 700 per day; these have wooden pins. The second set make those from eight to ten inches in length at the rate of 520 per day; these have iron pins. The third set make those from eleven to eighteen inches in length at the rate of 200 per day; so that upwards of 1,400 blocks may be made daily! All the blocks for the service of the Navy are supplied from these machines.

## THE DIVING BELL.

The first diving bell which we read of in Europe was tried at Cadiz, by two Greeks, in the presence of Charles the Fifth, and many thousand spectators; it resembled a large kettle inverted. The first introduced into this country was in the reign of Charles the Second, by one Phipps, an American black-smith, and who, from the fortune which he acquired by going down to a rich Spanish Galleon, laid the honours of the Mulgrave family, the head of which is now the Marquis of Normandy.

Uses of the Diving Bell.



Operations on the wreck of the Royal George, sunk at Spithead, in 1782.

But the first Bell of any note, was one made by Doctor Halley, and is most commonly represented in the form of a tunicated cone, the smallest end being closed, and the larger one open. It is weighted with lead, and so suspended that it may sink full of air, with its open base downwards, and as near as may be parallel to the horizon, so as to be close to the surface of the water.

Mr. Smeaton's diving bell was a square chest of cast iron, four feet and a half in height, four feet and a half in length, and three feet-wide, and afforded room for two men to work in it. It was supplied with fresh air by means of a forcing pump. This was used with great success at Ramsgate.

The diving bell invented by Messrs. Cottam and Hallen, which is shown daily at the Polytechnic Institution, Langham Place, Regent Street, is composed of cast iron, open at the bottom, with seats around, and is of the weight of three tons; the interior for the divers is lighted by openings in the crown, of thick plate glass, which is firmly secured by brass frames, screwed to the bell; it is suspended by a massive chain to a large swing crane, with a powerful crab, the windlass of which is grooved spirally, and the chain passes over four times into a well beneath, and to which is suspended the compensation weights, and is so accurately arranged that the weights of the bell is, at all depths, counterpoised by the weights acting upon the spiral shaft; the bell is supplied with air by two powerful air pumps, of 8 inch cylinder, conveyed by the leather hose to any depth.

To illustrate the principle of Messrs. Cottam and Hallen's diving bell, you have only to take a glass tumbler, plunge it into water with the mouth downwards; you will find that very little water will rise into the tumbler, which will be evident if you lay a piece of cork upon the surface of the water, and put the tumbler over it, for you will see that though the cork should be carried far below the surface of the water, yet that its upper side is not wetted, the air which was in the tumbler having prevented the entrance of the water; but as the air is compressible, it could not entirely preclude the water which, by its pressure, condensed the air a little.

Mr. Spalding's bell varies considerably from the above. It has a bell-like form, and is suspended by four ropes, with ballast weights, by means of which the mouth of the bell is always kept parallel to the surface of the water. By these weights alone the bell, however, will not sink; another is therefore added, by means of which it can be raised or lowered at pleasure. In descending, this balance weight hangs considerably below the bell—in case the edge of the bell is caught by any obstacle, the balance weight is immediately lowered down, so that it may rest upon the bottom. By this means the bell is lightened, and all danger of oversetting is removed; for being lighter without the balance weight than an equal bulk of water, it is evident that the bell will rise as far as the length of rope affixed to the balance weight will permit. This serves therefore as a sort of anchor, to keep the bell at any desired depth. Instead of wooden seats, ropes are used, suspended by hooks across the bottom of the bell, and on these the diver stands; two windows made of strong thick glass are fixed near the top of the bell.

Two air casks (each will contain forty gallons) having a flexible tube, are attached with a cock to discharge the hot air when needed. By another very ingenious contrivance, the diver can raise the bell to the surface, or stop it at any desired depth, and thus safety is preserved, although the communicating rope with those above may be broken. This is accomplished by affixing a *second bell* of smaller dimensions over the large one; in the top of which is a cock, which can be opened by the diver to let the air escape from the upper bell; there is also another cock in the top, which permits the air to pass out of the great bell and rise into the smaller one. There is also space left between the two bells, so that the water has free entrance into both, and when the bell is first let down the upper cock is opened, therefore the air escapes and lets in the water. In this state the bell is lighter than an equal bulk of water without the balance weight, though, with the addition of it, it is heavier. Now, if the divers wish to raise themselves, they turn the lower cock, by which a communication is made between the bells, and the quantity of air rushing from the lower to the upper bell forces the water out, and this air being replaced from the air barrel, thus renders the bell lighter, by the whole weight of water which is displaced. Therefore, if a certain quantity of air is admitted into the upper cavity, the bell, with the balance, will descend very slowly; if a greater quantity, it will remain stationary, and if a larger quantity of air is still admitted, it will rise to the top.

The diving bell which is commonly used, resembles a large box without its bottom; it is in length six feet by five and a half, and is four and a half high. It is formed of cast iron, very thick, and its own weight sinks it; it is made in one piece, air tight, and the thickness of the sides prevents the possibility of its being injured by fracture in descent; its weight is about four tons. In the top of this bell is a round aperture, communicating by a number of small circular holes with the interior, where the holes are all covered and closed by a piece of thick leather, which acts as a valve and admits air. A strong leather hose is screwed on to the external aperture, and from two holes near its sides rise two strong chains, uniting in a ring, by which the whole machine is to be suspended. In the top are cemented twelve thick lenses, to admit light.

At the ends of the bell are two seats, placed at such a height that the top of the head is but a few inches below the upper part of the bell; and in the middle, about six inches below the lower edge, is placed a narrow board on which the feet of the divers rest. On one side, nearly on a level with the shoulders, is a small shelf with a ledge to contain tools, chalk for writing, and a ring to which a rope is tide. A board is connected with this rope, which is held by the man above, who thus can receive and reply to any message. On the top of the bell on the inner side, it is usual to have some contrivance by which stone or other bodies may be suspended from the bell. The leather hose is connected with a double condensing pump, usually worked by four men. In order to give motion to the bell, it is suspended by a windlass purchase tackle, which is fixed on a moveable platform having four wheels; the wheels move along an iron railway, which is itself fixed on another platform, having, by the same means, a motion in a direction transverse to the former, at right angles to each other. Thus, by two iron railways established on beams, and supported by piles, the lower being fixed in the direction of the length of the wall, and the upper being on the lower moveable plane, it is possible to give the bell any position which may be required.

Taking into account the extensive use of the diving bell for the last fifteen years, at Plymouth and other sea ports, very few accidents have occurred, and nothing but gross mismanagement and ignorance can now occasion any, the mode of using them being so simple and well defined. In fact, the workmen vie with each other who shall descend and work for hours under water, as readily as above; immense treasure, &c. from sunken vessels, has been recovered by means of the diving bell; as in the case of the Thetis, &c.

Mr. Babbage thus describes his feelings during a descent in a diving bell at Plymouth, with Mr. Harvey. "To enter the bell, it is raised about three or four feet above the surface of the water, and the boat in which the persons who purpose descending are seated, is brought immediately under it. The bell is then lowered so as to enable them to step upon the foot board within it, and having taken their seats, the boat is removed and the bell gradually descends to the water. On touching the surface, and thus cutting off the communication with the external air, a peculiar sensation is perceived in the ears; it is not, however, painful. The attention is soon directed to another object. The air rushing in through the valves at the top of the bell, overflows and escapes with a considerable bubbling noise under the sides. The motion of the bell proceeds slowly and almost imperceptibly, and on looking at the glass lenses close to the head, when the top of the machine just reaches the surface of the water, it may be perceived by means of the little impurities which float about it, flowing into the recesses containing the glasses. A pain now begins to be felt in the ears, arising from the increased external pressure; this may sometimes be removed by the act of yawning or by closing the nostrils and mouth, and by attempting to force air through the ears. As soon as the equilibrium is established the pain ceases; but recommences almost immediately by the continuance of the descent. On returning, the same sensation of pain is felt in the ears, but it now arises from the dense air which had filled them endeavouring, as the pressure is removed, to force its way out."

"If the water is clear and not much disturbed, the light in the bell is very considerable, and even at the depth of twenty feet was more than usual in many sitting rooms. Within the distance of eight or ten feet the stones at the bottom began to be visible.

"The pain in the ears still continued at intervals, until the descent of the bell terminated by its resting on the ground.

Signals are communicated by the workmen in the bell to those above, by striking against the side of the bell with a hammer. Those most frequently wanted, are indicated by the fewest number of blows; thus a single stroke is to require more air. The sound is heard very distinctly by those above."

Another method adopted of divers reaching vessels to fasten tackling to weigh the sunken mass, by means of buoys formed of copper, air tight, is by being clothed in a water proof diving dress, by which means they can descend to any required depth and rise at pleasure.

Many of the guns (two of which, of large calibre, are shown to visitors of the Tower of London), stores, &c. of the Royal George, which sunk at Spithead on the 29th of August, 1782, have been recovered by means of the diving bell, in which men can work with equal facility at almost any depth in water, as upon the surface of the earth.

Notwithstanding these attempts to lighten the wreck of the Royal George, in the hope of raising her by means of copper cylinders air tight, yet they were only partially successful, and the great obstruction caused by the wreck induced the Lords of the Admiralty to employ Colonel Pasley, R.E., to destroy the remains of the sunken vessel by the same process which he had successfully employed upon two steamers, which were sunk in the Thames, by coming in collision with each other.—The following is a description of the means employed by Colonel Pasley: " At two o'clock on Monday afternoon, September 23, 1839, a cylinder, containing 2,320lb. of powder, was carefully lowered to the bottom, where it was placed alongside the most compact portion of the wreck which has yet been discovered by the divers. This operation was effected by means of hauling lines rove through blocks attached to the bottom of the ship by the divers. When every thing was ready, the vessel in which the voltaic battery was placed, was drawn off to the distance of 500 feet, which is the length of the connecting wires, and instantaneously on the circuit being completed the explosion took place, and the effects were very remarkable. At first the surface of the sea, which had before been perfectly smooth and calm, was violently agitated by a sort of tremulous motion, which threw it into small irregular waves, a few inches only in height. This lasted for three or four seconds, when a huge dome of water made its appearance, of a conical, or rather bee-hive shape. At first it appeared to rise slowly, but rapidly increased in height and size till it reached the altitude of 28 or 30 feet, in a tolerably compact mass. It then fell down and produced a series of rings, which spread in all directions. The first, or outer one of these, having the aspect of a wave several feet in height, curled and broke, as if it had been driven towards the shore. Neither the shock nor the sound was so great as had been expected by those who had witnessed the former explosions by Colonel Pasley, where the quantity of powder was only 45lb., but the effect produced on the water at the surface, considering that the depth was 90 feet, was truly astonishing. What the effect has been upon the wreck will not be fully ascertained by the divers till the present spring tides are over, and the long periods of slack water at the neaps enable the divers to remain for upwards of half an hour under water. In the mean time it is highly satisfactory to know that Colonel Pasley has completely established his command over the application of the voltaic battery to submarine purposes, and that he can now with certainty explode his charges at any depth of water. This will give him the power of placing his cylinders against the most refractory parts of the wreck, and, by blowing these to pieces, and dislocating the knees, timbers, and beams, enable him to draw the whole up, bit by bit, to the surface. Any person who has seen the operation of breaking up a ship on land knows that this is the only way of going to work with a mass so firmly bound together as a line of battle ships, that even the action of 57 years of decay under water goes but a small way to disintegrate the parts. The manly perseverance of Colonel Pasley, therefore, we are well convinced, will, in the end, effectually clear the noble anchorage of Spithead of this extremely troublesome obstruction."

Upon an after examination by the divers, when the tide permitted, it was found that the explosion had been most successful; since which time several other explosions have taken place, from the effects of which vast masses of the wreck have been forced to the surface of the water, and the anchorage cleared.

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BLASTING ROCKS UNDER WATER BY MEANS OF THE DIVING BELL.

In this process three men are employed in the diving bell, one holds the jumper or boring iron, which he keeps constantly turning, the other two strike alternately quick smart strokes with hammers. When the hole is bored of the requisite depth, a tin cartridge filled with gunpowder, about two inches in diameter, and a foot in length, is inserted, and sand placed above it. To the top of the cartridge a tin pipe is soldered, having a brass screw at the upper end. The diving bell is then raised up slowly, and additional tin pipes with brass screws are attached, until the pipes are about two feet above the surface of the water. The man who is to fire the charge is placed in a boat close to the tube; to the top of which a piece of cord is attached, which he holds in his left hand. Having in the boat a brazier, with small pieces of iron, red hot, he drops one of them down the tube; this immediately ignites the powder, and blows up the rock. A small part of the tube next the cartridge is destroyed, but the greater part which is held by the cord, is reserved for future service. The workmen in the boat experience no shock; the only effect is a violent ebullition in the water, arising from the explosion; but those who stand on the shore, and upon any part of the rocks connected with those blowing up, feel a very strong concussion. The only difference between the mode of blasting rock at Howth and at Plymouth, is, that at the latter place they connect the tin pipes by a cement of white lead. A certain depth of water is necessary for safety, which should not be less than from eight to ten feet.

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## DIVING APPARATUS.

In the ordinary Diving Bell the labors of the divers are confined to the spot upon which the bell rests; this greatly confines the sphere of its utility. A diving dress has been invented by Mr. W. H. James, by which he can carry on his operations without the aid of a diving bell or air tube. The apparatus consists of a copper hood or helmet; this may be made of any water-tight material, but thin copper is found to be best adapted for that purpose; in front is fixed a strong plate of glass, to enable the divers to see the surrounding objects. Inside the helmet is a flexible tube, with a mouth piece at the end, which comes near the diver; through this the air is discharged from his lungs, and passes out by a valve at the top of the helmet. At the lower part of the helmet, and round the breast and shoulders, a water-proof garment is attached to the body of the wearer (this, in Mr. James's apparatus, fits closely to the body, in others it is loose), and made fast by elastic bandages. To secure the diver from being inconvenienced by the pressure of the air within the helmet from becoming too great, a safety valve is added. In the front of the diver's body is a portable vessel, placed round and adapted to the figure of the body; this contains the condensed air, and which is filled by means of a condensing air pump; it has a series of strong metallic tubes, or of one continuous tube, coiled elliptically round the body, and connected together by bands, to which straps are attached to secure it in its position; there is a valve opening inwards, through which the air is forced by a pump, until it has acquired the proper density, which will depend on the time it remains under water; there is also a tube of india rubber for conveying the air into the helmet by means of a valve, which is entirely under the control of the diver. Nothwithstanding the weight of the apparatus (nearly fifty pounds), the density of the water, in great depths, would render the body of the diver too buoyant to enable him to keep on his legs and perform his work; in this case it is usual to attach weights capable of easy removal at the pleasure of the diver, who, it is scarcely necessary to say, can rise or sink at pleasure.

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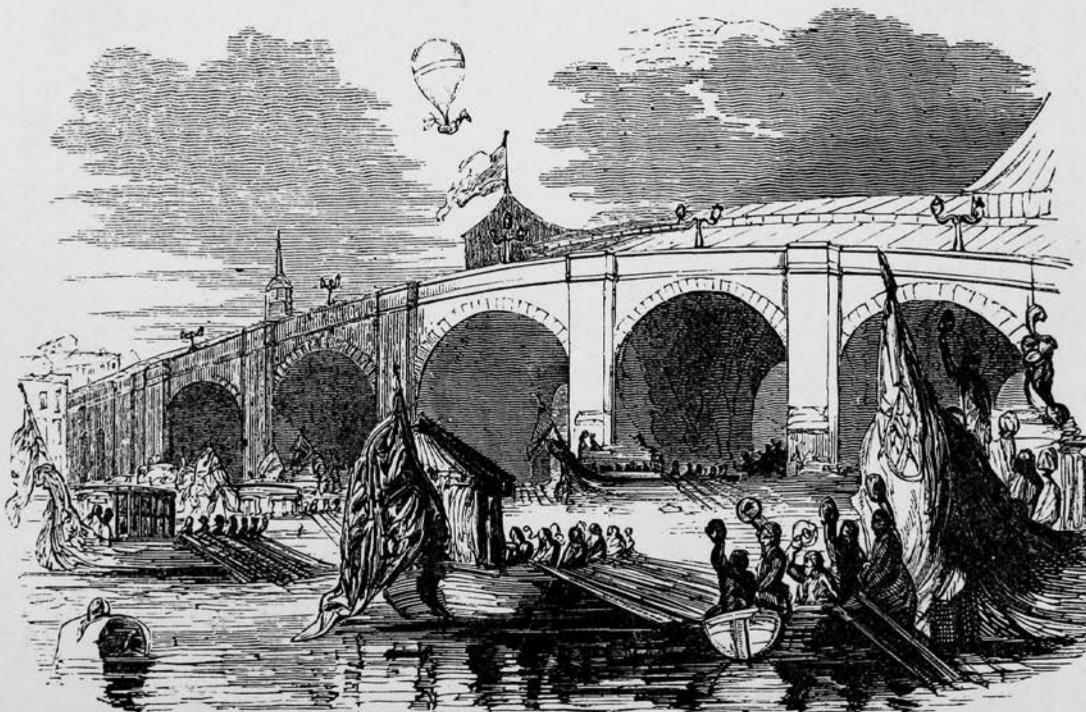
Diving Apparatus.—A similar Apparatus, but without the weights (in that case unnecessary), might be employed in mines or other places, filled with deleterious gases. Of late years the diving apparatus has been applied by Messrs. Deane, Bush, and others, as a means of fixing either chains suspended from windlasses, placed on lighters above, or else some buoyant body to foundered vessels, for the purpose of raising them.

## SUB-MARINE AND WRECK-WEIGHING MACHINES.

A Company has been formed for this highly praise-worthy object; the following is a brief description of the method adopted in the process of raising sunken vessels. "Supposing a vessel to have *sunk* with her cargo, we go (say the company) to the spot as early as possible; the divers descend clothed in their diving dresses, inspect the wreck, secure round her strong chains, such as are used for ships' anchors or moorings, which are lowered from a proper vessel floating above, and from which air is also supplied to the divers; this done, they give signals to be furnished with India-rubber air chambers (these chambers are constructed of very strong fabrics, similar to the best sail cloth, with a very thick layer of India-rubber between such fabrics, whereby they are air and water-proof, and to which chambers sufficient length of pipe is attached); these air chambers being fixed to the links of the chains previously made fast round the wreck, are filled with air by the pumps, through the connecting tubes before mentioned; their size and number being such that their buoyancy may be sufficient to again float the vessel, which can then be conveyed to a place of safety." Now, it is a well ascertained fact, that for every cubic foot of water thus displaced, a floating power of about 62lbs. avoirdupoise is obtained; the recovery of any weight from the bed ofthe sea must appear easily practicable; thus, supposing the air chambers to be only 6 feet in diameter, and 18 feet long, they would contain 525 cubic feet of air; which, if we reckon at 60lbs. per cubic feet, would give a sustaining power of 14 tons each; twelve of these, six on each side, would possess a raising power of 168 tons, sufficient to float a vessel of upwards of 300 tons burthen. For larger ships, however, chambers of 12 feet in diameter, and 36 feet long (a size easily constructed), would possess a power of upwards of 112 tons each, and twelve of this size would have a power of 1,344 tons, which would raise a vessel of upwards of 2,000 tons burthen; and a greater power may be obtained, either by increasing the number or size of the air chambers. Several vessels of large burthen have been raised already by these means, by the Company's Engineeer, Mr. Bush.



**BALLOON ASCENT.**—Opening of London Bridge, August 1st, 1831.

## HISTORY OF THE BALLOON.

Passing over the fables of the ancients, who pretended to the art of flying, the first notion which we find of a balloon, is by the Jesuit Francis Lana, in 1670, who asserted the possibility of raising a vessel by means of metal balls, strong enough when exhausted to resist the pressure of the external air; but, at the same time, so thin, as in the same circumstances to be lighter than their bulk of air. To the possibility of this, he says he sees no objection, except that the Almighty would never allow an invention to succeed, by means of which civil government could so easily be disturbed. A reason of this sort was all-powerful in his age, which abounded in the knowledge of the minutest secrets of Providence; had the good father tried the experiment, he would have found, that strength to resist the external air is incompatible with the necessary degree of thinness in the material. After Cavendish had ascertained how much hydrogen weighs less than air, it immediately occurred to Dr. Black, that a light substance filled with this gas would rise itself. But he did not pursue the idea further, and Carvallo, who tried to put it in practice in 1782, could not succeed in raising, by means of hydrogen, any thing heavier than a soap bubble. The next and most successful, were Stephen and Joseph de Montgolfier, who were paper manufacturers near Lyons. They were good chemists, and had studied natural philosophy, so that, as it has been remarked, we owe the discovery of the balloon, either to paper makers being philosophers, or philosophers being paper makers. Having tried in vain to confine a sufficient quantity of hydrogen in paper, they next applied fire underneath the balloon. The experiment succeeded, and a balloon of 23,000 cubic feet (French) was raised with considerable force; this took place in 1782, and is thus described by M. M. Montgolfier:—"An organised body, in a state of ignition, decomposes air and furnishes chalky, mephitic, and imflammable gases. The state of ignition facilitates the union of the eletric fluid with this body of vapour; the heat arising from combustion is concentrated, so as by itself to dilate the heaviest of the gases, and make it specifically lighter than common air; therefore the balloon rises, &c. It afterwards falls to the earth, because the heat is dissipated, the vapours are concentrated and have lost their electricity." The first public experiment was made at Annonay near Lyons, June 5th, 1783.

At the appointed time nothing was seen in the public place of the town but immense folds of paper one hundred and ten feet in circumference, fixed to a frame, the whole weighing about five hundred pounds, and containing 22,000 cubic feet (French measure). To the great astonishment of all, it was announced that the balloon would be filled with gas, and would rise to the clouds, which few would believe. On the application of fire underneath, the mass gradually unfolded, and assumed the form of a large globe, striving at the same time to burst from the arms which held it. At length it arose with great rapidity, and in less than ten minutes was at one thousand toises of elevation. It then described an horizontal line of seven thousand two hundred feet, and gradually sunk. This balloon contained nothing but heated air, maintained in a state of rarefaction by fire, the receptacle of which was attached underneath the globe of paper, which had an orifice opening downwards. Machines on this principle were called *Montgolfier's*, to distinguish them from hydrogen balloons, which were made immediately afterwards. This success created a great sensation in France, and a subscription was opened to repeat the experiment upon a balloon of lutestring, dipped in a solution of India rubber, and filled with hydrogen; at first it failed, but the second time it was successful, and it ascended on the 27th of August from the Champs de Mars; rose beautifully to a great height, and fell five leagues from Paris, after being about a quarter of an hour in the air. The balloon on its next ascent had occupants, viz. a sheep, a cock, and a duck—this was Montgolfier's; and on the 15th of October, 1783, the first human being ascended one hundred feet, and again three hundred and twenty-four feet, the balloon being held by a rope; this adventurous man was M. Pilatre de Rozier, who, with the Marquis d'Arlandes, first performed the daring feat of leaving the earth entirely, at the Chateau de la Muette near Passy, November 21st 1783, in a *Montgolfier*. The *procès verbal*, which bears the signatures of the great Benjamin Franklin and several French Noblemen, described the balloon as seventy feet high, forty-six feet in diameter, contained sixty thousand cubic feet, and carried a weight of one thousand six hundred or one thousand seven hundred pounds; it rose to the height of five thousand toises* in twenty-five minutes. However, we shall let one of the *Voyageurs* tell his own tale. Marquis d'Arlandes writing to a friend, thus describes his perilous and novel feât:—"We set off at fifty-four minutes past one. The balloon was so placed that M. de Rozier was on the west and I on the east. The machine, says the public, rose with majesty. I think few

* A toise is 6 feet, French. French feet stand in relation to English, as 16 is to 15.

of them saw, that at the moment when it passed the hedge, it made a half turn, and we changed our positions, which, thus altered, we retained to the end. I was astonished at the smallness of the noise or motion, occasioned by our departure, among the spectators. I thought they might be astonished or frightened, and might stand in need of encouragement (pretty cool this), I waved my arm with little success; I then drew out and shook my handkerchief, and immediately perceived a great movement in the garden. It seemed as if the spectators all formed one mass, which rushed, by an involuntary motion, towards the wall, which it seemed to consider as the only obstacle between us. At this moment M. de Rozier called out, "You are doing nothing, we do not rise." I begged his pardon, took some straw, moved the fire, and turned again quickly, but could not find La Muette. In astonishment I followed the river with my eye, and at last found where the Oise joined it. Here then was Conflans; and naming the principal bends of the river by the places nearest them, I repeated Poissy, St. Germain, St. Denis, Seve; then I am still at Poissy or Chaillot. Accordingly looking down through the car, I saw the Visitation de Chaillot. M. Pilâtre said to me at this moment, "here is the river, we are descending." "Well, my friend," said I, "more fire," and we set to work. But instead of crossing the river, as our course towards the Invalides seemed to indicate, we went along the Ile des Cygnes, entered the principal bed again, and went up the stream, till we were above the barrier La Conférence. I said to my brave associate, "Here is a river which is very difficult to cross." "I think so," said he, "you are doing nothing." "I am not so strong as you," I answered, "and we are well as we are." I stirred the fire, and seized a bundle of straw, which being too much pressed did not light well; I shook it over the flame, and the instant after I felt as if I had been seized under the arms, and I said to my friend, "we are rising now, however." "Yes, we are rising," he answered from the interior, where he had been seeing that all was right. At this moment I heard a noise high up in the balloon, which made me fear it had burst; I looked up but saw nothing; but, as I had my eyes fixed on the machine, I felt a shock, the first I had experienced. The shock was upwards, and I cried out, "What are you doing—are you dancing?" "I am not stirring." "So much the better," I said, "this must be a new current, which will, I hope, take us off the river. Accordingly, I turned to see where we were, and found myself between the Ecole Militaire and the Invalides, which we had passed about four hundred toises. M. Pelâtre said, "We are in the plain." "Yes," I said, "we are getting on." I heard a new noise in the machine, which I thought came from the breaking of a cord; I looked in and saw that the southern part was full of round holes, several of them large. I said "we must get down." "Why." "Look," said I; at the same time I took my sponge and easily extinguished the fire, which was enlarging such of the holes as I could reach; but, on trying if the balloon was fast to the lower circle, I found that it easily came off; I repeated to my companion, "We must descend." He looked round and said, "We are over Paris." Having looked to the safety of the cords, I said "We can cross Paris." We were now coming near the roofs; we raised the fire and rose again with great ease; I looked under me and saw the Missions Etrangers, and it seemed as if we were going towards the towers of St. Sulpice, which I could see. Raising ourselves, a current turned us south. I saw on my left a wood, which I thought was the Luxembourg. We passed the Boulevard, and I said, "Pied à terre." We stopped the fire; but the brave Pilâtre, who did not lose his self-possession, thought we were coming upon mills, and warned me. We alighted at the Butte aux Cailles, between the mill Des Merveilles and the Moulin Vieux. The moment we touched land, I held by the car with my two hands; I felt the balloon press my head lightly, I pushed it off and leaped out. Turning towards the balloon, which I expected to find full, to my great astonishment it was perfectly empty and flattened."

The second voyage was that of M. M. Charles and Robert, just at sunset, December the 1st, 1783, from the Tuileries, in a hydrogen balloon of twenty-six feet diameter. After coming down, M. Charles re-ascended alone, and was soon one thousand five hundred toises high, or nearly two miles. He saw the sun rise again, and, as he says, "I was the only illuminated object, all the rest of nature being plunged in shadow." A small balloon, launched by Montgolfier just before the ascent, was found to have run a totally different course; which first gave rise to the suspicion of different directions in the currents of the air at different heights.

The third voyage from Lyons, January 19th, 1784, was made in the largest Montgolfier yet constructed (one thousand one hundred and two feet in diameter, one hundred and twenty-six feet high), by seven persons, among whom were J. Montgolfier and M. de Rozier. It had been intended for six only, and these were found too many; but no persuasion could induce any one to abandon his place. The instant after the rope had been cut, a seventh person jumped in. A rent in the balloon caused it to descend with great velocity, but no one was hurt.

A small balloon, not containing any living thing, crossed the Channel, February 1784, from Sandwich, and was found nine miles from Lisle ; it travelled at the rate of thirty miles an hour.

March the 2nd, 1784, M. Blanchard made his first ascent from Paris, in a hydrogen balloon. He added wings and a rudder, but found them useless. He first carried a *Parachute*, or open umbrella, attached above the car, to break the fall in case it separated from the balloon.

M. M. de Morveau and Bertrand ascended April the 25th, 1784, thirteen thousand (English) feet at Dijon. Some effect was found, they thought, to be produced by the use of oars.

May the 20th, 1784. Confidence in the balloon so far established, that M. Montgolfier, two other gentlemen, and four ladies ascended, the balloon being confined by ropes. A lady (Madam Thible) ascended with only one other person in a fire balloon at Lyons, June the 4th, in the same year.

November 25th 1783.—The first balloon was launched in England, from the Artillery-ground London, by Count Zambeccari; it was filled with hydrogen, and was ten feet in diameter; it was found near Petworth, forty-eight miles from London.

Mr. Boulton (well known as the partner of the celebrated Watt) constructed a balloon to which a match and serpent were attached, that the gas might explode in the air. The object was, to see whether the reverberating growl of thunder is caused by echo, or by successive explosions; the point remained unsettled, owing to the shouting of the people; but, those who did hear it, thought it growled like thunder—this voyage was made December 26th, 1784.

September the 15th 1784—The first voyage made in England by Vincentio Lunardi, accompanied by a cat, a dog, and a pigeon. He started at the Artillery-ground and descended at Standon, near Ware.

January the 7th, 1785—M. Blanchard and Dr. Jeffries crossed the Channel, it being the fifth voyage of the former in the same balloon. They set out from Dover and landed at Guinnes, having been compelled to throw out all their stock to keep the balloon from falling into the sea.

June the 15th, 1785—M. Pilâtre de Rozier and M. Romain ascended from Boulogne in a Montgolfier, of thirty-seven feet in diameter, with the intention of crossing the Channel. They had not been twenty minutes in the air when the balloon took fire; both fell from a height of one thousand yards, and were killed upon the spot.

July 22—General Money ascended at Norwich; the balloon dropped into the water, in which the traveller remained six hours before he was rescued.

In 1802 (September the 21st), M. Garnerin descended successfully from a balloon by means of a parachute, near the Small Pox Hospital, St. Pancras, London. The height from which he descended was so great, that he could scarcely be distinguished. At first (before the parachute opened) he descended with great velocity, but as soon as it opened, the descent became very gentle and gradual.

In 1807, M. Garnerin ascended again from Paris, and landed at, or rather was dashed against Mont Tonnerre, three hundred miles from that city, after running great risks.

Three voyages have been undertaken since the beginning of the present century, for purposes professedly scientific. In 1804 M. M. Gay Lussac and Biot ascended in Paris to a height of thirteen thousand feet, and the same year M. Gay Lussac ascended alone, to the height of twenty-three thousand feet; but neither voyage offers any remarkable circumstance, or produced any scientific result worth naming. In 1806 Carlo Briochi, A. R., of Naples, made an ascent with Signor Andreani (who had previously been the first Italian aëronaut). Trying to rise higher than M. Gay Lussac had done, they got into an atmosphere so rarefied as to burst the balloon. Its remnants checked the velocity of the descent, and this, with their falling on an open space, saved their lives.

Two other fatal accidents have occurred; one on the 25th of May, 1824, to a Mr. Harris, who ascended with a female named Stocks, when, from some mismanagement they both fell out, and the former was killed; and in 1837 Mr. Cocking was killed in attempting a descent from Mr. Green's balloon, in a parachute.

In November, 1836, Mr. Green (who has made his two hundredth ascent), accompanied by Messrs. Monk Mason, and Captain Hollond, started from Vauxhall Gardens in an immense balloon, and after being in the air all the night made a safe descent at Nassau, in Germany.

Mrs. Graham has also ascended in her balloon many times, and upon one occasion, when accompanied by the Duke of Brunswick, both fell out, the lady was much injured.

Mr. Hampton during the year 1839 made one or two successful descents in his parachute.

Attempts innumerable have been made to guide the balloon, but all have been unsuccessful; indeed, it has now become a toy, and for any scientific purpose, is perfectly useless; even its attraction as a holiday show is now worn out, for scarcely a week passes during the Vauxhall season but several ladies and gentlemen, ambitious of a sky-rocket reputation, accompany Mr. Green in his "Monster Balloon," accounts of which would be but so much learned lumber. It is said of Benjamin Franklin, that on being asked what was the use of a balloon, replied by asking his interrogator another question—"What is the use of a new born infant? It may become a man." If that eminent philosopher was now alive, he would see that it had grown, certainly, but was as far off maturity as when first invented.

The means now adopted to inflate balloons is by the ordinary coal gas. and they usually ascend from the immediate neighbourhood of gas works; this process is more expeditious and much less expensive than the old system.

## CHAIN PIER, AT BRIGHTON.

This beautiful object of suspensive power was begun in 1822, from plans by Captain Brown, who was the Engineer; under whose immediate superintendence it was erected and opened in 1829. To those who are acquainted with the town of Brighton, it is unnecessary to point out the advantages of such a jetty; but, to those who have never visited that fashionable watering place, it may be interesting to know that the bold, open, lee shore of Brighton, rendered the task of embarkation or disembaration a work, at most times of the tide, of difficulty and danger —hence the necessity of the Chain Pier.

It consists of a platform, about thirteen feet wide, and about a thousand feet long, suspended from eight chains passing over four towers; the chains being at one end fixed in the cliff, and at the other end fastened to the masonry sunk in the sea. The eight chains are arranged in pairs, side by side, there being two pairs on each side of the platform, one being hung about twelve inches above the other. The parts between them are named bridges, and, by way of distinction, they are called first, second, &c., from the cliff.

The towers are made of cast iron, and each rests upon twenty piles, driven with more than the usual force into the bed of chalk; the last tower, and the extension of the platform, forming the pier head, rests upon 100 piles, well bound together, and further stiffened by piles driven diagonally.

The four main chains are made of wrought iron, two inches in diameter, in links ten feet long, and the platform is suspended from the main chains by suspension rods of about one inch in diameter; the upper ends of the suspension rods are inserted in hollow caps, resting on the joints of the main chains. It stood manfully the test of all weathers, until the great storm, on the 15th October, 1833, on the evening of which day it blew a tremendous gale from the west. The principal damage done then was to the second and third bridges; the platforms of which were more or less destroyed, most of the suspension rods snapped, and the main chains were left hanging almost independent of the platform, one of the upper pair of chains being separated from its companion and twisted round the pair below it. In the first and fourth bridges, the only damage done was the sinking of the main chains, in consequence of the counter-balancing weight of the second and third bridges being removed, some of the suspension rods were found bent, and the towers thrown a little out of their perpendicular.

As no person was spectator of the damage done during the storm, its cause is only conjectural; by some it was attributed to lightning, but this was disproved by the thickness of the rods and their uninjured state after the storm; then it being low water at the time, the action of the sea was not the cause; but it is, with great probability, attributed to the wind, which, being *due west*, would fall at right angles on the pier, and producing continued vibration at stated intervals, would cause so violent a motion as to break some of the centre suspension rods, where the vibration would of course be greater, and these giving way, the increased weight would be thrown upon the adjoining rods; and hence the damage done.

It was shortly afterwards substantially repaired by stay chains being added, and has ever since bravely stood amidst the "war of elements" an object of beauty and utility.

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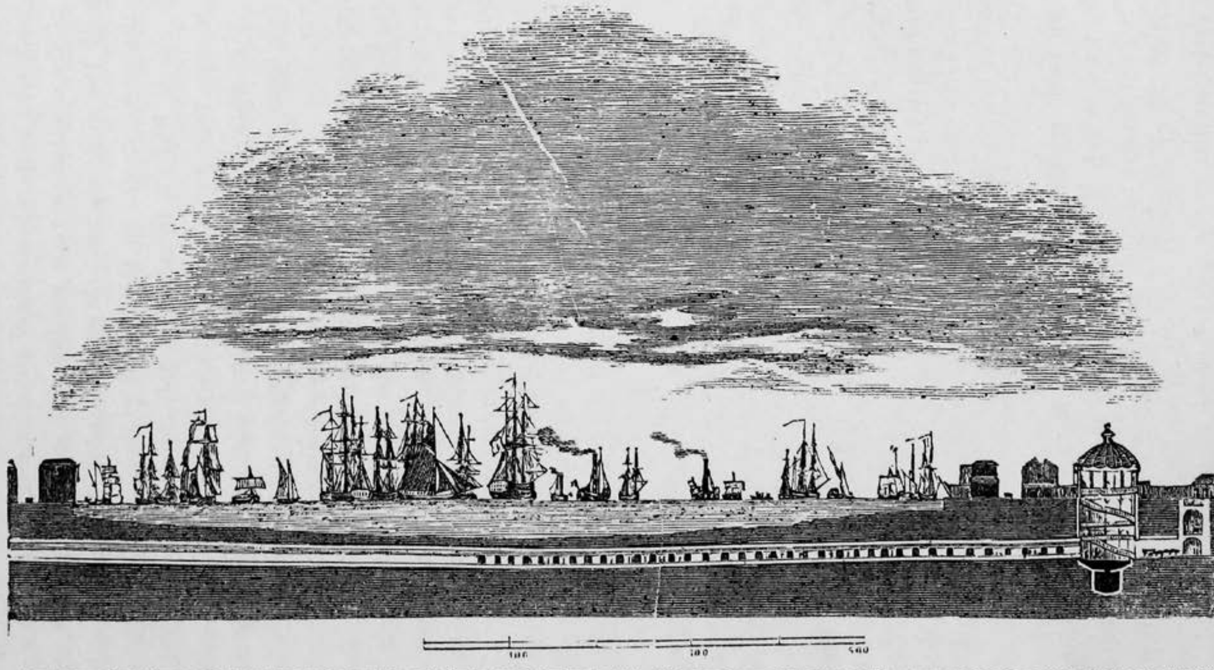
As we have spoken of *stay chains*, it may not be uninteresting to describe those which Mr. Brunel, senior, applied as additional securities to the two suspension bridges, which he erected for the French Government in the *Isle of Bourbon;* where, from the violence of storms with which that island is so frequently visited, the greatest possible strength was required. Mr. Brunel obtained a proper resistance by employing a double system; first, the usual upper chain; secondly, lower and inverted chains, united to the roadway of the bridges by vertical rods, which are, properly speaking, the suspending rods of the inverted chains. In order to give firmness to the road of the bridges, horizontal with the stream, the lower chains, instead of being on a




Thames Tunnel.

parallel plane with the upper chains, diverge from them near the points of support. The two bars of the inverted chains, and the lower suspension rods, are fastened together ; the upper part of the suspending rod goes through the corresponding beam close to one of the upper rods, and is fastened by a screw to its head. The last bar of the inverted chain goes through the whole thickness of the masonry of the central pier of the bridge, and on coming out is set in a large plate of cast iron; thus a great part of the pier has to support the great strain or tensions which the inverted chains must experience during storms, and when the wind blows upwards. The same system is used to attach the other extremities of the inverted chain to the abutments ; these inverted, or, as they may be called, *stay chains*, have been found fully to answer the purpose for which they were intended.

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## THE THAMES TUNNEL.

This stupendous attempt—this gigantic effort of art to triumph over nature, was commenced in 1824, under the superintendence of Mr. Brunel, senior, the celebrated civil engineer, whose design has been strictly adhered to, and whose scientific perseverance has successfully combatted the most unparelleled difficulties.

Two abortive attempts were made to form a Tunnel under the Thames, one in 1799, at Gravesend, and the other in 1804, from Rotherhithe to Limehouse, both of which were very soon abandoned.

The site of that which we shall endeavour to describe is most admirably selected, and is perhaps the only spot between London Bridge and Greenwich where such a roadway could be attempted, without interfering essentially with some of the great mercantile establishments on both sides of the River, being situate in a very populous and highly commercial neighbourhood, and where a facility of land communication between the two shores is very desirable, and must of necessity be most advantageous, not only to the immediate neighbourhood but also to the adjacent counties.

Mr. Brunel began his operations by making preparations for a shaft 50 feet in diameter, which he commenced at 150 feet from the river on the Surrey side; this he effected by constructing first on the surface of the ground a substantial cylinder of brick work of that diameter, 42 feet in height, and 3 feet in thickness. Over this he set up the Steam Engine necessary for pumping out the water, and for raising the earth to be taken from within the cylinder, and then proceeded to sink it *en masse* into the ground, in the way that the shafts of wells are usually sunk. By this means he succeeded in passing through a bed of gravel and sand 26 feet deep, full of land-water, constituting in part a quicksand, in which the drift makers of the former undertaking had been compelled to suspend their work.

Being warned by eminent geologists of the existence of a bed of sand, lying at a greater depth, Mr. Brunel caused the fifty feet shaft to be sunk to the depth of sixty-five feet, and a smaller one was made of twenty-five feet diameter, destined to serve as a well or reservoir, for the drainage of the water; this was sunk from the lower level, but on approaching the depth of eighty feet the ground gave way suddenly, sinking the smaller shaft several feet at once, thus proving the existence of the bed of sand before alluded to, and which the active mind of Mr. Brunel had effectually guarded against, and thus succeeded in obtaining the desired level. This accomplished, the shaft and reservoir having been completed, the horizontal excavation for the body of the Tunnel was then commenced at the depth of sixty-three feet, and in order to have sufficient thickness of ground to pass safely under the deep part of the river, the excavation was carried on to a declivity of two feet three inches per hundred feet. This excavation is thirty-eight feet in breadth, and twenty-two feet six inches in height, presenting a sectional area of eight hundred and fifty feet, and being more than sixty times the area of the drift which was attempted before. As an illustration of the magnitude of the excavation for the Tunnel, it is larger by sixty feet than the interior of the old House of Commons, and the base of the excavation, in the deepest part of the river, is 76 feet below high water mark.

We shall now proceed to notice (too briefly, we fear) the process by which this great excavation has been effected, and the double roadway and paths which extend about eight hundred and sixty feet under the River, have at the same time been constructed within it.

It was accomplished by means of a powerful apparatus of iron, which has been designated a "shield," and which consisted of twelve great frames, standing close to each other, like so many volumes on the shelf of a book-case; these frames being twenty-two feet in height, and about three feet in breadth. They were divided into three stages or stories, thus presenting thirty-six chambers or cells for the workmen; namely, the miners, by whom the structure is simultaneously formed, and which serves as a scaffolding for them. Towards the head and foot of the shield were horizontal screws, a pair of which, being attached to each of the divisions, and turned so as to press against the brickwork, and used to propel each division forward.

The divisions of the shield were advanced separately and independently of each other by the means before mentioned; each division with boards in front (known by the technical name of polling boards), supported and kept in position by means of jack screws, which were lodged against the front of the iron frame; these boards being in succession taken down, while the earth in front of which was excavated, the first board being *always replaced* before a second was removed, thus forming a constant firm buttress.

The interior is quite a *fairy scene*, and consists of two immense avenues, brilliantly lighted with gas; these avenues are divided by a thick wall of brick-work, which is firmly set in cement; the middle wall is for greater security, while in progress, built *quite solid*; but for convenience, light, and general effect, a succession of arches are opened in that middle wall, so as to admit of frequent communications between the two carriage ways.

In November, 1839, the Tunnel was completed to the extent of 30 feet, beyond low watermark, on the Middlesex side, and then progressed at the weekly average rate of three feet; the whole extent being 1,300 feet.

To facilitate the access to the Tunnel, the carriage-way is by circular descents, and does not exceed, in any part the slope of Ludgate Hill, or Waterloo Place, Pall Mall.

From the great success attending the completion of this stupendous undertaking, it is almost ungracious to notice former failures; but we do so only to express our admiration at the scientific resources of that mind which has overcome all but insuperable obstacles. The works were thrice interrupted, in 1826, by the breaking off of the clay, leaving the shield exposed to the influx of land water for six weeks; on the 18th May, 1827, and again in January, 1828, when the river broke in and filled the Tunnel; this was quickly remedied by filling the holes or chasms with strong bags of clay; the structure, however, on clearing the tunnel of the water, was found in a most satisfactory state.

The works from that time were suspended for seven years, when they were again resumed, and the workmen have continued their labours, to the satisfactorily surmounting of all obstacles. As to the ultimate pecuniary success of the speculation, that may be problematical; but should it prove a loss to the Company, it is to be hoped Government will make it a "National Affair," and take it into their own hands.

## PLYMOUTH BREAKWATER.

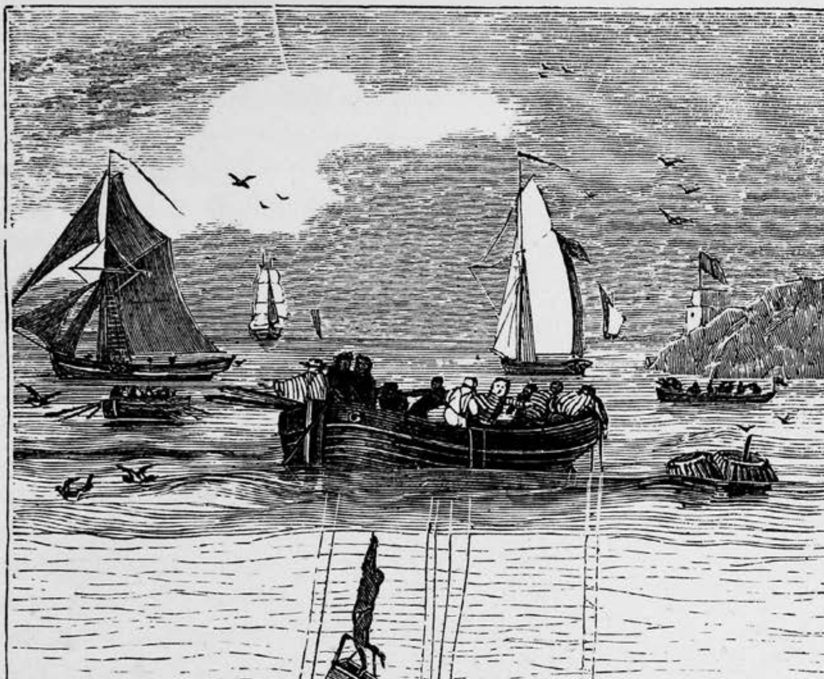
Navigators had long complained that this, the second port in the kingdom, possessing, as it does, capacious anchorage, numerous inlets, and the advantages of the large river Tamar, which flows to the very walls of the dock-yard, was still exposed to gales from S. W. to S. E.; which, blowing directly into the harbour, produced a heavy sea, and at such seasons the shipping often suffered serious damage for want of proper shelter.

But it was not until 1806 that the Government, at the suggestion of the late Earl of St. Vincent, directed a Survey to be made by Mr. Whidbey, in conjunction with Mr. Rennie, who reported the practicability of making the anchorage safe by means of a Breakwater. The plan adopted was, to form an impenetrable barrier of large stones, in the middle of Plymouth Sound, extending from east to west, 1,700 yards, and leaving an entrance on each side sufficiently capacious to allow the largest man-of-war an easy passage in and out of the harbour. The centre of the breakwater was to be 1000 yards in a straight line, continued 350 yards more at either end, at an angle of 120°, by which form it was expected the force of the waves would be more effectually resisted; the breadth of the base was fixed at 210 feet, at the top 30 feet, and the depth from the upper surface to the bed of the sea 40 feet.

It was computed that 2,500,000 tons of stone would be required to construct the whole work, and the entire cost was calculated at £1,171,000 sterling. To facilitate the undertaking, a quarry of grey marble, of about 25 acres in extent, was purchased of the Duke of Bedford, for £10,000. This lying contiguous to Catwater, which is at the head of the harbour, presented a secure spot to embark the stones.

Twelve vessels of a suitable construction were built in the dock-yard, and forty others were hired to convey the stones to their appointed station. Several hundred artificers and labourers of all descriptions were engaged for the whole service. The first stone was deposited on the 12th August, 1812.

The vessels were laden and discharged by means of the following contrivance:—small iron trucks, each capable of carrying a stone of from two to six tons weight, were conducted along an iron railway leading from the quarry, through the stern port into the vessel's hole. Each vessel carried 16 of these trucks. The place where they were to



Pearl Fishery of Ceylon.

discharge their cargo was marked by buoys, and by sights erected on the shore. On arriving at the spot, the trucks with their burthens were drawn out successively to the entrance port, the fall of which dropped the stone into its place, while the carriage remained suspended by its tackle. In this manner a cargo of eighty tons was discharged in forty or fifty minutes!

At the end of two years the breakwater was so far advanced as to prove a very serviceable security to the harbour. The work stood the utmost fury of the elements until the winters of 1816-17, when some damage was done to the upper stratum of stone, which was washed over the inner side, but produced no other mischief, and it was the opinion of the oldest seaman, that had it not been for the breakwater, even in its present unfinished state, every vessel in the Catwater would have been wrecked. Since which period it has only required some trifling repairs, not in the slightest degree affecting its solidity; and it remains a lasting testimonial of the Architect's genius and foresight.

## POMPEY'S PILLAR.

Every traveller in Egypt has differed from the preceding one as to the origin and objects of this column, and the only thing in which they do agree is, that the name of Pompey's pillar is a misnomer; yet it is certain, that a pillar of some kind was erected at Alexandria, to the memory of that great man, which was supposed to have been found in this remarkable column. Montague thinks that it was erected to the honor of Vespasian; Savary calls it the pillar of Severus; Clark supposes it to have been dedicated to Hadrian, according to his version of a half effaced Greek inscription on the west side of the base; others trace the name of Diocletian in the same inscription. As no mention is made of it, either by Strabo or Diodorus Siculus, we may reasonably conclude that it did not exist at that period. The celebrated French *savan*, Denon, believes it to have been erected about the time of the Greek Emperors, or the Caliphs of Egypt, and dates its acquiring its present name in the fifteenth century. This pillar stands on a small eminence midway between Alexandria and Lake Marostis, about three quarters of a mile from either place, and quite detached.

It is of red granite; but the shaft, which is highly polished, appears to be of earlier date than the pedestal, which has been made to correspond. It is of the Corinthian order, and while some have eulogised it as being a fine specimen of that order, others declare it to be in very bad taste;

the capital is of palm leaves, but not indented. The column consists only of three pieces, the capital, the shaft, and the base; and is poised on a centre stone of breccia, with hieroglyphics on it, less than a fourth of the dimensions of the pedestal of the column, and with the smaller end downward; from which circumstance the Arabs believe it to have been placed there by God. The earth about it has been examined, probably in hopes to find treasure, and pieces of white marble (which is not found in Egypt) have been discovered connected to the breccia. It is owing probably to this disturbance, that the pillar has an inclination of about seven inches to the southwest. It is remarkable, that while the polish on the shaft is still perfect to the northward, corrosion has began to effect the southern face, owing probably to the winds passing over the vast tracts of sand in that direction.

The centre part of the cap-stone has been hollowed out, forming a basin on the top; and pieces of iron still remaining in four holes, prove that this pillar was once surmounted by a figure or other trophy. The operation of forming a rope ladder to ascend the column has been performed several times of late years, and is very simple. Clarke describes one of these which he witnessed; a kite was flown with a string to the tail, and when directly over the column, it was dragged down, leaving the line by which it was flown across the capital. With this a rope, and afterwards a stout hawser, was drawn over; a man then ascended, and placed two more parts of the hawser, all of which were pulled tight down to a piece of ordnance; small spars were then lashed across, commencing from the bottom, and ascending each as it was secured, till the whole was complete, when it resembled the rigging of a ship's lower masts. The ascending this required some nerve even in a seaman, but to the Turks it was fearful. The view from the top is said to be highly interesting, in the associations excited by gazing on the ruins of the city of the Ptolemies lying beneath. Various statements have been published of its altitude, but the following may be relied on for its accurracy.

| | feet | inches |
|---|---|---|
| Top of the capital to the Astragal (one stone) . | 10 | 4 |
| Astragal to first plinth (one stone) . . | 67 | 7 |
| Plinth to the ground . . . . | 20 | 11 |
| Whole height . . . . | 98 | 10 |
| Measured by line from top . . . | 99 | 4 |

It is to be remembered that the pedestal of the column does not rest on the ground,

| | feet | inches |
|---|---|---|
| Its elevation being . . . . | 4 | 6 |
| The height of the column itself is therefore . | 94 | 10 |
| Diagonal of the capital . . . | 16 | 11 |
| Circumference of shaft (upper part) . . | 24 | 2 |
| Ditto (lower part) . . | 27 | 2 |
| Length of side of the pedestal . . . | 16 | 6 |

Clarke's reading of the inscription on the column is—

"Posthumus Prefect of Egypt, and the people of the Metropolis (honor), the most revered Emperor, the protecting divinity of Alexandria, the divine Hadrian Augustus."

The version of other travellers—

"To the Deocletianus Augustus, most adorable Emperor, tutelar deity of Alexandria—Pontius Prefect of Egypt dedicates this."

It must be recollected, that some of the characters are very faint, while others are altogether destroyed by time; hence the fancy of the travellers has been exerted to supply the defficiency in accordance with their different tastes.

## SCRATCHELL'S BAY, ISLE OF WIGHT.

In the beautiful and sublime scenery—much of it of a kind peculiar to itself—the Isle of Wight is surpassed by few spots on the globe. At the back of the island, a considerable portion of its coast presents an impregnable rampart, composed for the most part of cliffs of chalk, intermixed with flint or clay, and in many parts rising to a height of some hundreds of feet above the level of the sea. Some of the most elevated of these rocks occur in the course of the range that extends in both directions, from the west point of the island, forming Alum Bay, to the north, and what are called the Freshwater Cliffs, to the south. An indention, much smaller than Alum Bay, immediately adjacent to this terminating promontory on the south side, is known by the name of "Scratchell's Bay." Here is a magnificent arch of 150 feet in height, and is one of those numerous caves which pierce the Freshwater Cliffs; some of which are 400 feet in height, and the highest (called Main Beach), is 600 feet high. Here, however, the precipice is not quite perpendicular, The singular looking rocks that are seen rising out of the water beyond the promontory, looking through the arch, are the celebrated "Needles," a name which they derive from one of their number rising 120 feet above low water mark, much like a needle in shape; that, however, has long since disappeared (Worsley says this happened in 1764).

Scratchell's Bay, and all the neighbouring cliffs, are frequented by vast masses of sea fowls, which the country people are in the habit of catching by the hazardous method (practiced also at Shetland and the Feroe islands) of being swung over the brow of the rock by a rope made fast in the earth above! Scratchell's Bay is often visited by the tourist, and the most magnificent view of it is obtained by descending a very steep grassy slope of one of the cliffs in the neighbourhood ; but this should never be attempted without a guide. Nothing can be more interesting, particularly to those who are fond of aquatic excursions, than to sail between the cliffs and the needles. The wonderfully coloured cliffs of Alum Bay, the lofty and towering chalk precipices of Scratchell's Bay, of the most dazzling whiteness, and the most elegant forms; the magnitude and singularity of the spiry insulated masses, which seem at every instant to be shifting their situations, and give a mazy perplexity to the place; the screaming noise of the aquatic birds; the agitation of the sea, and the rapidity of the tide, occasioning not unfrequently a slight degree of danger; all these circumstances combine to raise in the mind unusual emotion, and to give to the scene a character highly singular and even romantic.

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## PEARL FISHERY.

The fullest as well as the most intelligent account of the pearl fishery of Ceylon appears in "Memoires relatifs à l'expedition, Anglaise de l'Inde en Egypte, par le Compte de Noé," from whose highly interesting work we copy our statement. The pearl oyster, like the common one, lies in banks at greater or less depths of the sea. These banks occur on the western side of the island of Ceylon, about 15 miles from the sea, viz: Aripo, Chilow, and Condatchy, where the average depth is about 12 fathoms; and here the greatest of all pearl fisheries has been carried on for many centuries. Since the occupation of the island by the British, our government has continued to sell by auction the privilege of fishing for them; these sales are only made for one season. The season always begins in April, because in those latitudes the sea is then in its calmest state, and it is generally continued until the middle or end of May. It

Bell Rock Lighthouse.

not only attracts a multitude of Cingalese, or natives of the island, to the coasts, but crowds of spectators from all parts of the vast Indian peninsular, whose variety of language, manners, and dress is described as being very striking and pleasing. The temporary abodes erected for them are also curious and picturesque.

These huts are merely composed of a few poles stuck in the ground, interwoven with light bamboos, and covered with leaves of the cocoa-nut tree. The signal for commencing the fishery is given at day break by the discharge of a cannon, on which a countless fleet of boats that have started from the shore at midnight, and favoured by a land breeze, have reached the banks before dawn, cast anchor in the respective parts of the banks for which their owners have contracted, and proceed to work. Government vessels are on the spot, to prevent any boat fishing beyond its proper limits. The boats of the pearl fishers generally carry a captain, a pilot, and twenty men, ten of which are experienced divers; the ten divers are divided into two companies of five each, and these companies plunge and relieve each other by turns.

In order that they may descend through the water with greater rapidity to the base of the bank round which the oysters are clustered, the divers place their feet on a stone attached to the end of a rope, the other end of which is made fast to the boat. They carry with them another rope, the extremity of which is held by two men in the boat, whilst to the lower part which descends with the diver there is fastened a net or basket. Besides these, every diver is furnished with a strong knife to detach the oysters, or serve him as a defensive weapon in case he should be attacked by a shark.

As soon as they touch ground, they gather the oysters with all possible speed, and having filled their net or basket, they quit their hold of the rope with the stone, pull that which is held by the sailors in the boat, and rapidly ascend to the surface of the water.

There are marvellous stories told of the length of time these divers can remain under water; but one who has had much experience, from a long residence at Ceylon, says that he never knew of a diver being longer than fifty seconds in his submersion. Although sharks are numerous in the seas round Ceylon, accidents rarely happen. This may be attributed to the noise and stir occasioned by the gathering of so many boats on one spot, and the continued plunging of the divers, which must frighten and disperse the voracious animals; but the superstitious natives attribute their safety to certain charms which they buy of old women, who pretend they can bewitch the sharks, and prevent them from attacking their customers.

Instances have however occurred, when neither the natural noise kept up by the boats, nor the supernatural protection, has deterred the shark, and the diver, by means of his knife and great dexterity, has killed the monster, and escaped unhurt.

Alternately plunging and reposing, the divers continue their occupation until 10 o'clock in the forenoon, when the sea breezes begin to blow, and one of the Government vessels fires a gun, which is a signal for the whole flotilla to return to shore. As soon as the boats touch the beach, an immense number of labourers, men, women, and children, rush to them, and carry off the produce of the day's fishing. Every speculator has his own group of huts, and in the midst of each of these is a *couttó*, or space of ground enclosed with poles and transverse pieces of bamboo, but open to the air. In these *couttó's* are deposited the oysters as they are landed, and there they are left to putrefy, which they soon do under a burning sun. It is a curious fact, that though these numerous *coutto's*, each containing an enormous mass of oysters, all putrefy together on a narrow extent of soil, and emit the most destestable odours, yet the health of the precarious but crowded population is by no means affected. As soon as the putrefaction is sufficiently advanced, the oysters are taken from the *couttó* and placed in troughs made of the trunk of trees hollowed; sea water is then thrown over them. In their putrid state the oysters easily render the pearls they contain; and a number of men, all standing on the same side of the trough, rapidly shake them out and wash them. Inspectors are appointed, who stand at each end of the trough to see that the labourers secrete none of the pearls, and others are in the rear to examine whether the shells thrown aside as worthless may not contain some of the precious substance. The workmen are prohibited, under penalty of a beating, to lift their hands to their mouths while they are washing the pearls. Yet, spite of these precautions and the vigilance of the inspectors, a man sometimes contrives to swallow a pearl of value. After all the shells are thrown out, the pearls they may have contained remain in the sand at the bottom of the trough. The largest of these pearls are carefully picked up and washed with clean water; the next in size and quality are merely taken from the trough, and spread out on white napkins to dry in the sun; it is not till this is done, that any attention is paid to the smallest pearls, which are generally left to the care of the women who pick and dry them. To assort the pearls afterwards, they make use of three sieves placed one above the other. The apertures in the uppermost sieve are the largest, and those of the second are larger than the third. Thus the pearls, which do not pass through the first sieve, are of the first class; and so on to the second and third. It remains, however, for an after examination, to decide on other qualities which give value to the pearls, as their regularity of form, colour, &c. It is somewhat strange, that while we in Europe most esteem the pearls that are purely white, the people of the island prefer those which are rose coloured, and the Indians, and other Orientals, those which are yellow.

Besides these colours, pearls are found of a delicate blue tint, and some have a golden or a silvery tint.

The pearl is a *malady* of the oyster, which requires seven years to develope itself completely. If the shell is not fished at that time, the animal dies, or the pearl is lost. When the season happens to be stormy, the oysters often suffer, and their produce is consequently diminished. Perhaps, on these occasions they open and disgorge their pearls. The pearl oyster is the same size as our own, but oval in shape and flat on one side. The testaceous fish enclosed in the shell has a beard like the muscle.

At the time of this fishery at Ceylon, besides the numerous speculators that come from India, there arrive annually troops of Indian artizans, who are very expect in piercing or drilling the pearls, and who practice their art on the spot for very moderate wages. These men sit in the open air before the hut of the fisher or speculator by whom they may be employed. Nothing can well be more simple than the implements they use; these are merely a block of wood, in the form of an inverted cone, which rests on three legs, and whose upper surface is pierced with circular holes of various diameter, fitted to receive the variously sized pearls. Their drill is merely a short sharp needle, inserted in a stick which is made circular at the top, and set in motion by a bow like those used by a watch maker.

They hold the right hand between the bow and the pearl, and move the bow with the left hand. Sitting on the ground cross-legged, they keep the block of wood between their knees, and apply the drill perpendicularly to the pearl, which they are said to pierce with extraordinary rapidity and correctness.

During the prosecution of the fishery, few places can be more animated than the western point of Ceylon. The oysters, or the cleansed pearls, are bought and sold on the spot; and besides this trade, the confluence of so many crowds from different countries attracts dealers in all sorts of merchandize.

The long line of huts is a continuous bazaar, and all is life and activity; but the fishery over, both natives and strangers depart, the huts are knocked down, scarcely a human habitation can be seen for miles, and the most dreary solitude prevails until the next year.

## THE COLOSSEUM OF ROME

Was commenced by Vespasian and finished by Titus (A. D. 79). This enormous building occupied only three years in its erection, and cost as much as would build a capital city. We have the means of ascertaining exactly its original dimensions, and its accommodations, from the great mass of wall which is still entire; although the very clamps of iron and brass that held together the ponderous stones of that wonderful edifice were removed by Gothic plunderers, and succeeding generations have resorted to it as to a quarry, for their temples and their palaces; yet the "enormous skeleton" still stands in prodigious majesty! The colosseum is of an oval form, and occupies the space of nearly six acres. It may be justly said, with Messrs. Cresy and Taylor, who visited it in 1813, "to have been the most imposing building, from its apparent magnitude, in the world; the pyramids of Egypt can only be compared with it in the extent of their plan, as they cover nearly the same surface." The greatest length, or major axis, is six hundred and twenty feet, the greatest breadth, or minor axis is, five hundred and thirteen feet. The outer wall is one hundred and fifty-seven feet high in its whole extent; the exterior wall is divided into four stones, each ornamented with one of the orders of architecture. The cornice of the upper story is perforated for the purpose of inserting wooden masts, which passed also through the architrave and frieze, and descended to a row of corbels immediately above the upper range of windows, on which are holes to receive the masts. These masts were for the purpose of attaching cords to, for sustaining the awning which defended the spectators from the sun or rain. Two corridors ran all round the building leading to staircases, which ascended to the several stories; and the seats which descended towards the arena, supported throughout upon eight arches, occupied so much of the space that the clear opening of the present inner wall next the arena is two hundred and eighty-seven feet by one hundred and eighty feet. Immediately above and around the arena was the Podium, elevated about twelve or fifteen feet, on which were seated the emperor, senators, ambassadors of foreign nations, and other distinguished personages in that city of distinctions. From the podium to the top of the second story, were seats of marble for the equestrian order; above the second story the seats appear to have been constructed of wood. In these various seats eighty thousand spectators might be arranged according to their respective ranks; and, indeed, it appears, from incriptions, as well as from expressions in Roman writers, that many of the places in this immense theatre were assigned to particular individuals, that each might find his seat without confusion.

The ground was excavacated over the surface of the arena in 1813; a great number of substructions were then discovered, which, by some antiquaries, are considered to be of modern date, and by others to have formed dens for the various beasts that were exhibited.

The descriptions which have reached us from historians and other writers, of the variety and extent of the shows, would induce the belief that vast space and ample conveniences were required beneath the stage to accomplish the wonders which were doubtless there realized in the presence of assembled Rome.

Gibbon, in his twelfth book, has given a splendid description of the sports of the Circus, and has well observed, "While the populace gazed with stupid wonder on the splendid show, the Naturalist might, indeed, observe the figure and properties of so many different species, transported from every part of the ancient world into the amphitheatre of Rome. But this accidental benefit, which science might derive from folly, is surely not sufficient to justify such a wanton abuse of the public riches." Upon this a modern writer has added, "The prodigal waste of the public riches, however, was not the weightiest evil of the sports of the Circus; the public morality was sacrificed upon the same shrine as its wealth. The destruction of beasts became a fit preparation for the destruction of man."

A small number of these unhappy persons, who engaged to fight with the wild animals in the arena, were trained to these dangerous exercises, as are the Matadors of Spain of the present day. These men were accustomed to exhaust the courage of the beast by false attacks; to spring on a sudden past him, striking him behind ere he could recover his guard; to cast a cloak over his eyes, and then dispatch or bind him at this critical moment of his terror; or to throw a cup full of some chemical preparation into his gaping mouth, so as to produce the stupefaction of intense agony. But the greater part of the human beings who were exposed to these combats, perilous even to the most skilful, were disobedient slaves and convicted malefactors.

The imperial edicts against the early Christians, furnished more stimulating exhibitions to the popular appetite for blood, than the combat of lion with lion or gladiator against gladiator. The people were taught to believe that they were assisting at a solemn act of justice, and they came therefore to behold the tiger and the leopard tear the quivering limb of the aged and the young, of the strong and the feeble, without desire to rescue the helpless or succour the brave."

Byron gives this beautiful picture of the gladiator dying in the Circus.

" I see before me the gladiator lie :
He leans upon his hand—his manly brow
Consents to death, but conquers agony,
And his droop'd head sinks gradually low—
And through his side the last drops, ebbing slow
From the red gash, fall heavy, one by one,
Like the first thunder-shower; and now
The arena swims around him—he is gone,
Ere ceased the inhuman shout which hail'd the wretch who won.

He heard it, but he heeded not—his, eyes
Were with his heart, and that was far away;
He reck'd not of life he lost, nor prize,
But where his rude hut by the Danube lay,
*There* were his young barbarians all at play,
*There* was their Dacian mother—he their sire,
Butchered to make a Roman holiday—
All this rush'd with his blood—shall he expire,
And unavenged? Arise, ye Goths, and glut your ire !"

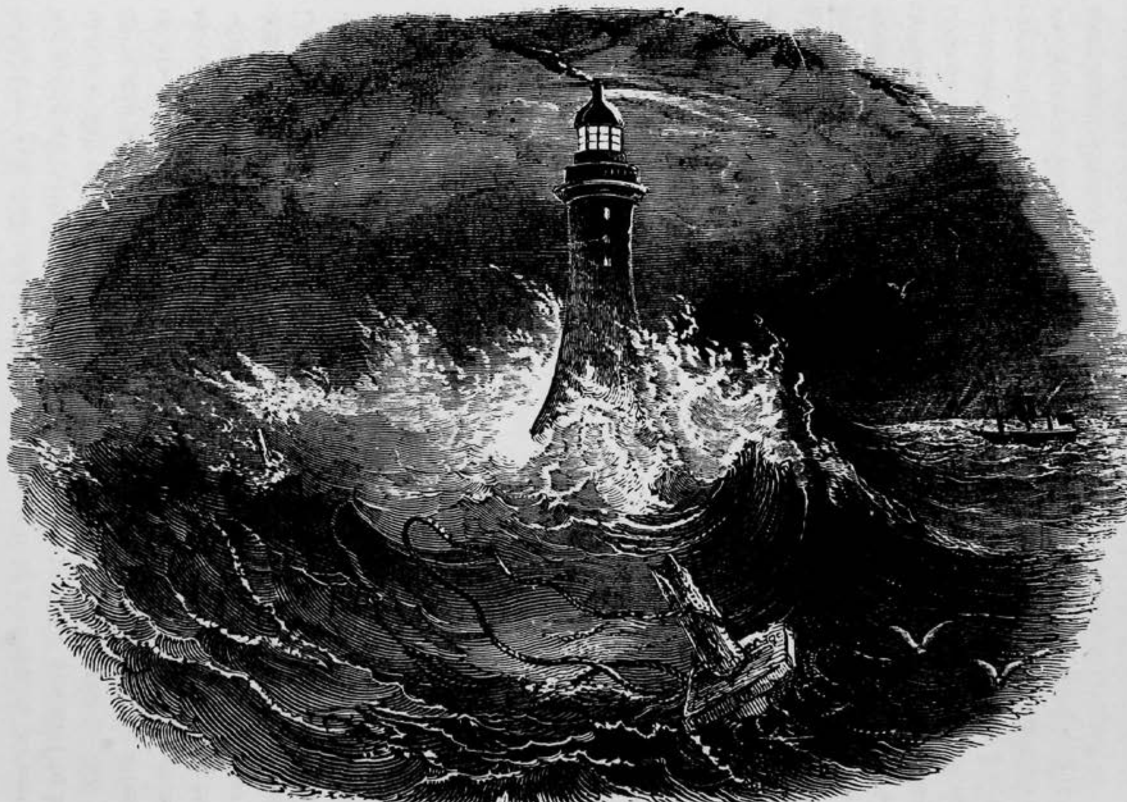
## EDDYSTONE LIGHT-HOUSE.

The Eddystone Rocks are supposed to have got this name from the great variety of contrary eddies of the tide or current among them, both upon the tide of flood and the tide of ebb. They are situated nearly S. S. W., from the middle of Plymouth Sound, off the Coast of Devonshire, in the south of England. The nearest land to the Eddystone Rocks is the point to the west of Plymouth, called the Ram Head, from which they are about 10 miles directly south. As these rocks were not very much elevated above the sea at any time, and at highwater were quite covered by it, they formed a most dangerous obstacle to navigation, and several vessels were every season lost upon them. Many a gallant ship which had voyaged in safety across the whole breadth of the Atlantic, was shattered to pieces on this hidden source of destruction, as it was nearing the port, and went down, with its crew, in sight of their native shores. It was therefore of first rate importance that these dangerous rocks should be pointed out by a warning light. But the same circumstances which made the Eddystone Rocks so formidable to the mariner, rendered the attempt to erect a Lighthouse upon them a difficult enterprise. This task was at last undertaken by a Mr. Winstanley, of Little Bury, in Essex, a gentleman of fortune, but not a regular bred engineer or architect; and was more than four years in building. "Not," says the builder, "for the greatness of the work, but for the difficulty and danger of getting backwards and forwards to the place. The difficulties were many and the dangers not less, for these rocks, lying 12 miles from the land, are surrounded by a deep and troubled ocean, which covers the greater part of them, and, whenever it blows hard, rolls over them with resistless fury; hence it is impossible to bring a boat close to them, or to land on them, except in perfectly calm weather." At length, in the third year, all the work was raised, which, to the weather-cock at top, was 80 feet in height. Being all finished, with the lantern and all the rooms that were in it, they ventured to lodge there soon after Midsummer, for the greater dispatch of the work. But the first night the weather became bad, and continued stormy so long, that it was 11 days before any boats could come near them again; and not being acquainted with the height of the sea rising, they were almost all the time drenched with wet, and their provisions in as bad a condition, though they worked night and day to make a shelter for themselves. In this storm they lost some of their materials, although they did what they could to save them; but the boat then returning, they all left the Lighthouse to be refreshed on shore, and as soon as the weather permitted they returned again and finished all; the light was put up on the 14th November, 1698, which being so late in the year, it was not till within three days of Christmas that they had relief to go on shore, being at the last extremity for want of provisions.

The fourth year, finding in the winter the effect the sea had upon the house, the waves rolling over the lantern at times, although more than 60 feet high, Mr. Winstanley, early in the spring, surrounded the building with a new work of 4 feet thickness from the foundation, making all solid near twenty feet high, and taking down the upper part of the building, and enlarging every part of it in proportion, he raised it forty feet higher than it was at first; and yet the sea, in time of storm, flew, in appearance, a hundred feet above the weather-cock; and at times covered half the side of the house and lantern as if they had been under water! On the finishing of this building it was generally said, that in the time of hard weather, such was the height of the sea, that it was very possible for a six oared boat to be lifted up upon a wave and driven thr-ugh the open gallery of the light-house. In November, 1703 the fabric wanting some slight repairs, and Mr. Winstanley went down to Plymouth to superintend them. The opinion of the common people was that the building would not be of long duration. Mr. Winstanley held, however, different sentiments; being among his friends, previous to his going off with his workmen to make the repairs, it was said to him, that one day or other the light-house would certainly overset. To this he is said to have replied, "that he was so well assured of the strength of his light-house, that he should only wish to be there in the greatest storm that ever blew under the face of the heavens, that he might see what effect it would have upon the building." In this wish he was too fatally gratified: for while he was there with his workmen and light-keepers, that dreadful storm began, which raged the most violently upon the night of the 26th November, 1703; and of all accounts of the kind with which history furnishes us, we have none which has exceeded this in Great Britain, or was more injurious or extensive in its devastations. The next morning when the storm was abated, nothing of the light-house was to be seen, it having been totally swept away by the waves of the sea!

The single thing left was a piece of iron chain, which had got so wedged into a cleft that it stuck there till it was taken out, more than fifty years afterwards.

By all accounts this light-house was a polygonal (or many cornered) building of stone, of about a hundred feet in height, after it had received its last additions. The light-house had not long been down, when the Winchelsea, a homeward bound Virginian, was split upon the rock where that building stood, and most of the men were drowned. The great utility of the late light-house had been sufficiently evident to those for whose use it had been erected; and the loss of a large merchant vessel coming from America proved a powerful spur to such as were interested, to exert themselves for its restoration. The undertaker was a Captain Lovell, or Lovett, who took a lease of the rock for 99 years, to commence from the day that the light should be exhibited; the Captain engaged Mr. John Rudyerd to be his engineer or architect. The building was began in July, 1706; a light was up on the 28th July, 1708, and it was completely finished in 1709. The quantity of materials used in the construction, was 500 tons of stone, 1,200 tons of timber, 80 tons of iron, 35 tons of lead; of tre-nails, screws, and rock bolts, 2,500 each. Louis 14th, being at war with England during the building of this light-house, a French privateer made prisoners of the men at work upon it, and carried them, together with their tools, to France, and the captain was in expectation of a reward for the achievement. While the captives



Eddystone Lighthouse.

lay in prison, the transaction reached the ears of Louis the 14th. That monarch immediately ordered them to be released, and the captors to be put in their place, declaring, that though he was at war with England, he was not at war with mankind ; he therefore directed the men to be sent back to England, with presents, observing, that the Eddystone Lighthouse was so situated as to be of equal service to all nations having occasion to navigate the channels that divide France from England. This light-house differed much from the former one, it being composed of wood, and perfectly round. Its entire height was 92 feet. The building, notwithstanding some severe storms which it encountered, particularly one on the 26th September, 1744, stood till the 2nd of December, 1755. About two o'clock on that morning one of the three men who had the charge of it, having gone up to snuff the candles in the lantern, found the place full of smoke, from the midst of which, as soon as he opened the door, a flame burst forth. A spark, from some of the twenty four candles which were kept constantly burning, had probably ignited the wood work, or the flakes of soot hanging from the roof. The man instantly alarmed his companions; but they being in bed and asleep, it was some time before they came to his assistance. In the mean time he did his utmost to effect the extinction of the fire, by heaving water up to it (it was burning four yards above him) from a tub full which always stood in the place. The other men, when they came, brought up more water from below; but as they had to go down and return a height of 70 feet for this purpose, their endeavours were of little avail. At last a quantity of the lead on the roof having melted, came down in a torrent upon the head and shoulders of the man who remained above. He was an old man of 94, of the name of Henry Hall, but still full of strength and activity. This accident, together with the rapid increase of the fire, notwithstanding their most desperate exertions, extinguished their last hopes, and making scarcely any further efforts to arrest the progress of the destroying element, they descended before it from room to room, till they came to the lowest floor. Driven from this also, they then sought refuge in a hole or cave on the eastern side of the rock, it being fortunately by this time low water. Meanwhile the conflagration had been observed by some fishermen, who immediately returned to shore and gave information of it. Boats of course were immediately sent out. They arrived at the light-house about 10 o'clock, and with the utmost difficulty effected a landing, and the three men, who were by this time almost in a state of stupefaction, were dragged through the water into one of the boats. One of them, as soon as he was brought on shore, as if struck with some panic, took flight and was never heard of more. As for old Hall, he was placed immediately under medical care, but although he took his food tolerably well, and seemed for some time likely to recover, he always persisted in saying that the doctors would never bring him round, unless they could remove form his stomach the lead, which he maintained had run down his throat, when it fell upon him from the roof of the lantern. Nobody could believe that this notion was anything more than an imagination of the old man; but on the 12th day after the fire, having been suddenly seized with cold sweats and spasms, he expired; and when his body was opened, there was actually found in his stomach, to the coat of which it had partly adhered, a flat oval piece of lead, of the weight of seven ounces five drachms! An account of this most extraordinary case is to be found fully reported in the forty ninth volume of the Philosophical Transactions.

As there was still more than half a century of their lease unexpired, the proprietors (who by this time had become numerous) felt that it was not their interest to lose a moment in setting about the rebuilding of the light-house.

Application being made to Lord Macclesfield, at that time President of the Royal Society, he strongly recommended Mr. Smeaton, (who had recently left his business of mathematical instrument maker, and devoted his talents to engineering); so that, for the third time, this great work was undertaken by a self-educated architect. It being determined that the light-house should be built of stone, Mr. Smeaton, after several trials, selected that from the isle of Portland. His models and designs being approved by the Lords of the Admiralty, he began his operations on the 12th of June 1757, when the first stone was laid, and his workmen continued to labor as long as the weather would permit. From this time the building proceeded with regularity and dispatch, and with no other interruption than what might be expected from the nature of the work, until the 9th of October, 1759, when, after innumerble difficulties and dangers, a happy period was put to the great undertaking, without the loss of life or limb to any one concerned in it, or accident by which the work could be said to be materially retarded. During all this time there had been only four hundred and twenty-one days, comprising two thousand six hundred and seventy-four hours, which it had been possible for the men to spend upon the rock; and the whole time which they had been at work, was only one hundred and eleven days ten hours, or scarcely sixteen weeks! It now remained only to test its durability. The hard weather of 1759-60 and 1761, appeared to make no impression.

It was equally proof against the tempestuous weather which ushered in the year 1762, one storm of which was of extraordinary fury.

Smeaton's light-house has stood ever since, and promises yet to stand for many centuries. It is, as has been mentioned, of stone, and is a round building, gradually decreasing in circumference from the base up to a certain height, like the trunk of an oak, from which the architect states that he took the idea of it. On the morning after the storm had spent its chief fury, many anxious observers pointed their glasses to the spot, where they scarcely expected ever again to descern it, and a feeling almost of wonder mixed itself with joy and pride of their architect, as they, with difficulty, descried its form through the still dusk and troubled air. The light-house is attended by three men, who receive but £25 each per annum, with an occasional leave of absence in the summer. Formerly there were only two, who watched by turns every four hours; but, one being taken ill, and dying, the necessity of an additional hand became apparent. After the death of his companion, the living man found himself in a very awkward situation. Being apprehensive if he tumbled the dead body into the sea (which was the only way that he could dispose of it), he might be charged with murder, he was induced for some time to let the dead body lie, in hopes that the boat might be able to land and relieve him from the distress he was in. By degrees the body became so offensive, that it was not in his power to get quit of it without help, for it was near a month before the attending boat could effect a landing, and it was not without the greatest difficulty that it could be done, when they could land. To such a degree was the whole building filled with the stench of the corpse, that it was all they could do to throw the body into the sea. It is related, that while two light keepers only were employed, they forbore, upon some disgust, to speak to each other. A person observing to one of them, how happy they might live in their state of retirement, "Yes," replied the man, "very comfortable, if we could but have the use of our tongues, but it is now a full month since my partner and I have spoken to each other." It is also said, that a shoemaker was going out to be light-keeper; the boatman said to him, "how comes it, friend Jack, that you should choose to go out to be light-keeper, when you can on shore, as I am told, earn half a crown and three shillings a-day; whereas the light-keeper's salary is but £25 a year, which is scarcely ten shillings a-week?" "I go to be light-keeper," replied the shoemaker, "*because I don't like confinement.*"

## BELL ROCK LIGHT-HOUSE

Is situate on the reef of rocks on the eastern coast of Scotland, near Arbroath in Forfarshire. These rocks had always been particularly dangerous for shipping, and, it is said, that in ancient times the monks of the Abbey of Arbroath erected a bell, called the inchcape bell, on the rock, which was rung by machinery during the flowing and ebbing of the tide, in a manner probably similar to the ingenious one at New Channel, Liverpool. The Bell Rock light-house was begun in 1807, and completed in 1810, by Mr. Stevenson, at a cost of £60,000. The rock itself measures four hundred and twenty-seven feet in length by two hundred broad, and is about twelve feet under water at the spring tides. The light-house is a circular building, forty-two feet in diameter at the base, and thirteen feet at the top, the masonry is one hundred feet high, and, including the lightroom, is one hundred and fifteen feet; the ascent from the rock to the top of the solid or lowest story, thirty feet, used to be by means of a trap ladder, but is now by brass stairs, and to the other rooms by wooden steps. The lower courses of stones are trenailed, and wedged together with oak timber, to the height of upwards of forty feet, or throughout the solid part of the building. At the stone staircase leading from the door to the first floor, the walls are of the medium thickness of about seven feet; this thickness gradually diminishes upwards, till under the cornice of the building it extends only to eighteen inches. The stones of the walls of the several apartments are connected at the ends with dove tailed joints, instead of square joggles, as in the solid and in the staircases; the floors are constructed in a manner which adds much to the bond or union of the fabric. Instead of being arched, which would have given a tendency or pressure outwards on the walls, the floors are formed of long stones radiating from the centre of the respective apartments, and at the same time forming a course of the outward wall of the building; these floor stones are also joggled sideways, and upon the whole form a complete girth at each story. In this manner, the pressure of the floors upon the walls is rendered perpendicular, while the side joggles resemble the groove and feather in carpentry. In the stranger's room, or library, the roof takes an arched form, but the curve is cut only by the interior ends of the stones of the cornice, the several courses of which it is composed being all laid upon level beds; the stones used in this surprising structure, weighed from half a ton to two tons each. There are six distinct rooms; in the lowest is the fuel and water tanks, the second contains oil cisterns, the third is used as a kitchen, the fourth is a bed room, the fifth is the library, and the sixth (which is entirely formed of iron) contains the lights.

The light is from oil, with argand burners placed on the faces of silver plated reflectors, hollowed with extraordinary accuracy to the parabolic curve, simply by the process of hammering; these reflectors measure 24 inches over the lips, and the light is so powerful that it can be readily seen at the distance of 7 leagues, in fair weather. The Bell-rock light may be easily distinguished from all others, by its showing a natural or common bright light, alternately with a red coloured light. Two men constantly reside in the building, and a third is stationed on a high tower at Arbroath, and holds communications with the lighthouse by means of signals. As the light in foggy weather is not visible at any considerable distance, two large bells are hung in the building, and kept constantly ringing at those times. These bells, each weighing about 12 cwt., are tolled by the same machinery which moves the lights.

To give some idea of the force which this light-house has to withstand, it is only necessary to quote a passage from Mr. Stephenson himself. "It is awfully grand, at the time of high water, to observe the sprays rising on the building, and even to be on the rock at low water, when the waves are about to break. Being, in a manner, only a few yards distant, they approach as if they were about to overwhelm us altogether. But now that we are accustomed to such scenes, we think little of it. You will perhaps form a better idea of the force of the sea during these gales, when I relate to you, that on 15th February, a large piece of lead that was used as a back weight of the balance crane, weighing 4 cwt. 3 quarters 17lbs., or nearly a quarter of a ton, was fairly lifted by the sea, and carried a distance of six feet from the hole on which it had laid since the month of August. It was found turned round with the ring bolt downwards, and it was with great difficulty that four of us could muster strength enough to return it to its former shelf on the rock."

There is a legend connected with the Inchcape Bell, which most veritably describeth, that once "a bloodie and remorsefull Pyrate" did, in drunken frolic, steal from the "goode Abbotte" his warning Bell; and for which "greate sinne" his vessel was afterwards driven on these rocks, and all on board perished:—all of which is duly set forth in a "righte dolefull" ballad.

## HISTORY OF LIGHT HOUSES.

The most celebrated light-house of ancient times was that erected about 283, B. C., in the reign of Ptolemy Philadelphus, on the island of Pharos, opposite to Alexandria. It is from this building, or rather from the island on which it stood, that light-houses have in many countries received their generic name of Pharos; the most celebrated of modern times are those already described. The erection of light-houses in this country has not proceeded upon any systematic plan, but in every instance they have been constructed simply because of the disastrous losses that have occurred for want of them. From this cause it arises that our light-house establishments in the several parts of the United Kingdom are conducted under an entirely different system, different as regards the constitution of the management, the rates or amounts of the light dues, and the principle on which they are levied. In England there are now 44 light-houses, and 13 floating lights, which are considered as general lights, besides 46 light-houses and 4 floating lights, which are local or harbour lights, making in all 107 lights. Of the general lights, 30 light-houses, and the whole of the floating lights (13 in number), are under the management of the Trinity House, three are in private hands under leases granted by the same board, seven are in private hands under leases granted by the crown, and the remaining four are held by patents or by acts of Parliament. In Scotland there are 25 light-houses under the management of the Board of Commissioners for northern lights, besides 18 local or harbour lights. In Ireland there are 24 light-houses and three floating lights, which are all general lights, 76 light-houses and four floating lights, which are harbour lights, being in the whole 168 light-houses and 20 floating lights, constantly maintained on the coasts, and at the entrances of the harbours of these kingdoms. A principal object in the establishment of these buildings is, to give intimation to vessels approaching the coast during the night, as to the place in which they are. It is therefore of importance, that the lights exhibited on the same line of coast should have some essential difference, so as to be readily distinguished by the mariners. The different appearances thus required are given by having two lights placed either *vertically* or *horizontally* with respect to each other, or three lights, as at the Casket rocks, or by causing the lights to revolve or to appear only at certain intervals, and to remain in sight for a given number of seconds at each appearance, or by the employment of lamps of different colours, as in some of the harbour lights which do not require to be seen at a great distance.

The mode of lighting now generally used in this country is that of placing an argand burner in the focus of a parabolic reflector. This instrument is made of silver strengthened with copper, and is about three or four inches in focal length, and 21 inches in diameter. The number and arrangement of reflectors in each light-house depend upon the light being fixed or revolving, and upon other circumstances connected with the situation and importance of the light-house. The mode in use in the light-houses of France consists in placing a large argand lamp, having four concentric wicks, and giving a very powerful light in the centre of the upper part of the building, and placing around the lamp a series of glass lenses of a peculiar construction; thus rising a refracting, instead of a reflecting instrument, to collect the light, and only one lamp instead of a greater number. The lens employed is about 30 inches square, plano-convex, and formed of separate rings or zones, whose common surfaces preserve nearly the same curvature as if they constituted portions of one complete lens, the interior and useless part of the glass being removed. To form a lens of such magnitude out of one piece of glass would be hardly possible, and, if it were possible, the necessary thickness of the glass would greatly obstruct the light; the merit of the invention consists in building it of separate rings. The light thus obtained is found by experiment to be equal to that afforded by nine common reflectors, and it is calculated that by a consumption of oil equal to that of 17 common argand lamps with reflectors, an effect is produced equal to that of 30 lamps and reflectors. There is this further advantage in the French over the English apparatus, that in the English light-house of equal illuminating power with the French, there would be daily employment in trimming 30 lamps and cleaning an equal number of reflectors, which having a very delicate silver surface, require much care and attention, while in the French light-house there is only one lamp to trim, and the lenses being of glass require little or no labour to keep them bright; on the other hand, these dioptric lights have not the wide dispersive range which is so necessary in *fixed* lights. On the northern and western coasts of France there are 80 excellent lights, and the Dutch have 20 lights on their sea coasts and in the Zuyder Zee. The rates of light duty charged to vessels passing within certain limits vary considerably in respect of different lights: for some of those which are under the management of the Trinity House, as little as a farthing per ton is charged on British, and a half-penny per ton on foreign vessels, while for other lights the rates are as high as a penny and twopence per ton upon British and foreign ships respectively. The ships belonging to countries with which we have treaties of reciprocity, are entitled to admission to our ports on the same terms as English vessels, and accordingly pay no higher rate of duties. The Trinity House has relinquished, in those cases, the right to any increased charge, but in the case of those light-houses which are held by private individuals, the difference is made good to those parties out of the customs revenues.

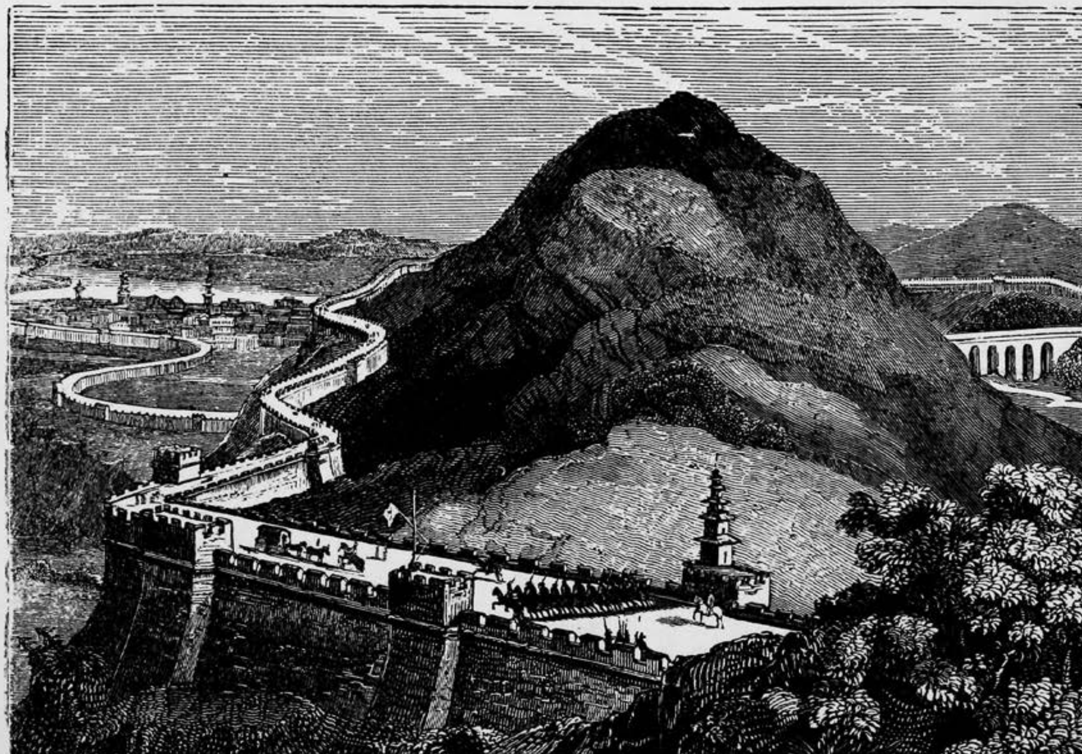
Light dues are collected not only upon ships frequenting our ports for commerce, but such also as are driven in by stress of weather, or if they come within sight of our light-houses in their voyage from one port to another: this is most unjust, and has been greatly complained of by foreigners.

## THE LONGSTONE LIGHT-HOUSE.

This is situate near the group of barren rocks, called Fern Islands, on the coast of Northumberland. It is only an ordinary light-house, but has excited much attention of late, and acquired a time-enduring celebrity as being the scene of the heroic efforts of Grace Darling and her gallant father, in rescuing part of the passengers and crew (nine in number) out of 53 persons, from the wreck of the Forfarshire Steam Packet, on the 17th September, 1838. No eulogy, however brilliant, can add to the glory of this gallant achievement, performed as it was under the frightful dangers of a most tremendous storm.

## EXTRAORDINARY LABYRINTH OF ROCKS, IN SILESIA.

"From Trautenau, I proceeded," says a recent traveller, in his interesting tour in 1836, "to visit Andersbach, the famous labyrinth of rocks—a natural phenomenon I believe unique of its kind, at least for magnitude and extent, being upwards of four leagues in length and two in breadth. That in Westphalia, called Exteretein, so celebrated by travellers, and which I had seen some years before, is a mere baby's toy compared with this. In short, the only freak of Nature that I ever saw at all comparable to it, is that in Upper Styria, called Johnsbackerthal. These rocks are entirely composed of sandstone, and form a part of the same sandstone ridge, which runs through the province of Glatz on one side, and through Saxon Switzerland towards Dresden on the other. Among the various theories that have been advanced to explain this



Great Wall of China.

phenomenon, it has been asserted that the water had gradually washed away the softer parts of the rock; but most travellers with whom I have conversed upon the subject, could not reconcile this with the sharp angular edges of the rocks, and felt more inclined to refer it to some instantaneons convulsion of nature that had shivered to pieces a vast mountain.

On a near approach the traveller might rashly fancy he was beholding a city of gigantic architecture in ruins, for we can literally walk through its interior, as we would in the squares and streets of a town, and it hardly requires a stretch of the imagination to say that we see dismantled towers, triumphal arches, dilapidated fortifications, &c. Tradition has baptized many of these masses of rock with the most fanciful appellations: here we have the statues of burgomasters and soldiers, there friars and nuns, and in another place the emperor's throne, and, singular enough, he road that leads to it is over the devil's bridge. One of the loftiest of these rocks, termed the watch tower, is, I should think, between four and five hundred feet high, but its circumference is not more than that of the object from which it borrows its appellation. Another of nearly equal altitude, which goes under the name of the Zucker hut (sugar loaf), is in form an inverted cone, and being isolated and at some distance from all the rest, has a most singular appearance.

## THE GREAT WALL OF CHINA.

THIS has ever been considered one of the world's wonders, although considerable doubts have been entertained of the greatness and extent which some writers have invested it, and perhaps the extreme jealousy of the Chinese to allow foreigners to go beyond certain limits, has thrown around it a mystery; and hence, the many exaggerated accounts which have reached us of its vastness. Father Gerbillon, the Missionary, who passed through (according to his own account) most of its principal gates, and saw more of it than any other European, describes it as "one of the most surprising and extraordinary works in the world; yet it cannot be denied, that those travellers who have mentioned it, have over magnified it, imagining, no doubt, that it was in the whole extent the same as they saw in the parts nearest Pekin, or at certain of the most important passes, where it is indeed very strong and well built, as also very high and thick." According to this authority, from the Eastern Ocean to the frontiers of the province of Chan-si, or for the distance of 200 leagues, it is generally built of stone and brick, with strong square towers, sufficiently near for mutual defence, and having besides, at every important pass, a formidable and well built fortress. In many places in this line and extent, the wall is double and even tripple. But from the entrance of the province of Chan-si, to its eastern extremity, the wall is nothing but a terrace of earth, in many places so much obliterated that the missionary could cross and recross it on horseback. There are numerous towers on this part of the wall, but they, too, are chiefly built of earth. The wall is in many places carried over the tops of the highest and most rugged rocks. Near every one of the gates, Father Gerbillon found a town or large village. Other writers describe, that near one of the principal gates which opens on the road towards India is situated Siningfu, a city of prodigious extent and population. Here the wall is said to be so broad at the top, " that six horsemen, placed abreast, might run a race along it without inconvenience to one another." The esplanade on the top of the wall is much frequented by the citizens of Siningfu, the prospect from it is exceeding pleasant, and the stairs which give ascent to the walls are broad and convenient; they add, that from this city to that of Sucien it is 18 days journey on the wall!

The great wall, which has now, even in its best parts, numerous breaches, is made of two walls of brick and masonry, not above a foot and a half in thickness, and generally many feet a part; the interval between them is filled up with earth, making the whole appear like solid masonry and brickwork; for six or seven feet from the earth these encasing walls are built of large square stones, the rest is of brick, the mortar used in which is of excellent quality. The wall itself averages about twenty feet in height, but the towers, which are distributed along it, are seldom less than forty feet high. At their base, these towers are fifteen feet square, but they gradually diminish as they ascend; both walls and towers have battlements. There are inclined planes as well as stairs to ascend to the top. The rapidity with which this work was completed is as astonishing as the wall itself (it is calculated as being 1,500 miles in length), the whole is said to have been done in five years, by many million of labourers, the Emperor impressing three men out of every ten throughout his dominions, for its execution. It was finished 205 years before the birth of Christ; the period of its completion is an historical fact, as authentic as any of those which the annals of ancient kingdoms have transmitted to posterity: it was built to defend the Empire from the incursions of the Tartars. The contrast between the country within the wall and the wilds without is described as being at certain points most striking; looking down from the battlements and towers which frequently fringed the loftiest rocks, on one side was to be seen a cultivated expanse covered with numberless habitations, and on the other all the wildness of the desert, that seemed never to have been trod by human footsteps, but abounded with all sorts of wild beasts. The view from the wall itself must be equally imposing as it traverses one vast plain after another, and strides over lofty mountains—its numerous towers here entire, and there falling into ruins, the sides of the walls here free and open, there overgrown with creeping plants and garlanded with hardy trees, that shoot from their interstices, or that spring from their base; the whole, to appearance, stretching out as if it were to girdle th globe, or as if it had no end.

## THE FIRE DAMP.

This is the most frightful accident to which coal mines are exposed; it is the most frequent, and by far the most calamitous, and is thus caused:—All coal, even in the charcoal-like variety, called Anthracite, appears to contain in its natural state, while underground, a considerable quantity of free uncombined gas, which it parts with when exposed to the air, or when it is relieved from great superincumbent pressure. The gas is evolved from the coal in great quantity at the ordinary temperature of the mines; and instances have been known of explosions on board ships laden with fresh worked coals. Coals lying deep give out more gas than those near the surface, because there are openings at the top by which it escapes; but in the deep mines it cannot have such an outlet, and therefore it accumulates in all the fissures of the stone above the coal; and this sort of natural distillation is constantly going on. The fissures of the roof are in some places very great, and there are sometimes miles of communication from one fissure to another: they may be considered as natural gasometers, and having no outlet, and as the process of distillation is constantly going on, the gas becomes accumulated in them in a very highly condensed state, the degree of condensation depending on the thickness of the surrounding rock and quantity poured in. In the course of pursuing the workings, the miners sometimes cut across one of these fissures, or approach so near to it, that the intervening rock becomes too weak to resist the elastic force of the compressed gas; it gives way, and then, in either case, the gas rushes out with immense force. These *blowers*, as they are called, emit sometimes as much as seven hundred hogsheads of gas in a minute, and continue in a state of activity for months together. It has been found that an uniform current of gas existed for two years and a half in one of the mines. This gas, in the state in which it issues from the coal, burns with a bright flame like ordinary gas, but when united with a certain portion of atmospheric air, the mixture becomes explosive, *i. e.*, the whole volume of air, upon the approach of a flame, suddenly catches fire, and goes off like gunpowder, with a tremendous explosion. The frightful consequences of these explosions have been greatly lessened, and would, with care, be prevented altogether, by the constant use of Sir Humphry Davy's

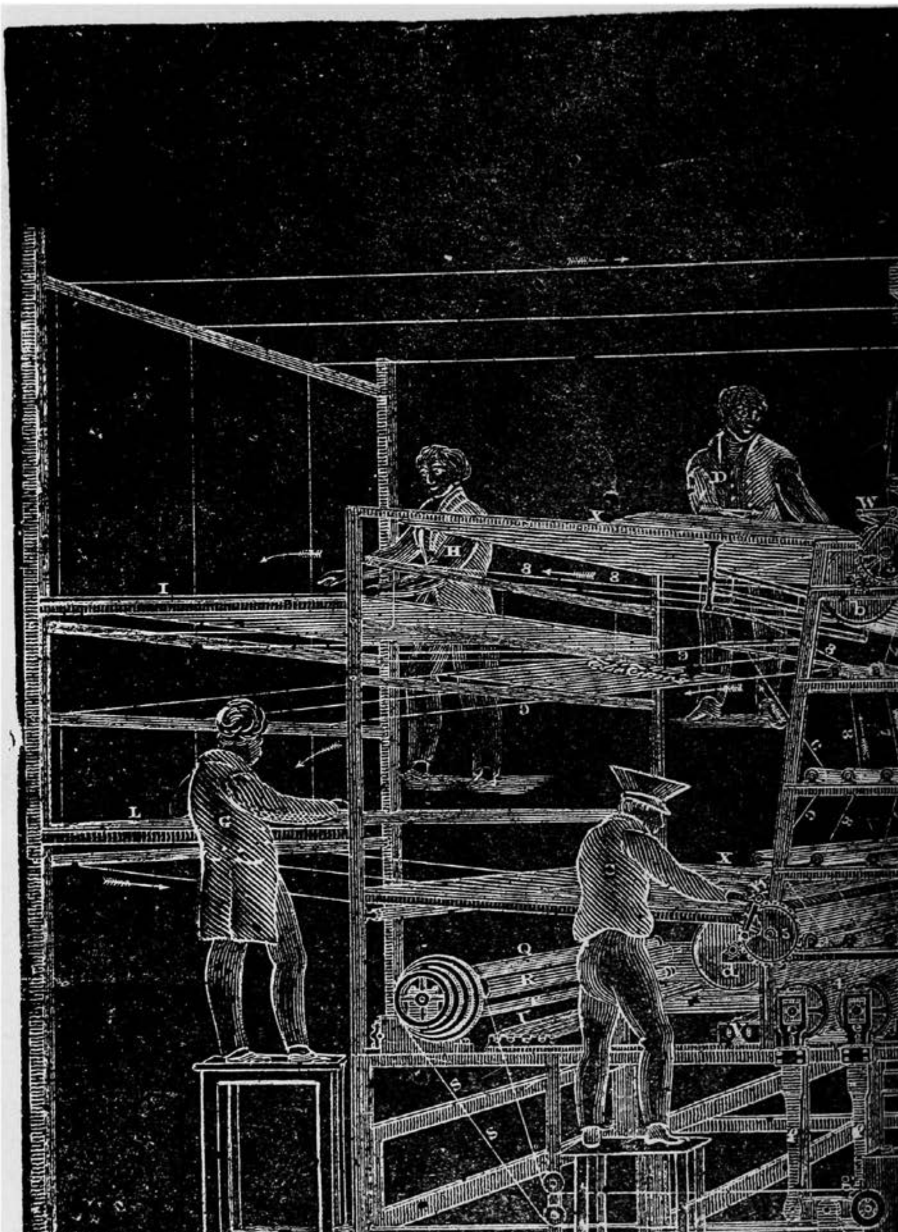
SAFETY LAMP.

That eminent man, by numberless experiments on the nature of fire damp, and on the proportions with which it must be mixed with the air of the atmosphere to be explosive, found that in respect of combustibility, the fire damp differs most materially from the other common inflammable gases, inasmuch as it requires a far higher temperature before it can be set on fire; an iron rod at the highest degree of red heat, and at the common degree of white heat, did not inflame explosive mixtures of the fire damp, and an explosion only took place when a flame was applied. He also made the important discovery, that flame will not pass through a tube with a small bore; and guided by this principle, he was led through a train of ingenious experiments to the construction of a lamp, which has saved already hundreds of lives, and whose value is inestimable. It is very simple in its construction. It is a lamp in which oil is burned, and there is a small bent wire, moved by passing through a hole in the bottom, for trimming the wick. There is also a cover of fine wire gauze, which is fastened upon the lamp, and generally locked to prevent the miners taking it off, and this cover is strengthened by upright wires twisted at the top to receive a ring for carrying the lamp. When the lamp is carried into a part of the mine which is highly charged with fire damp, the flame of the wick begins to enlarge, and the air, if it contain so much inflammable gas as to be highly explosive, takes fire as soon as it has passed through the gauze, and then burning within the lamp extinguishes the flame of the wick, by cutting off all communication with the pure air of the atmosphere. Whenever this appearance is observed, the miner must instantly withdraw, for although the flaming gas within the lamp cannot pass through the gauze so as to set fire to the explosive mixture outside, it makes the wire gauze so hot that it would very speedily be wasted, and a hole large enough to let the flame come out would be burned.

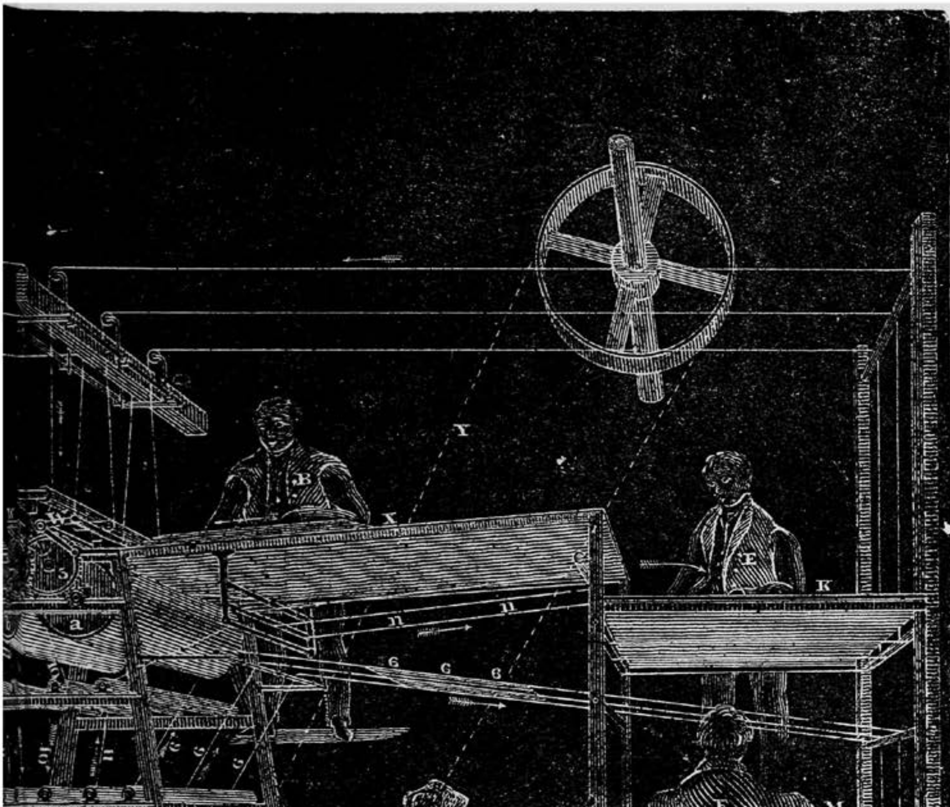
The Autumn of 1815 is rendered memorable by the discovery of this lamp, one of the most beneficial applications of science to economical purposes ever invented. "Davy," says his biographer, "was led to the consideration of this subject by an application from Dr. Gray, now Bishop of Bristol, the Chairman of a Society established in 1813, at Bishop Wearmouth, to consider and promote the means of preventing accidents by fire in coal pits. Being then in Scotland, he visited the mines on his return southward, and was supplied with specimens of fire damp, which, on reaching London, he proceeded to analyze. He soon discovered that the carburetted hydrogen gas, called 'fire damp' by the miners, would not explode when mixed with less than six, or more than fourteen times its volume of air; and further, that the explosive mixture could not be fired in tubes of small diameters and proportionate lengths. Gradually diminishing these, he arrived at the conclusion that a tissue of wire, in which the meshes do not exceed a certain small diameter, which may be considered as the ultimate limit of a series of small tubes, impervious to the inflamed air, and that a lamp covered with such tissue may be used with perfect safety even in an explosive mixture, which takes fire and burns within the cage, securely cut off from the power of doing harm. Thus, when the atmosphere is so impure that the flame of the lamp itself cannot be maintained, 'the Davy' still supplies light to the miner, and turns his worst enemy into an obedient servant". This invention, the certain source of large profit, he presented with characteristic liberality to the public. The words are preserved, in which, when pressed to secure to himself the benefit of it by patent, he declined to do so, in conformity with the high-minded resolution which he formed upon acquiring independent wealth, of never making his scientific eminence subservient to gain. "I have enough for all my views and purposes, more wealth might be troublesome, and distract my attention from those pursuits in which I delight. More wealth could not increase my fame or my happiness. It might, undoubtedly, enable me to put four horses to my carriage; but what would it avail me, to have it said, that Sir Humphrey drives his carriage and four?" And such was the man—the philosopher—whose monument we look for in vain at Westminster Abbey, because his widow would not submit to "Priestly extortion!"

## THE TIMES NEWSPAPER.

"The establishment of the 'Times Newspaper,'" says Mr. Babbage (Economy of Machinery and Manufactures, C. Knight, London, 1832), "is an example, on a large scale, of a manufactory in which the division of labor, both mental and bodily is admirably illustrated, and in which also the effect of domestic economy is well exemplified. It is scarcely imagined by the thousands who read that paper in various quarters of the globe, what a scene of organized activity the factory presents during the whole night, or what a quantity of talent and mechanical skill is put in action for their amusement, and information. Nearly a hundred persons are employed in this establishment, and during the sessions of parliament twelve reporters are constantly attending the Houses of Commons and Lords, each, in his turn, after about an hour's work, returning to translate into ordinary writing the speech he has just heard and noted in short hand. In the mean time, fifty compositors are constantly at work, some of whom have already set up the beginning, whilst others are committing to type the yet undried manuscript of the continuation of a speech, whose middle portion is travelling to the office in the pocket of the hasty reporter, and whose eloquent conclusion is, perhaps, at that very moment making the walls of St. Stephen's vibrate with the applause of its hearers. These congregated types as fast as they they are composed, are passed in portions to other hands, till at last the scattered fragments of the debate, forming, when united with the ordinary matter, eight and forty columns, re-appear in regular order on the platform of the printing press. The hand of man is now too slow for the demands of his curiosity, but the power of steam comes to his assistance; ink is rapidly supplied to the moving types by the most perfect mechanism, four attendants incessantly introduce the edges of large sheets of white paper to the junction of two great rollers, which seem to devour them with unsatiated appetite, other rollers convey them to the type already inked, and having brought them into rapid and successive contact, re-deliver them to four other assistants, completely printed, by the almost momentary touch. Thus, in one hour 4,000 sheets of paper are printed on one side, and an impression of 12,000 copies from above 300,000 moveable pieces of metal, is produced for the public in six hours."




"TIMES" PRINTI



ING MACHINE.

## THE TIMES PRINTING MACHINE.

### MECHANICAL EXPLANATION.

This machine is calculated to print 4,000 impressions per hour; and when the steam engine is driven with greater velocity than usual, it will throw off 200 or 300 more per hour. To work it, it is necessary to employ four men, A, B, C, D, to lay the paper on the *drums*, *a*, *b*, *c*, *d*, and four boys, E, F, G, H, to receive it at the fly boards, I, K, L, M, after having received the impression. It has four printing cylinders of cast iron, 1, 2, 3, 4, turned perfectly parallel, which are cloathed all round with a covering of flannel wove for that purpose. These cylinders revolve upon spindles in carriages, *e*, *e*, *e*, *e*, which are connected at the lower part of the frame to scale-beam leavers, *f*, *f*, *f*, *f*; they are alternately raised and lowered by an eccentric working in one end of the beams, to press; and, to avoid the form, these carriages are fitted with the greatest care into recesses left in the side frames, and are so made, that a portion of them can be removed when it is required to renew the cylinder cloths, without deranging any other part of the machinery. They receive motion from two intermediate wheels, *g*,*g*, contained in the square box, *h*, working in the driving pinion, Z, six revolutions of which are necessary to produce four sheets; therefore, to print 4,000 per hour, the driving spindle must revolve 6,000 times in the hour, or 100 times per minute. This spindle is driven by a pulley and leather strap from the steam engine, Y, Z. The wheels upon the ends of the two outer printing cylinders, 1, 4, give motion to the two lower, laying on drums, *c*, *d*, and by the spindle N, and the conical or level wheels, which are behind the machine, put in motion the two top drums, *a*, *b*. The side frames of this machine are about fourteen feet in length, and two feet six inches in height to the level of the moving table. They are fitted with great accuracy together, and made parallel, having internal projecting flanches, and likewise rollers, upon which the printing table (carrying the two inking tables and form) moves backwards and forwards, which alternate motion it receives from an endless rack and pinion; the rack is attached to the under side of the printing table, and the pinion is a fixture in the centre of the frame of the machine, and receives its motion by a pair of bevel wheels from the driving spindle. The rack is made with a parallel motion, by which means it is moved from one side to the other of the pinion. It has two radius bars, *a*, *a*, the ends of which are fixed to the moving table, containing the form of type and inking tables; there is a centre transverse bar, *b*, *b*, which unites them, and at the other ends there are two parallel guide rods, *c*, *c*, which connect the rack.

At each end of the moving table there are smooth surfaces which are called *inking-tables*, one of which is shown in the engraving, O, the other being under the middle inking-rollers; and in the centre is placed the type or form, P; at each end of the side frames are two troughs, Q, Q, which contain ink; these, when filled, will hold a sufficient quantity for the working off 6,000 impressions; in each trough, there is an iron roller, R, called the doctor, which is kept continually revolving by a cat-gut band, S, S, over pulleys, while the machine is at work; underneath this roller there is another roller called the vibrating roller, T, which is worked by an eccentric motion, and is made to receive the ink from the doctor, R, and then to fall upon the inking table, O, at each termination of its stroke; by this means the ink is laid upon the table, and is afterwards equally distributed over the surface by four distributing rollers, U, U, at each end placed in an angular direction across the frame, which gives them a transverse motion over the table, and so the ink is regularly laid over the surface, and is prepared for the inking rollers, V, V, V, receiving it, two of which are on the outside of the printing cylinders, and two in the centre; these rollers have a small guide wheel at each end, upon which they revolve; they are made of iron, and are covered (as well as the distributing and vibrating rollers) with a coating of composition, made by certain proportions of glue and treacle; these rollers lay the ink upon the type previous to the printing rollers pressing upon it to give the impression.

On the ends of the spindles of the lying-on drums, *a*, *b*, *c*, *d*, there are small pinions, which work on what are called shape wheels, 5, 5, 5, 5; on the face of each of these wheels there is a plate that has a part of its circumference removed, as shown in the engraving; upon the outside of this cam or plate, are placed the ends of the laying-on levers, W, W, W, W, the height of which causes them to fall into the recess in the plate, and so depresses the outer end, which is kept revolving by a gut band, and has four brass pulleys, toothed, that touch the paper on the laying-on boards, X, X, X, X, and gradually draw it round the drums, *a*, *b*, *c*, *d*. The paper is kept in its proper position by a double set of tapes, which conveys it over the rollers in a zigzag direction to and from the printing cylinder, the direction of which is shewn by the arrows in the Engraving.

The Devil's Bridge, near Aberystwith.

The Rock Bridge of Virginia.

## GENERAL DESCRIPTION.

The whole machine is set in motion by the leather strap, Y, connecting with the steam engine and spindle wheel, Z. The operation of printing commences by the laying-on man, A, placing the paper for the levers and rollers, W, which revolving and falling upon the paper, instantaneously draw it through the tapes round the drum, C, and then round the cylinder, No. 1, where the *form of type*, P, inked by passing under the right hand inking rollers, V, is ready to receive it, and by the pressure ofthe cylinder, No. 1, the paper receives the impression, passes up through the tapes, 6, 6, 6, 6, and is at lengh received at the fly board, M, by the boy, F. Meantime, the form, deprived of its ink, passes rapidly on under the second cylinder, No 2, which is lifted up with its carriage, *e*, by the eccentric motion of the lever, *f*, to permit the form to pass, which is again inked by the two middle rollers, V, (which had been supplied by the left-hand inking table) and is then ready for the sheet, supplied by the laying-on man, D, and taken by the circulating rollers through the tapes, round the drum, *b*, and down through the tapes, 7, 7, 7, and under the cylinder, No. 3, where it meets the form, receives the impression, and passes up through the tapes, 8, 8, 8, 8, on to the taking-off broard, I, where it is received by the boy, H; the form, again deprived of its ink, the cylinder, 4, is now raised to permit it to pass, when by the eccentric motion of the rack underneath, it moves back again, receives the ink from the left-hand inking rollers, V, and it again passes under the cylinder, No. 4, when the sheet laid on by the man, C, passing round the drum, *d*, meets it, receives the impression, and is carried up through the tapes, 9, 9, 9, and is delivered to the boy, G, at the fly-board, L; and the form again deprived of its ink, the cylinder, No. 3, is now raised by the lever, *f*, the form passes under, is again inked by the middle roller, V, passes under the cylinder, No. 2, where the sheet, supplied by the man, B, passing round the drum, A, and down through the tapes, 10, 10, 10, meets it, receives the impression, and passes round, up through the tapes, 11, 11, 11, is received at the fly-board, K, by the boy, E; thus the printing-table, traversing the carriage with the greatest rapidity, throws off two impressions in its passage each way.

## PAPYRUS.

The first manufactured paper of which we have any record, is the celebrated papyrus, made of a species of reed growing in Egypt, on the banks of the Nile. According to a passage in Lucan, which is likewise corroborated by other authorities, this paper was first manufactured at Memphis, but it has been a subject of great controversy to fix the exact date of its invention.

There is no doubt, however, but that it formed, at a very early period, a considerable branch of commerce to the Egyptians, and was one of the manufactures carried on at Alexandria. It obtained an increasing importance among the Romans as literature became more valued and diffused; in the Augustan age it grew into most extensive demand. We are told, that a popular revolt took place in the reign of Tiberius, from the scarcity of this valuable article. The commerce in papyrus continued to flourish for a long period, from the supply being unequal to the demand. Its value is said to have been so great at the end of the third century, that when Firmus, a rich and ambitious merchant, striving at empire, conquered for a brief period the city of Alexandria, he boasted that he had seized as much paper and size as would support his whole army!

Papyrus was much used by St. Jerome, who wrote at the latter end of the fourth century. As an article of much importance in commerce it was made largely to contribute to the coffers of the Roman empire, and fiscal duties were laid upon it by successive rulers until they became oppressive. These were abolished by Theodoric at the end of the fifth or the beginning of the sixth century, this "gracious act," as Cassidorus calls it, procured for him high praise. The exact period when this description of paper fell into disuse, is equally a matter of doubt and controversy as its introduction; with some, it is said to be in the fifth, and others as late as the eleventh century. The real date may be considered as in the seventh century, when the Saracens became masters of Egypt; and the commerce between the Egyptians and Rome was interrupted. From this period it is found that all public records are upon parchment instead of papyrus. Pliny, in his Natural History, gives an accurate description of the plant, and Bruce also describes the process of making the papyrus, which was done in his own presence. The roots of the plants are tortuous, the stem triangular, rising to the height of twenty feet, tapering gradually towards the extremity, which is surmounted by a flowing plume; paper was prepared from the inner bark of the stem, by dividing it with a kind of needle into thin plates or pellicles, each of them as large as the plant would admit. Of these strata the sheets of paper were composed; the pellicles in the centre were considered as the best, and each plate diminished in value according as it receded from that part. After being thus separated from the reed, the pieces, trimmed and cut smooth at the sides, that they might the better meet together, were extended close to and touching each other on a table; upon these other pieces were placed at right angles. In this state the whole was moistened with the water of the Nile, and while wet was subjected to pressure, being afterwards exposed to the rays of the sun. It was generally supposed that the muddy waters of the Nile possessed a glutinous property, which caused the adhesion to each other of these strips of papyrus. Bruce, however, affirms that there was no foundation for this supposition, and that the turbid fluid has in reality no adhesive quality. On the contrary, he found that the water of this river was, of all others, the most improper for the purpose, until, by the subsidence of the fecula, it was entirely divested of the earthy particles it had gathered in its course. This traveller made several pieces of papyrus paper, both in Abyssinia and in Egypt, and fully ascertained that the saccharine juice, with which the plant is replete, causes the adhesion of the parts together, the water being only of use to promote the solution of this juice, and its equal diffusion over the whole. When there was not enough juice in the plant, or when the water failed to dissolve it sufficiently, the strips were united with paste made of the finest wheaten flour, made with hot water and a small proportion of vinegar: after being dried and pressed, the paper was then beaten with a mallet, by which means it was still farther smoothed and flattened. Paper, thus made, was esteemed according to its strength and whiteness. Sufficient evidence of the abundant use of papyrus is to be found in the fact, that nearly 1,800 manuscripts written on paper of this description, have been discovered in the ruins of Herculaneum.

Paper made of cotton entirely superseded the papyrus in the course of time, as being much more durable, and better calculated for all the purposes to which paper is ordinarily applied. This new substance was called *charta bombycina.* It cannot be exactly ascertained when this manufacture was first introduced. Montfaucon fixes the time at the end of the ninth or early in the tenth century, a period when the scarcity of parchment, and the failure in the supply of papyrus, called forth the powers of invention to supply an adequate substitute. It was about this time, that the dearth of writing materials induced the Greeks to pursue the almost sacrilegious practice of erasing the valuable writings of ancient authors, that they might obtain the parchment on which these were inscribed. The more abundant manufacture of cotton paper, though not before the destruction of much that was excellent, happily prevented a still more extensive destruction. Many proofs are afforded, that in the beginning of the twelfth century cotton paper was commonly used in the eastern empire for books and writings; but it was not deemed sufficiently durable for important documents, for which purpose parchment was still employed. The manufacture of this kind of paper has been a flourishing branch of industry in the Levant for many centuries, and is carried on with great success even to the present time. The paper produced from cotton is very white, strong, and of a fine grain, but not so well adapted for writing upon as the paper which is now used. Much ingenuity must have been exercised to reduce the cotton to a pulpy substance, and ultimately render it suitable to the purpose of writing.

After this invention the use of linen rags quickly followed, and their superiority being manifest, cotton was wholly laid aside.

## INVENTION OF PAPER.

There is no country which has not had its learned and elaborate inquiries, as to the means through which Europe became acquainted, some time about the eleventh century with the article of paper. Casiri, however, whilst employed in translating Arabic writers, has discovered the real place from which paper came. It has been known in China, where its constituent part is silk, from time immemorial. In the thirtieth year of the Hegira (in the middle of the seventh century), a manufactory of similar paper was established at Samarcand, and in 706, fifty-eight years afterwards, one Youzef Amrû, of Mecca, discovered the art of making it with cotton, an article more commonly used in Arabia than silk. This is clearly proved by the following passages from Muhamad Al Gazeli's De Arabicarum Antiquitatum Eruditione. "In the ninety-eighth year of the Hegira," says he, "a certain Joseph Amrû first of all invented paper in the city of Mecca, and taught the Arabs the use of it." And as an additional proof that the Arabians, and not the Greeks of the lower empire, as it has been long affirmed, were the first inventors of cotton paper, it may be observed, that a Greek of great learning, whom Montfaucon, mentions as having been employed in forming a catalogue of the old MSS. in the King's Library, at Paris in the reign of Henry the Second, always calls the article "*Damascus paper*." The subsequent invention of paper made from *hemp* or *flax*, has given rise to equal controversy; Maffei and Tiraboschi have claimed the honor on behalf of Italy, and Scaliger and Meumann for Germany; but none of these writers adduce any instance of its use anterior to the 14th century. By far the oldest in France is a letter from Joinville to St. Louis, which was written a short time before the decease of that monarch, in 1270. Examples of the use of modern paper in Spain date from a century before that time, and it may be sufficient to quote from the numerous instances cited by Don Gregorio Mayans, a treaty of peace concluded between Alfonso the 2nd of Aragon and Alfonso the 9th of Castille, which is preserved in the archives at Barcelona, and bears date in the year 1178; to this we may add, the *fueros* (privileges) granted to Valencia by James the Conqueror, in 1251. The paper in question came from the Arabs, who, on their arrival in Spain, where both silk and cotton were equally rare, made it of hemp and flax. Their first manufactories were established at Xativa, the San Felipi of the present day, a town of high repute in ancient times, as Pliny and Strabo report, for its fabrication of cloth. Edrisi observes, when speaking of Xativa, "Excellent and incomparable paper is likewise made here."

Valencia too, the plains of which produce an abundance of flax, possessed manufactories a short time afterwards; and Catalonia was not long in following the example. Indeed, the two latter places at this moment furnish the best paper in Spain. The use of the article made from flax did not reach Castille, until the reign of Alphonso the Xth, in the middle of the thirteenth century, and thence, it cannot be questioned, it spread to France, and afterwards to Italy, England and Germany. The Arabic MSS., which are of much older date than the Spanish, were most of them written on satin paper, and embellished with a quantity of ornamental work, painted in such gay and resplendent colors that the reader might behold his face reflected as if from a mirror.

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## MATERIALS FOR PAPER MAKING.

The rags of our own country do not furnish a fifth part of what we consume in the manufacture of paper. France, Holland, and Belgium, prohibit under heavy penalties the exportation of rags, because they require them for their own long established manufactories. Spain and Portugal also prohibit their exportation. Italy and Germany furnish the principal supplies of linen rags, both to Great Britain and the United States. They are exported from Bremen, Hamburg, Ancona, Leghorn, Messina, Palermo, and Trieste. The rags of our own country are generally pretty clean, and require little washing and no bleaching before they are ground into pulp; those from Sicily are so dirty, that they are washed in lime before they are fit for exportation, and those from the north of Europe are so dark in the color, and so coarse in their texture, that it is difficult to believe that they could ever have formed part of under garments. Many experiments have been made upon substances, proposed as substitutes for rags in the manufacture of paper. The bark of the willow, the beech, the aspen, the hawthorn, and the lime, have been made into tolerable paper; the tendrils of the vine, and the stalks of the nettle, the mallow and the thistle, have also been tried; the bine of English hops, it is said, will furnish paper enough for our consumption, and several patents have been taken out. Straw also has been used, and the late Mr. Cobbett had some made from the straw of Indian Maize.

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## MANUFACTURE OF PAPER BY MACHINES

Has nearly superseded the making of it by hand. It is exceedingly difficult, without wood cuts or diagrams, to explain this beautiful process, brought as it is, by various recent improvements, to the highest state of perfection; and it is scarcely possible to conceive (without personal inspection), the wonderful celerity with which the most filthy old shreds are transformed, by these machines, into the purest white paper.

*Sorting and cutting the rags.*—This is done by women over a wire frame, through which the dirt falls; the pieces of rag, according to their fineness, are put into different compartments of a box, first being cut into the size of three or four inches square, by the blade of a long knife set upright upon a table. A good hand can cut and sort about a hundred weight a day; the rags are then weighed and taken to the

*Washing Shed.*—Here they are put into chests, and by the introduction of steam power are washed, torn and beaten; and if very dirty, they are boiled. The water being run off by pipes, the mass is removed to the *press* for the purpose of driving out the water which yet remains in it; the mass is still a dirty whited brown color, and it is now placed in the

*Bleaching Chamber.*—This is composed of wood, from which the atmospheric air is carefully excluded. Into this chamber are conveyed pipes communicating with a retort, in which chlorine is formed by the application of heat to a due proportion of manganese, common salt, and sulphuric acid; the rags are now white, but they have an intolerable smell; to free it from this it is returned to the

*Washing Engine*, when the rags are driven round as before (viz. by the movement of a large horizontal wheel, which is connected with several oval cisterns about ten feet long by five feet broad), till the chlorine is thoroughly forced out. They are then let off into the

*Beating Engine.*—This is similar to the washing, except that the knives of the roller and the plate are closer together, the roller here is moved with more rapidity. Having been ground here for several hours, the rags become *pulp*, very similar in its appearance to milk: the pulp, which is now ready, is from the machine conveyed by a valve to the

*Chest.*—This is a large circular vessel which will hold several engines, full of pulp, or, as it is now called, *stuff*; the chest is twelve feet in diameter by five in depth. An *Agitator* revolves constantly round it to keep the stuff from sinking. At the bottom of the chest there is a cock, through which the pulp constantly flows into a *vat*, from whence it proceeds to the *sifter* (this is a wire frame, which is constantly moving up and down). Having passed the sifter the pulp falls like a sheet of water upon the *endless wire;* this wire is of the finest texture, and is constantly moving on at a very slow pace, with, at the same time, a shaking motion from side to side; the pulp (stuff) is still in a state of fluidity, but it soon assumes a state of consistence. Now a *wire cylinder* presses upon the pulp, and leaves some faint lines, which are sometimes observed in thin paper. From this cylinder its progress is onward upon an inclined plane, covered with *flannel* or *felt;* this absorbs gradually the moisture still remaining in the pulp. It is now seized by two rollers, which powerfully squeeze it. Here another beautiful process commences, viz. *drying:* the pulp although quite formed is still fragile and damp; it is therefore passed over a large cylinder, into which *heat* is conveyed, from whence it passes over a second cylinder or drum, hotter than the first, and again upon a third, with a still greater degree of heat; it is then pressed on one side and passes over the smooth surface of a cylinder, which gives a sort of glaze or polish—and it is PAPER. The *size* (made of sheeps skins, and without which we could not write upon paper), is now applied; sometimes, however, it is introduced in the washing machine.

The paper is now mounted upon a *drum*, and a circular knife cuts it into the required lengths and breadths. The sheets are now subjected to rigid examination by women, to remove every knot or speck, who also discover any broken or torn sheet. It is now counted into quires, and then into *mill reams* of twenty quires each ; it is afterwards put into stout paper wrappers, which the Excisemen mark with the class of the paper, the number of the mill, and the duty of 3d. per lb. weight. We have spoken of *mill reams;* those can only be sold by the paper makers (under a penalty of £100), the *perfect* or stationer's ream consists of 21½ quires, which contains 500 sheets, fit to be printed upon, exclusive of the outside, or what is technically called waste. Every paper maker must take out a license, and every mill has a distinctive number assigned to it by the excise. To encourage the exportation of paper or printed books, a drawback of 3d. per lb. weight is allowed by the Excise, a bond being given, with sureties, to export within a certain time. It must be observed, that although a sheet of paper can be made any length, so long as pulp is supplied, yet it cannot be made more than five feet in width. The first paper mill built in England was by a German, at Dartford, in the sixteenth century.

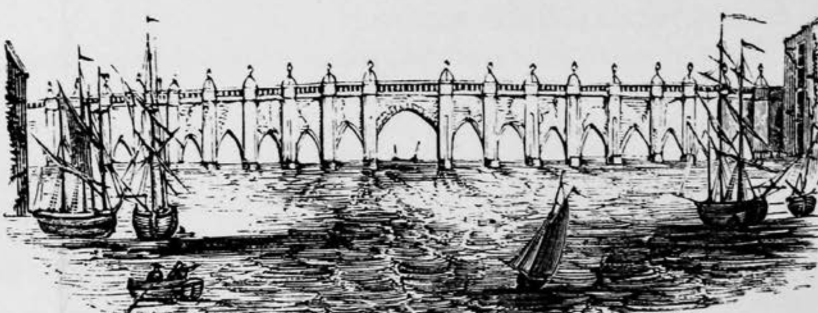
## PRINTING.

It is not our intention to fatigue the reader, either with the controversy so long carried on (without any satisfactory result) of the origin of printing by moveable types, or of entering into the minutiæ of this beautiful process by which mankind has so greatly benefited; we will endeavour, however, to give a general, but comprehensive description of the ordinary business of a printing office. First then, of the *Compositor*, who stands before a *frame ;* each frame has two pair of *cases*, the upper case with ninety eight partitions, which contains all the small letters, capitals, points, figures, &c.; these are the Roman characters ; the lower case is divided into partitions of four different sizes, and in all there are fifty-three holes or boxes for the letters, apportioned in size according to the required want of the particular letter; as for example, the letters used in compositions in English are as under :

| | | | |
|---|---|---|---|
| a — 8,500 | h — 6,400 | o — 8,000 | v — 1,200 |
| b — 1,600 | i — 8,000 | p — 1,700 | w — 2,000 |
| c — 3,000 | j — 400 | q — 500 | x — 400 |
| d — 4,400 | k — 800 | r — 6,200 | y — 2,000 |
| e — 12,000 | l — 4,000 | s — 8,000 | z — 200 |
| f — 2,500 | m — 3,000 | t — 9,000 | |
| g — 1,700 | n — 8,000 | u — 3,400 | |

LONDON BRIDGE.

As it appeared in 1666,



Pulled down, 1831.

The present Bridge, opened August 1st, 1831.

And these are not placed in their cells alphabetically, but as they are most frequently required; the *spaces* used to divide letters and words are in the lower case. With a *composing-stick* in his left hand (this is a small brass frame to hold the letters temporally), the compositor picks up each letter separately, places it in his stick, from which, after being filled, the letters are removed in a mass, then forming words, to a *galley*; the page required being composed, it is tied tightly with thin twine and transferred to the *chase*; this is an iron frame, in which the type is *locked*, by means of small pieces of wood being driven by a mallet tightly up the sides of the chase, to give the necessary margins to the pages; the whole being in one complete mass, so that every letter is firmly fixed, it is called the *form* —as outer and inner form for the two sides of the paper printed. Previous to the forms going to *press*, or *machine*, the pages or columns of type are carefully corrected with the manuscript, and again *revised* by the *Reader;* each compositor correcting his own matter. It is then "read for press," and is printed accordingly.

There are several sorts of printing presses, as the Columbian, Stanhope, &c., but where expedition, or a long number of impressions are required, the work is always done at "machine."

After the "copies" are printed, the forms are unlocked and the letters *distributed*, that is, returned to the divisions to which each letter belongs in the compositor's frame or case; when a page or form is broken by being badly *imposed*, the type thrown thus into confusion is called *pie*; this is the approbria of the printing office, and about as welcome as the night-mare.

Printing was introduced into this country by William Caxton in 1474, and the first printing press was in the Almonry, Westminster Abbey. The first book printed was "the Game and Play of Chesse."

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## STEREOTYPING.

Every body has seen at the bottom of title pages the words "stereotype edition," but very few, except "the trade," are acquainted with the ingenious process. The first idea of casting in metal plates emanated from one William Ged, a printer of Edinburgh, in 1725, and was so far successfully practised by him, that he was engaged by the University of Cambridge to print bibles and prayer books; but, by the jealousy and dishonesty of his workmen, in committing wilful errors, the process was considered defective, and the intention quickly abandoned. About fifty years afterwards it was revived by Tilloch, and was subsequently adopted by the celebrated Didot of Paris, and ultimately brought to perfection by the late Earl Stanhope. It must be understood, that stereotype plates are only adopted for standard works, and those likely to have a large sale, because the outlay is considerable, although the conveniences are very great, inasmuch as a reprint can take place at any time, and any required number, however small, can be taken off with the greatest facility, and the expence of recomposition in thus saved. We shall describe briefly the casting of the plates. The pages of the type are tied up separately, and the letters being rubbed over with an oily composition to make the mould come away freely, Gypsum (plaster of Paris) is then poured in a fluid state very carefully over them. This quickly setting, the mould is removed, and if the impression is perfect, the edges of the cast are dressed with a knife. The moulds are then baked in an oven of a settled témperature, and made by such means dry and hard. The mould is now placed in the *casting-box* upon what is called a *floating plate*, with its face downwards; the cover of the casting box is then screwed down, suspended by a crane over the pit which contains the molten metal, gradually lowered into it, and kept steadily there by a lever and weight; the lid of the box being open at the corners, the hot metal rushes in, and the nice interstices of the mould are filled up. It remains here about ten minutes, and is then swung into the *cooling trough* filled with water. The mould is then beaten away by a wooden mallet from the plate now cast, the superfluous metal broken off; the back of the plate is afterwards made of a sufficient thickness by means of a lathe (the letters standing from its face of a proper height), the stereotype is carefully examined, any excrescence picked off, and the process is complete. The plates are a little longer (we mean by the margin) than the pages of the moveable types, and if kept with care will produce any number of impressions, equal to the ordinary type.

## WRITING.

In the early ages of the world a rock, a stone, or a metal plate was used as the means of communication. " Come up to me into the mount and be there, and I will give thee tables of stone, and commandments which I have written." Exodus, Chapter xxiv. Again Job, chapter xix. "Oh! that my words were now written. That they were graven with an iron pen and lead in the rock for ever." The poems of Homer are said to have been written on plates of lead, and many ancient documents are still extant in India, written upon copper; the tablet stone is frequently met with, as are the sculptured rocks in the north of Europe. The Greeks and Romans used thin pieces of wood covered with wax. In Aristophanes, a debtor proposes to destroy his creditor's tablet, by means of a burning glass while he is summing up the account. The leaves and bark of trees were used by the Egyptians, Greeks and Romans; the latter also used linen painted or gummed over. Several of the Egyptian mummies have been found with linen manuscripts in them, and the Chinese wrote on silk and cotton cloths. The instrument used as a pen was a reed or bulrush, and these are even now used in the east to write Arabic characters (which are written from right to left), as being better than the pens made from quills: the Chinese make use of a camel's hair penci. in their writing. The "grey goose quill" was first used about the sixth century. The ink upon the manuscripts dug up at Herculaneum appears to have been of the most durable description, as the characters written with it are still legible and very black. Writing upon the skins of animals is very ancient, and the very early copies of the Bible, preserved by the Jews of Cochin in India, are said to be upon leather.

## HISTORY OF NEWSPAPERS.

The reign of Elizabeth was the period when periodical literature first appeared in England. The "English Mercurie" was published in the shape of a pamphlet in 1588; the first number is still preserved and to be seen in the British Museum; this can hardly be called a newspaper: the first one of a single sheet was published by Sir Roger L'Estrange, on the 31st of August, 1661; it was called "the Public Intelligencer." The first Gazette in England was published at Oxford (the court being there in consequence of the plague), November 7th, 1665; the court returning to London, the title was altered to "the London Gazette." The Orange Intelligencer was the third newspaper published; this was soon after the revolution of 1688, and was the only *daily* newspaper for some years; in 1690 there were only nine London newspapers published weekly. In 1709 these were increased in number to eighteen, but still there was only one daily paper, which was called "the London Courant." In the reign of George I. the number was three daily, six weekly, and ten published three times a week.

In 1753, the number of copies of newspapers annually published in the whole of England, was 7,411,757; in 1760 the circulation had increased to 9,404,790; in 1830 it amounted to 30,439,941! and since the reduction of the stamp duty in August, 1836, it has greatly increased.

Although the above has been taken from a respectable source, yet it is doubtful if there was not some description of periodical, which was considered as a newspaper, anterior to the above dates, as we find that during the Protectorate, a memorial was presented from certain officers of the Post Office, praying for protection of a privilege *which had always been enjoyed by them*, of forwarding newspapers by the post: this proves that the circulation of some kind of newspapers was on a systematic plan, prior to the year 1650.

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## OLD LONDON BRIDGE

Was begun to be built of stone in 1176, and was finished in 1209. It was nine hundred and fifteen feet long, and forty-five broad, the arches were nineteen in number, and, excepting the centre one, were only twenty feet wide. The bridge was many ages encumbered with houses on each side, which overhung, and leaned in a terrific manner. These at last becoming so dilapidated, they were wholly removed in 1756, and the upper part of the bridge built up in the most refined taste of that day; but it seems that no attempts were ever made to remove the unsightly and dangerous starlings upon which the piers of the bridge rested. The contracted space between the piers rendered the obstruction to the navigation of the river very great. At the ebb of the tide the fall of water was several feet, and the consequent sacrifice of human life frequently occurred. On the north east side were the *water works*. These consisted of four immense water wheels, turned by the stream, and which forced the water up to a basin on a tower one hundred and twenty feet above the level of the river. From this basin it descended into the main pipes, and from them it was conveyed in all directions through the town. These yielded to the great improvements made by the Water Companies, and, at last, after many patchings and contrivances, the bridge itself gave way to the enlarged spirit and genius of the age, and a Parliamentary grant produced the present beautiful Bridge, which is calculated by the solidity of its structure to last for ages.

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## NATURAL BRIDGES.

In the heart of the north Highlands of Scotland there is a narrow pass between the mountains in the neighbourhood of Bendearg, well known to the traveller who adventures into these wilds in quest of the savage sublimities of nature. At a little distance, it has the appearance of an immense artificial bridge thrown over a tremendous chasm; but on a nearer approach is seen to be a wall of nature's own masonry formed of vast and rugged bodies of solid rock, piled on each other as if the giant sport of the architect. Its sides are in some places covered with trees of a considerable size, and the passenger who has a head steady enough to look down the precipice, may see the eyries of birds of prey beneath his feet. The path across is so narrow that it cannot admit of two persons passing alongside; and, indeed, none but natives accustomed to the scene from infancy, would attempt the dangerous route at all, though it saves a circuit of three miles. Yet it sometimes happens, that two travellers meet in the middle, owing to the curve formed by the pass preventing a view across from either side; and when this is the case, one is obliged to lie down while the other crawls over his body! This natural bridge bears a name which, however euphonous it may sound in Gaelic, must not be mentioned in English "to ears polite." The following legend is connected with this spot. A deadly fued had long existed between the families of Macpherson of Bendearg and Grant of Cairn, and, though apparently reconciled by the intervention of mutual friends the enmity still existed, and required opportunity only to burst forth with redoubled violence—this soon occurred One day a Highlander was walking fearlessly along the pass; sometimes bending over to watch the flight of the wild birds that built below, and sometimes detaching a fragment from the top to see it dashed against the uneven sides, and bounding from rock to rock, its rebound echoing the while like a human voice, and dying in faint and hollow murmurs at the bottom. When he had gained the highest part of the arch he observed another coming leisurely up on the opposite side, and being himself of the patrician order, called out to him to halt and lie down; the person, however, disregarded the command, and the Highlanders met, face to face, on the summit. They were Cairn and Bendearg! the two hereditary enemies who would have gloried and rejoiced in mortal strife with each other on a hill side. They turned deadly pale at this fatal rencounter. "I was first at the top," said Bendearg, "and called out first; lie down that I may pass over in peace." "When the Grant prostrates himself before Macpherson," answered the other, "it must be with a sword driven through his body." "Turn back then," said Bendearg, "and pass as you came." "Go back yourself if you like it," replied Grant, "I will not be the first of my name to turn before the Macpherson." This was their short conference, and the result exactly as each other had anticipated; they then threw their bonnets over the precipice and advanced with slow and cautious steps closer to each other; they were both unarmed, and stretching their limbs like men preparing for a desperate struggle, they planted their feet firmly on the ground, compressed their lips, knit their dark brows, and fixing fierce and watchful eyes on each other, stood thus prepared for the onset. They both grappled at the same time; but being of equal strength were unable to shift each other's position; standing fixed on a rock with suppressed breath, and muscles strained to the "top of their heart," like statues carved out of the solid stone. At length Macpherson suddenly removing his right foot so as to give him greater purchase, stooped his body and bent his enemy down with him by main strength, till they both leaned over the precipice, looking downwards into the terrible abyss. The contest was as yet doubtful, for Grant had placed his foot firmly on an elevation at the brink, and had equal command of his enemy; but at this moment Macpherson sunk slowly and firmly on his knee, and while Grant suddenly started back, stooping to take the supposed advantage, whirled him over his head into the gulf; Macpherson himself fell backwards, his body hanging partly over the rock; a fragment gave way beneath him, and he sunk farther, till catching with a desperate effort at the solid stone above, he regained his footing. There was a pause of deathlike stillness, and the bold heart of Macpherson felt sick and faint. At length, as if compelled unwillingly by some mysterious feeling, he looked down over the precipice—Grant had caught, with a death gripe, by the rugged point of a rock; his enemy was almost within his reach; his face was turned upwards, and there was in it horror and despair—but he uttered no word nor cry. The next moment he loosed his hold, and the next his brains were dashed out before the eyes of his hereditary foe! The mangled body disappeared among the trees, and its last heavy and hollow sound arose from the bottom. Macpherson returned home an altered man.

## ICONONZO IN THE CORDILLERAS.

The chain of the Andes in South America presents many striking natural phenomena in the immense clefts which separate two contiguous masses of mountains, and in some instances are near five thousand feet deep. The valley of Icononzo is less remarkabie for its dimensions than for the extraordinary form of its rocks, which seem as if they were fashioned by the hand of man. Their naked and arid summits form a most picturesque contrast with the tufts of trees and herbaceous plants which cover the bottom of the crevasses or clefts. A little torrent has made itself a way through the valley, and lies sunk in a channel, which is so difficult of approach, that the river would hardly be passable if nature herself had not formed two bridges of rock, which are justly regarded as the greatest curiosity in that country. Humboldt and Bonpland crossed these natural bridges in 1801, on their route from Bogata to Quito. This natural arch is about forty-seven and a half feet long, forty-one and a half wide, and about eight feet thick in the centre. By careful experiments made on falling bodies, with the assistance of a good chronometer, combined with the measurement obtained by a plummet, it appears that the height of the upper of the two natural bridges above the level of the torrent, is about three hundred and thirteen feet. Sixty feet below the first natural bridge, there is another, formed by three enormous masses of rock, which have fallen in such a way as to support one another. The centre rock forms the key of the arch.

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## ROCK BRIDGE AT VIRGINIA, N. A.

There is an extensive range of mountains in this State, which is called the Blue Ridge; near the small town of Harper's Ferry the mountains rise on each side very abruptly, and their faces have a rugged and shattered appearance. Over the small stream, in the upper part of the great Valley of Shenandoah, is that splendid natural curiosity—the Rock Bridge. It is a noble arch of one solid mass of stone, somewhat curved in its highest part, and almost like the work of man. The same native rock forms on each side the supports of this enormous arch, which is said to be about eighty feet wide near the top; at the level of the water the width is only forty feet. The whole height from the outer top of the arch to the water, is about two hundred and ten feet, as ascertained by admeasurement with a string and a stone at the end; the vertical thickness of the arch is probably about thirty feet. The stream which runs beneath, though inconsiderable, adds to the general effect. Drops of water filter through the limestone and fall in quick succession from the arch, and, by the time occupied in their descent, their increasing velocity, and their full bright appearance, serve in some degree to give a measure of the height from which they fall, and increase the beauty of the scene. "Whatever may have been the origin of this bridge," says a recent visitor, "it seems pretty certain from an inspection of it, that it has not been produced by any sudden and violent cause." There is another natural bridge in Virginia, in Scot County, which is said to be above three hundred and forty feet high, but is inferior to that of Cedar Creek in form and completeness.

## NATURAL BRIDGE AND WATERFALL OF GOLLING IN THE TYROL.

The river Salza, or Salzach, rises in the mountains of the Tyrol; but it is in Austria Proper that it runs the greater part of its course, at first pursuing a westerly direction parallel with the Noric Alps, and then flowing northward at no great distance from the Bavarian frontier, until it joins the river Inn, which forms the north eastern boundary of Bavaria. The tourist, who is already familiar with Switzerland, would find much to delight and interest him, if, after lingering sometime in the Tyrol, he were to track the Salza at its source at Mont Brenner to its junction with the Inn. The valley of Salza is extensive, and the river is rendered impetuous by passing alternately through ravines and mountain defiles. The climate near the source is severe, and the snow lies there for several months in the year. About June the heat becomes very great, and the sirocco occasionally penetrates even to these regions; but it seldom lasts more than a few hours, and though sensibly felt, its effects are greatly lessened, and its power is chiefly shown in melting the snow and causing a sudden flood. The Salza begins to be navigable at Hallien, about twenty miles above the Inn; at five miles from its junction it passes by Salzburg, celebrated for its saltworks. The waterfall of Golling is in the upper part of its course a few miles from Hallien, near a mountain which rises two thousand five hundred and seventy-two feet above the level of the sea. Notwithstanding its grandeur, and the bold and romantic scenery which surrounds it, it is comparatively little known, owing to its lying out of the beaten path of the tourists. The

New London Bridge,—opened August 1st, 1831.

stream has perforated the rock in its descent, and falls in a sort of curtain over the lower part of it into the channel at the foot. Over these falls, and about half way up the mountains, there is a splendid arch or natural bridge; and still higher, where the chasm is narrower, there is also a rude bridge made by hand, with a kind of balustrade for additional protection to the adventurous passenger.

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## THE RIALTO AT VENICE.

This city of "bright and glittering palaces" is intersected in every direction by canals; and, it is said, that there are more than 500 bridges. Over the grand canal, which divides the city in two equal parts, is the celebrated Rialto. It is affirmed by one very competent to give an opinion, that the term Riva-alta, or Rialto, comprehended the little island upon which the first church was built in Venice by the fugitives from the persecution of Attila, and became the nucleus of the future city; modern times has confined the appellation to the bridge only.

It was commenced under the government of the Republic in 1588, (Pascal Cigogne being Doge), by the great Michael Angelo, and finished in 1594. It consists of one flat and bold arch of nearly 100 feet span, and only twenty-three feet above the water. The breadth of the bridge is forty-three feet, and is on the top divided by two rows of shops into three streets, of which that in the middle is the widest, and there is also in the centre an open archway by which the three streets communicate with one another; the whole exterior of the bridge and of the shops is of marble. At each end of the bridge there is an ascent of fifty-six steps, and the view from the top is very beautiful. The foundation of the structure extends ninety feet, and rests upon 12,000 elm piles. It is said to have cost 250,000 ducats.

In Shakspeare's time it was considered the most beautiful bridge in the world, and this celebrity probably caused its frequent mention in his Merchant of Venice as a mart or exchange, "where merchants most do congregate." Our readers will also recollect Shylock's first speech to Antonio:—

————"Many a time, and oft
On the *Rialto* have you rated me,
About my monies and my usances."

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## NEW LONDON BRIDGE.

THE first pile of this truly magnificent bridge was driven on the 15th March, 1824. A cofferdam was then made; this is the name given to a space enclosed in a river, bydriving piles of two or three rows, the spaces between the rows being filled up with earth, to prevent the admission of water, when that in the inner enclosure is pumped out. In this cofferdam the foundations of a pier are laid on the solid ground ; this being completed the first stone of the bridge was laid on the 27th of April, 1825. The building proceeded with great rapidity, and the first arch was *keyed in* on the 4th of August, 1827. The arcnes of the bridge being very flat elliptics, it was necessary that the *centres* (upon which the stones and other materials of an arch are supported during the progress of the work), should be particularly strong. Each centre of this bridge consisted of nearly eight hundred tons of timber and iron! The bridge was finally completed on the 31st July, 1831, having been seven years and a half in its building. It was opened in great state by William the Fourth, on the 1st of August, 1831.

The exact situation of this bridge is 180 feet higher up the river than the old bridge, by which means the steep approach by Fish Street Hill is altogether avoided. There are five semi-elliptical arches (exclusive of two dry arches which pass over Thames-street and Tooley-street), the least of these is larger than any other stone arch of this form ever erected. The centre arch is 152 feet span, with a rise above high-water-mark of twenty-nine feet six inches ; the two arches next the centre are 140 feet in span; the abutments are each 130 feet in span. The roadway is fifty-three feet wide between the parapets, the footways occupying nine feet each; the rise in the road is only one in 132. The length of the bridge from the extremities of the abutments is 928 feet; within the abutments 782 feet. The bridge is built wholly of Granite, and the total quantity of stone used was 120,000 tons. It cost nearly two millions sterling, partly by a grant from the Treasury, and the remainder by the Corporation of the City of London, who are allowed to levy a tax upon coals of 10*d*. per chaldron for twenty-six years. Sir John Rennie was the Architect.

## PRIMITIVE SUSPENSION BRIDGES IN SOUTH AMERICA.

Several bujucos are twisted together so as to form a large cable, of the length required to reach over the chasm of the mountains or rivers. Six of these are carried from side to side, two of which are considerably higher than the other four. On the latter are laid sticks in a transverse direction, and over these branches of trees as a flooring, the former are fastened to the four which form the bridge, and by that means serve as rails for the security of the passenger, who would otherwise be in no small danger from the continual oscillation.

## THE TARTABITA.

This is formed of a single rope made of bujuco, or thongs of an ox's hide, and consists of several strands of six or eight inches thick. This rope is extended from one side of the river to the other, and is fastened to each bank by strong posts. From the tartabita hangs a kind of leather hammock capable of holding a man, and a clue is attached at each end. A rope is fastened to either clue, and extended to each side of the river, for drawing the hammock to the side intended. On one of the banks is a kind of wheel or winch, to slacken the tartabita to the degree required, and the hammock being pushed, on first setting off, is quickly landed on the other side. For carrying over the mules two tartabitas are required, one for each side of the river, and the ropes are much thicker and slacker. The animal being secured by the girths round the belly, neck and legs, is launched in mid air, and immediately landed on the opposite bank. In this manner rivers are crossed between thirty and forty fathoms from shore to shore, at a height above the water of twenty-five fathoms.

## SUSPENSION BRIDGES OF THE HIMALAYA.

At some convenient spot where the river is rather narrow, and the rocks on either side overhang the stream, a stout beam of wood is fixed horizontally upon or behind two strong stakes, that are driven into the banks on each side of the water, and round these beams ropes are strained, extending from the one to the other across the river, and they are hauled tight and kept in their place by a sort of windlass. The rope used in forming a bridge is generally from two to three inches in circumference, and at least nine or ten times crossed to make it secure. This collection of ropes is traversed by a block of wood hollowed into a semicircular groove, large enough to slide easily along it, and around this block ropes are suspended forming a loop, in which passengers seat themselves, clasping its upper parts with their hands to keep themselves steady; a line fixed to the wooden block at each end, and extending to each bank, serves to haul it and the passenger attached to it from one side of the river to the other. The jhoola (as the bridge is called) at Rhampore was somewhat formidable, for the river trembles beneath in a very awful way, and the ropes, though they decline in the centre to the water, are elevated from thirty to forty feet above it; the space is from ninety to one hundred yards. "It was amusing enough to see several of our low-country attendants,'' says Frazer, "arming themselves with courage to venture on this novel mode of transit, and I must confess, that although it was evident that the actual danger was small, it was not without certain uncomfortable feeling that I first launched out to cross the Sutlej. We found, however, that accidents do sometimes occur, and it was scarcely twelve months since a Brahmin, who had come from Cooloo, having loaded the ropes with two great a weight of his goods, and accompanied them himself, fell into the stream, was hurried away, and dashed to pieces."

## SUSPENSION BRIDGES.

Although, perhaps, the idea of this description of bridge may have been taken from the Chinese, in whose country there are several of the rudest and most unscientific construction, yet it was only about a century ago that they were adopted in this country. The first was over the Tees at Winch, near Durham; it was constructed of iron wire, and was used by foot passengers only. In 1813 the late Mr. Telford proposed to erect a suspension bridge of three arches, and of two thousand feet long, over the Mersey, to communicate with the Bridgewater Canal. The boldness of the design frightened every body, and it was abandoned, Captain Brown was the first engineer who constructed a suspension bridge, capable of sustaining the heavy weights of carriages, &c.; this was erected over the Tweed at Kelso, in 1820; it is three hundred feet in length by eighteen feet in width. In Paris there is a pretty suspension bridge over the Seine; until 1830 it bore the name of the bridge of the Ile, but since the "glorious days" it is called the bridge of Arcole. In the United States there are several; the chief of which are—that at Newbury-port, over the Merrinack, which is a curve whose cord measures 244 feet—a second, over the Brandywine, at Wilmington, of 145 ft.—a third, at Brownsville, which measures 120 feet from point to point of suspension, and another close by, which has an inverted suspended arch of 112 feet cord The most remarkable in England is

## THE MENAI BRIDGE.

In 1818, the late Mr. Telford was employed by the then Government, to make surveys for the much needed improvements of the Holyhead road, to Ireland. Between Bangor and Holyhead, and dividing the main land from the Isle of Anglesea, where the latter is situate, there is a strait, or arm of the sea, called *Menai Straits*, through which the tide flows with great velocity, and, from local circumstances, in a very peculiar manner. Previous to 1818, the passage across the straits was accomplished by means of Ferry Boats; these, exclusive of the delay of transit (no ordinary consideration, by the way, in the immense traffic with the Irish capital) was very frequently attended with great danger. To remedy this evil, Mr Telford suggested the erection of a suspension bridge. The obstacles to be overcome, were a rapid stream, with high banks: to have erected a bridge of the usual construction would have obstructed the navigation; besides, too, the erection of piers in the bed of the sea was impracticable, and the advantage of obtaining direct communication with the Sister Kingdom was of the highest importance.

This bridge is partly of stone and partly of iron, and consists of seven stone arches, exceeding in magnitude every work of the kind in the world. They connect the land with the two main piers, which rise 53 feet above the level of the road, over the top of which the chains are suspended, each chain being 1714 feet from the fastening in the rock; the road way is 100 feet above the surface of the water, at high tide; the opening between the points of suspension is 560 feet; the platform is about 30 feet in breadth. The whole is suspended from four lines of strong iron cables, by perpendicular iron rods, five feet apart; the cables pass over rollers on the top of pillars, and are fixed to iron frames under ground, which are kept down by masonry; the suspending power of the chains is calculated at 2016 tons, the total weight of each chain is 121 tons, and the weight of the bridge between the points of suspension, is 489 tons. It is said, that "the top masts of the first three-masted vessel which had passed under the bridge, were nearly as high as those of a frigate, but they cleared 12½ feet below the level of the roadway." As we before said, the idea and execution of chain suspension piers is due to Captain Brown, who built not only the Brighton Chain Pier, but also a very substantial one at Leith, which advances 233 yards into the sea; it consists of three arches of suspension chains, each having 209 feet in space; thus the pier has four supports only; one on shore and three on piles in the middle of the sea. To test its capability of sustaining weight, a mass of 210 tons was kept upon it for some days, in addition to the ordinary weight of passengers, &c. This gentleman was the builder also of the Hammersmith Chain Bridge.

## SUSPENSION BRIDGE OVER THE AVON.

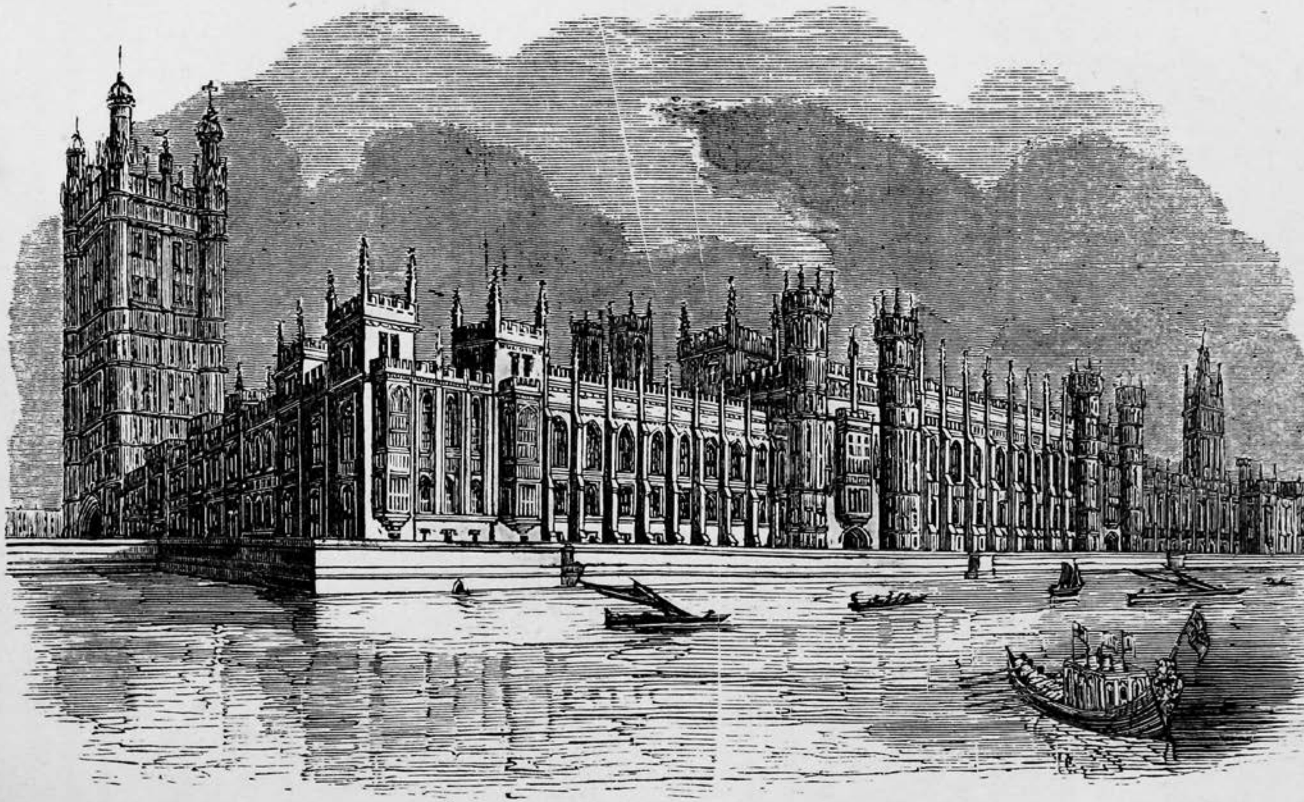
A very beautiful bridge has been constructed by Mr. Brunel, junior, across the river Avon, joining the rocks known by the name of Saint Vincent Rocks, at Clifton, about a mile below Bristol; the following are the dimensions:—

| | feet. |
|---|---|
| Distance from centre to centre of piers. . . | 700 |
| Height of roadway above level of the water . . | 240 |
| Width of roadway 20 feet; two footways 6 feet each, in all | 32 |
| From the roadway to the top of the sphynx . . | 100 |
| The gateway . . . . . . . | 40 |
| The base of the pier (height) . . . . | 120 |

The road is in the centre of the bridge; the footpaths being on each side, and outside of the chains and suspension rods. The Egyptian gateways are on a scale as large as some of the ancient ones from which they are copied. It will be perceived that the height from the level of the water is sufficient to admit of East and West Indiamen of the largest class to pass under it.

## SUSPENSION BRIDGE OVER THE AIRE, NEAR LEEDS.

A bridge of a somewhat novel construction was erected (by Mr. Leather, of Leeds) near Hunslet, in 1832; which, from its form and contradistinction to the *chain* suspension bridges, may not be unaptly called the *bow and string* suspension bridge. Instead of the chains, two strong cast iron arcs span over the whole space between the two abutments. These arcs spring from below the proposed level of the



New Houses of Parliament.

roadway, but rise in their course considerably above it; and from them the transverse beams, which support the platform of the bridge, are suspended by malleable iron rods. In the present instance, the supending arch is 152 feet wide, spanning over the river Aire, and the towing or hauling path; and there is, besides, a small land arch of stone on each side. The footpaths are on the outside of the two suspending arcs, and the carriage-way passes between them. Each of the suspending arcs is in six parts, and rowelled together, and the ends fit into cups cast upon the springing or foundation plates, forming a ball and socket-joint. The cast iron transverse beams, which support the roadway, are suspended at about every five feet. The roadway is of timber, with iron guard plates on each side, and upon the top of the planking are also hard malleable iron bars, ranging longitudinally for the wheel racks, and transversely for the horse tracks. The total length of the bridge is (including 88 feet for two abutments) 240 feet; width of roadway, 24 feet; pathways 7 feet each. The foundations of the bridge rest upon bearing piles, and the total expense was £4,200.

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## THE MONK BRIDGE, NEAR LEEDS.

This bridge, which is upon the same principle as the former, was built in 1827, by the same engineer, Mr. Leather. Besides the suspension arch, which spans over the river Aire, there are two small land arches, and a 24 feet elliptical arch, over the Leeds and Liverpool canal; which, at this point, is only about 50 feet from the river; this bridge is

| | feet. |
|---|---|
| Length. . . . . . . . | 260 |
| Span of Suspension Arch . . . . . | 112 |
| Width. . . . . . . . | 36 |
| Height, from the surface of the river to the spring of the suspending arcs . . . . | 7 |

---

Such are the most celebrated suspension bridges in this country (there are some others in the North of England and in Scotland, which we have not space to particularise), and it only remains to describe the principles upon which they are constructed. And this has been so pithily done in the Encyclopædia Americana, that we close our remarks by quoting it.

"In these, the flooring or main body of the bridge is supported on strong iron chains or rods, hanging in the form of an inverted arch, from one point of support to another. The points of support are the tops of strong pillars or small towers, erected for the purpose. Over these pillars the chain passes, and is attached at each extremity of the bridge to rocks or massive frames of iron, firmly secured under ground. The great advantages of Suspension Bridges consist in their stability of equilibrium, in consequence of which a smaller amount of materials is necessary for their construction than for that of any other bridge. If a suspension bridge be shaken or thrown out of equilibrium, it returns, by its own weight, to its proper place, whereas the reverse happens in bridges which are built above the level of their supporters."

## THE NEW HOUSES OF PARLIAMENT.

The destruction of the Houses of Lords and Commons on the 15th of October, 1834, rendered the erection of temporary buildings necessary, until the plan of a splendid edifice was decided upon, equally worthy of this great nation and the important purposes for which it is to be used. For which object premiums were offered for the best design, and innumerable were the plans, &c. sent into the Committee of the Commons in consequence: the first prize of £1,500. was adjudged to Mr. Barry, and his design selected. Our engraving will give a complete idea of the river front, by which it will be seen that it is in the most elegant and elaborate style of architecture; if it has a fault (and it is ungracious to prejudge), it consists in its being *too florid*, taking into account the density of our atmosphere and its situation by the river side. The reputation which St Stephen's Chapel has enjoyed for more than four centuries, as the place of legislation, has created a sort of halo around it, so that our modern Solons have decided it to be the only fitting site for their "Palavers." Although it may admit of a question, whether the bank of such a river as the Thames be the most elegible spot for such a magnificent building, there can be no doubt but that the architect, Mr. Barry, has made the most of the situation prescribed for him. The internal conveniences are as complete as the exterior is elegant; the latter will be a fitting and worthy companion to Westminster Abbey (this is no mean praise), and, together with its broad and extensive terraçe on the river's bank, will form a truly legitimate object of admiration and beauty.

# ARCHITECTURE. (1)

## THE PYRAMIDS.

The number of pyramids in Egypt is very great; but the most remarkable are those at Djizeh, Sakhara, and Dashour. The great pyramid (that of Cheops) may be assumed to have the following admeasurement—viz., four hundred and eighty feet high, on a base of seven hundred and fifty in length, or as covering an area of about eleven acres, and rising to an elevation of one hundred and twenty-seven feet above the cross of St. Paul's Cathedral.

Herodotus ascribes the great pryamid to Cheops, 2095 years B. C., an arbitrary and savage monarch; one of the "Shepherd Kings" who are supposed to have occupied the throne of the Pharoahs some time between the birth of Abraham and the captivity of Joseph. This account is so graphic, and has been confirmed by all modern writers, that we shall at once copy it. Speaking of Cheops, he says, "He barred the avenues to every temple, and forbade the Egyptians to offer sacrifice to the Gods, after which he compelled the people at large to perform the work of slaves. Some he condemned to hew stones out of the Arabian mountains, and drag them to the banks of the Nile; others were stationed to receive the same in vessels, and transport them to the edge of the Libyan Desert. In this service one hundred thousand men were employed, who were relieved every three months; ten years were spent in the hard labor of forming the road on which these stones were to be drawn, a work of no less difficulty, I think, than the erection of the pyramid itself. This causeway is five stadia in length, forty cubits wide, and its greatest height thirty-two cubits. Ten years, as I have observed, were consumed in forming this pavement, in preparing the hill on which the pyramids were raised, and in excavating chambers under the ground. The pyramid itself was a work of twenty years; it is of a square form, every side being eight plethra in length, and as many in height. The stones are very skilfully cemented, and none of them of less dimensions than thirty feet.

The ascent to the pyramid was regularly graduated, by what some call steps, and others altars. Having finished the first tier, they elevated the stones to the second by means of machines, constructed of short pieces of wood; from the second, by a similar engine, they were raised to a third, and so on, to the summit. Thus, there was as many machines as there was courses in the structure of the pyramid, though there might have been only one, which being easily manageable could be raised from one layer to the next in succession; both modes were mentioned to me, but I know not which of them deserves most credit. The summit of the pyramid was first finished and coated, and the process was continued downwards till the whole was complete. Upon the exterior were recorded, in Egyptian characters, the various sums expended in the progress of the work for the radishes, onions, and garlic consumed by the artificers. This, as I well remember, my interpreter informed me amounted to no less a sum than one thousand six hundred talents. If this be true, how much more must it have cost for iron tools, food and clothes, for the workmen! particularly when we consider the length of time they were employed in the building itself, besides what was spent on the quarrying and carriage of the stones, and construction of the subterraneous apartments. According to the accounts," he adds, "given to me by the Egyptians, this Cheops reigned fifty years. He was succeeded on the throne by his brother Cephrenes, who pursued a policy similar in all respects. He also built a pyramid, but it was not so large as his brother's, for I measured them both. It had no subterraneous chambers, nor any channel for the admission of the Nile, which in the other pyramid is made to surround an island, where the body of Cheops is said to be deposited. Thus, for the space of one hundred and six years, the Egyptians were exposed to every species of oppression and calamity, not having had, during this long period, permission to worship in their temples. Their aversion for the memory of these two monarchs is so great, that they have the utmost reluctance to mention even their names. They call their pyramids by the name Philitis, who, at the epoch in question, fed his cattle in that part of Egypt." With the exception of there being "no subterraneous chambers" in the pyramid of Cephrenes, which Belzoni has proved to be incorrect, this account may be received as that of any modern traveller. That the pyramids were built with higher objects than that of being made catacombs or tombs there can be no question, and the reasonable conclusion is, that they were erected as temples of worship.

As we have before said, there are a number of pyramids in Egypt; the chief ones are those we have named. The first is situate on the west side of the Nile, about ten miles from its banks; and others more distant. Though removed several leagues from the spectator they appear to be quite at hand, and it is not until he has travelled some miles in a direct line with their bearing, that he becomes sensible of their vast bulk, and also of the pure atmosphere through which he had viewed them. They are situate on a platform of rock, about one hundred and fifty feet above the level of the surrounding desert; a circumstance at once which contributes to their being well seen, and also to the discrepancy that still prevails among the most intelligent travellers as to their actual height. Of the several chambers in the pyramids both of Cheops and Cephrenes, and the successful efforts made by Belzoni and others to penetrate into them, we have not space enough to describe. The works of these travellers should be consulted, to elucidate further these wonderful structures. The base of the great pyramid is the exact size of Lincoln's Inn Fields.

## ST. PETER'S AT ROME.—(2.)

Instead of being cooped up like St. Paul's, there is a noble amphitheatre formed by a splendid elliptical colonnade of a quadruple range of 300 pillars. The site of this wonderful pile is upon that of the ancient church of Constantine; the first stone of the present edifice was laid by Pope Julius the second, in 1506; the first architect was Brahmante Lazzarri, but he dying soon after, the task devolved upon the great, the unrivalled Michael Angelo Buonarotti, whose sublime genius is manifest at every step. He kept strictly to the original design, which was that of a *Greek cross*, but after his death the plan was departed from, and the lengthy unequal Latin cross substituted; this occasioned the great architectural defects of the building. Although aided by the wealth and power of the Roman church, yet it took 115 years and the reigns of 18 popes to finish the temple only! A period of 150 years more was occupied in building the colonnade and ornaments. Up to the year 1622 the church cost the see of Rome forty millions of crowns, and from that time to 1784, ten millions more were expended: it is estimated that it costs now thirty thousand crowns annually to keep the immense mass in repair.

The clear inside length of the church is six hundred and fifteen feet, and its breadth at the transeps four hundred and forty-eight feet; the extreme height from the piazza to the cross is four hundred and sixty-four feet! from the portals of the church to the extreme line of the ellipsis of the colonnade is nine hundred feet; so that the outside of St. Peter's, including its thick walls, &c., is nearly one third of a mile!

The masonry of the church, its cupola (which is covered on the outside with lead), is of Travertine stone. Vast as the structure is, it is said that there is a still vaster quantity of stone which remains unseen; the depth of the foundations, and the enormous thickness of the substructures, being such, that there is actually more of the material below than above the surface of the ground on which it stands.

A beautiful Egyptian obelisk, which had once adorned the centre of the circus of Nero, and still remained standing on its original site, was removed by Domenico Fontana, one of the architects of St. Peter's, to the piazza or square in the west front, which was further beautified by two magnificent fountains, each consisting of an immense basin nearly thirty feet in diameter at the level of the pavement, with a stem springing out of the centre, supporting two diminishing granite basins at different heights, and raising itself to the height of upwards of fifty feet. From the summit of each of these stems or shafts gushes and sparkles a torrent of water, the central jets of which rise to nearly seventy feet from the pavement in perpendicular height, and thence the water falls in a tripple cataract from the summit of the jets into the upper, which is the smallest vase or basin; then passing over the rim of this upper basin in an enlarged column, it descends into the second basin, from which in still greater columns it drops into the lowest, the largest basin of the three, thus producing the beautiful effect of a *cone of falling waters*. The quantity of water thus in continual play is so great that the materials of the fountains are completely enveloped and hidden from view, though of course, from the translucency of the fluid, the general form of the fountain is obvious enough. The copious supply of water is brought by an ancient Roman aqueduct, from the Lake of Bracciano, about seventeen miles from Rome; the effect of these fountains are striking and beautiful beyond description, and their flowing is perpetual and undiminished day and night. Every thing is vast in this splendid pile, the interior of which is surpassingly grand; the figures of the Evangelists in the inside of the Cupola are of colossal size; the pen in the hand of St. Mark is six feet long.

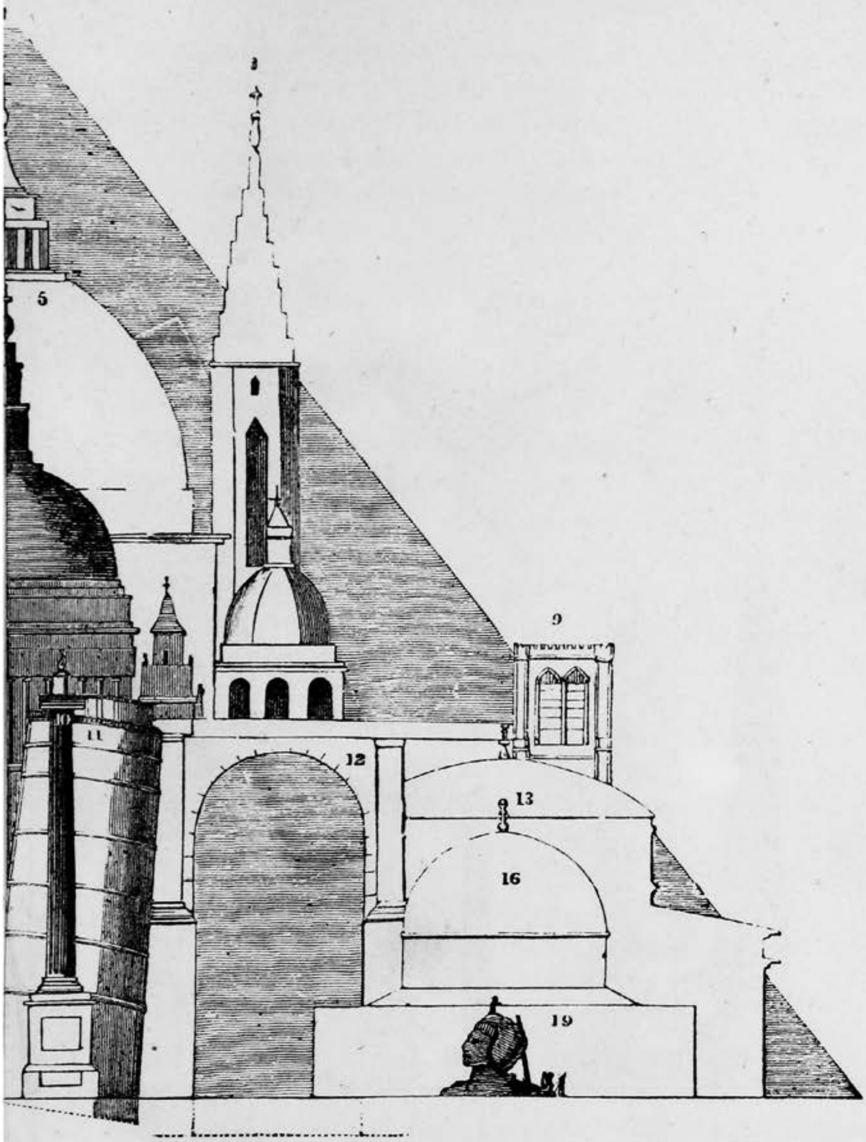
The central nave is one hundred and fifty-two feet high, and eighty-nine feet broad; it is flanked on either side by a noble arcade, the piers of which are decorated with niches and fluted pilasters of the Corinthian order. A semicircular vault, highly enriched with sunken pannels, is thrown across from side to side, and has a most splendid appearance. "The Cupola" (Michael Angelo's Cupola), says Forsyth, "is glorious, viewed in its designs, its altitude, or even its decoration; viewed either as a whole or apart it enchants the eye, it satisfies the taste, it expands the soul. The very air seems to eat up all that is harsh or colossal, and leaves us nothing but the sublime to feast on, a sublime peculiar to the genius of the architect, and comprehensible only on the spot." The


COMPARATIVE HEIG

| | | Feet. |
|---|---|---|
| 1. | The Great Pyramid . . . . | 480 |
| 2. | St. Peter's at Rome . . . . | 464 |
| 3. | Strasburg Cathedral . . . . | 494 |
| 4. | Salisbury Cathedral . . . . | 404 |
| 5. | St. Paul's, London . . . . | 404 |
| 6. | St. Giralda, Seville . . . . | 304 |
| 7. | Tower of Minar, Delhi . . . . | 262 |

8. Porcelain Tower, Nan
9. Notre Dame, Paris
10. Monument, London
11. Leaning Tower of Pis
12. Bridge of Alcantara
13. Mosque of St. Sophia,

The respective and proportionate heights of these several buildings




## HTS OF BUILDINGS.

| | Feet. | | | Feet. |
|---|---|---|---|---|
| kin . . . | 249 | 14. | Place Vendome, Paris . . . | 153 |
| . . . | 232 | 15. | Trajan's Column, Rome . . | 151 |
| . . . | 202 | 16. | Mosque of Omar, Jerusalem . . | 125 |
| a . . . | 180 | 17. | The Luxor Obelisk, removed to Paris . | 110 |
| . . . | 211 | 18. | Acqueduct of Segovia . . . | 102 |
| , Constantinople . | 189 | 19. | Sphynx, Egypt . . . | 33 |

are shown in the cut contrasted with the height of a man of six feet.

concave surface of the cupola is divided into compartments, and enriched with magestic figures of saints in mosaic and other grand works of art, and is brilliantly lighted from above and below. In the centre of the cross, where the sea of light pours down from the dome, and ten or twelve feet beneath the pavement of the present church, is the tomb of St. Peter, before which one hundred lamps are constantly kept burning.

## STRASBURG CATHEDRAL. (3)

The present cathedral was begun in the eighth century by the French King Pepin, the father of Charlemagne, and finished by the latter monarch; the walls of the choir still remain as originally built, but the rest of the ancient cathedral was destroyed in 1002. It was restored in 1015 by bishop Werner; it is stated, that above 100,000 persons were employed upon it at one time upon very cheap terms, as many of them were paid in "pardons and indulgencies," and yet the body of the church was not finished until 1275; the tower was yet to be built: this was undertaken in 1277 by Ervin de Steenbach, whose work proved him to have been an architect of first rate genius; the spire was superintended, after the death of Ervin, by his son, and was completed in 1438 by John Hûbz. By the most accurate measurement, it is four hundred and ninety-four feet high, being within thirty feet of the largest of the Egyptian pyramids. Besides its unsurpassed elevation, its structure has all the other characters of a perfect work. Nothing can be conceived more wonderful, than the consummate art by which the architect has combined the greatest strength with the most admirable lightness and airiness. The masonry does not present to the eye a solid mass, but is almost from the base to the summit a succession of columns and arches with openings between springing up, as if, instead of being supported by, they grew out of each other. The outline of the whole at the same time is one of faultless beauty, while the ornamental sculpturing is so rich and delicate, that its appearance has been usually compared to that of lace. The interior, which is very beautiful, is from east to west three hundred and fifty-five feet, the breadth of the nave one hundred and thirty-two feet, and the height is seventy-two feet.

## SALISBURY CATHEDRAL.—(4.)

This is, in some respects, the most imposing structure of English cathedrals, and it may be said to stand completely isolated, having only on one side its own cloisters and chapter house: the external appearance is noble and striking, and the spire is the finest thing of the kind in this country. The inside, though it cannot vie with the magnificence of other cathedrals, can yet lay claim to be considered chaste and beautiful. The façade of the west front is nearly in the form of a square, and is richly ornamented with niches, statues, tracery, &c. Over the central door is a large window divided into three compartments, the middle one rising considerably above the others. The length of this front is one hundred and twelve feet, but the line is extended for two hundred and seventeen feet farther to the south, by the west wall of the square forming the cloisters; east from this is the square chapter house, an octagonal building, fifty-eight feet in diameter by fifty-two in height. The extreme length of the church, externally, is four hundred and seventy-four, and of the transept two hundred and thirty feet; the height from the floor of the nave to the roof is eighty-one feet. But the glory of Salisbury Cathedral is its greatest central tower, with the sharp pointed spire by which it is crowned. The entire height is four hundred and four feet (according to some, four hundred and forty-three feet). It is the highest building of stone in England; the tower up to the point at which the spire commences, is adorned with pilasters, columns, pinnacles, &c.: the spire is evidently of more modern erection, and it is said that the spire is, from the sinking of the tower, twenty-two inches out of the perpendicular. The cathedral (except the spire) was finished in 5260, by Giles de Bridport, the then bishop of the diocese.

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## SAINT PAUL'S CATHEDRAL.—(5.)

The following is an estimate of its dimensions:—

| | feet. |
|---|---|
| From east to west within the walls . . . . . | 510 |
| From north to south within the doors of the Porticos . | 282 |
| Breadth of the west entrance. . . . . . | 100 |
| Its circuit . . . . . . . . | 2292 |
| Its height within, from the centre of the floor to the Cross . | 404 |

| | feet. |
|---|---|
| Circumference of the Dome . . . . . . | 420 |
| Diameter of the Ball . . . . . . . | 6 |
| From the Ball to the top of the Cross. . . . | 30 |
| Diameter of the Columns of the Porticos . . . | 4 |
| Their height is . . . . . . . | 48 |
| To the top of the west Pediment under the figure of St. Paul. | 120 |
| Height of the Tower of the west front . . . | 287 |

It was commenced in 1675, and finished by Sir Christopher Wren, the chief Architect, in 1710. It cost building £1,500,000. The extent of ground-plat on which it is built is 2 acres, 16 perches, 23 yards, 1 foot.

It is built upon an eminence on the site of the ancient Gothic Cathedral destroyed by the Great Fire in 1666, formed entirely of Portland Stone, and in the purest style of Grecian Architecture. The general shape is that of a cross. The same architect (Wren), the same mason (Strong), the same Bishop (Compton), saw the first stone laid, and witnessed its completion.

## THE GIRALDA—SEVILLE CATHEDRAL. (6)

The exterior of this Cathedral presents a grotesque grandeur produced by the combination of three utterly different species of architecture. The church itself is of gothic construction, partly erected at an earlier period than the eighth century. The sacristy is entirely in the modern taste, while the court and garden adjoining with the thrice-famous Giralda, date from the dominion of the Arabians. This wondrous tower of Giralda was built towards the close of the 12th century, in the reign of Jacob Almanzor, by Algeber,* a famous mathematician and architect. Originally it rose to an elevation of 280 feet, and was surmounted by an iron globe of prodigious size; which, being splendidly gilded, reflected, and almost rivalled the brilliancy of the sun. Immediately beneath this ball was the gallery, whence the mulzzims convoked the faithful to their stated devotions. The ascent of the tower is effected by a spiral stairway without steps, and of such gradual inclination, that a person walks up with scarce an effort, as he would ascend a gentle hill. In more modern times the globe has been removed, and a small tower of inferior diameter has been erected above, making

* The first who introduced Algebra into Spain.

the entire present of the whole construction, 364 feet; more than two thirds of the higher pyramid. This immense mass terminates in a colossal statue in brass of a female, intending to represent the Faith. This is the famous *Giralda*, or *weather-cock*, one of the great wonders of Spain, and the subject of many a poetic allusion. "It is certainly a little singular," says a modern visitor (A Year in Spain, by a young American), "that any good Catholic should have thought of setting the emblem of his faith for a weather-cock, to turn about with every change of wind; though the different destinies which have ruled Seville, and the widely different religions as ages with which this same tower has been associated, all point to the possibility of variation. As I walked up the winding ascent in the interior of the tower, it was evident to me that two cavaliers, accoutred with spear, shield and helmet, and mounted upon their war horses, might easily ride side by side to the top, as is said to have been done on more than one occasion; and as for the Knight of the Mirrors, though he told Don Quixote many a lie, he was at least within bounds of probability, when he recounted his adventures with the giantess Giralda." The view from this immense elevation is a very fine one; the interior of the church is 420 feet by 260, with a central nave rising to an immense height; but the finest sight of all, is the matchless collection of pictures which adorn its walls; these are by Murilla and Valesquez. The city of Seville is not a handsome one, and, although it contains some beautiful buildings, will not bear out the vain Spanish proverb,

> "Quien no ha visto Sevilla
> No ha visto maravella,"

which may be rendered thus,

> "He who hath not Seville seen,
> Hath not seen strange things, I ween."

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## TOWER OF MINAR—DELHI. (7)

According to tradition, this city was founded 300 years B.C., by Delu; it formerly stood on the left bank of the Jamna, and is said to have covered a space of 20 square miles. The emperor Shah Jehan built a new city in 1631, on the right bank of the Jamna; this is the modern Delhi. It is about 7 miles in circumference, and surrounded by walls constructed of large blocks of granite, having several towers and bastions. The city has seven gates of freestone, and contains the remains of several fine palaces, the former dwellings of the chief Omrahs of the empire; the palaces are each of considerable extent. There are also several beautiful mosques; the largest of these, the Jumma Musjeed, was built by Shah Jehan, and completed in six years. The gardens of Shah Jehan are said to have cost a score of rupees (£1,000,000); the original character of which is completely lost, and they now form a neat park. There are also some ruins of splendid Mausoleums in good preservation. A remarkable tower, called the "Minar," stands here; it is of great antiquity, and perfectly circular, being divided in five parts or stories; it is built in a peculiar style of architecture, and is computed to be 262 feet in height.

## PORCELAIN TOWER, AT NANKIN. (8)

It is so called from its being entirely covered with porcelain tiles, beautifully painted; the form of it is octagonal, contains nine stories, and is 249 feet in height; the base (which is of solid brickwork) has a wall 12 feet in thickness, which is lessened gradually as it ascends; upon the top is a pine apple upon a spire or pyramid. It has a rough marble balustrade surrounding it, and there is an ascent of 12 steps to the first floor, from whence there is access to all the other stories, but the staircases are very narrow, steep, and inconvenient. Upon every story there is a pent house on the outside of the tower, and at each corner are small bells, which, when moved by the wind, produce a pleasing sound. The interior divisions of the stories are only large pieces of timber, having rough boards laid across them. The ceilings of the rooms are ornamented with paintings, and the light to them is by lattices, made of wire; the niches of the wall are filled with Chinese idols, and other ornaments, which are said to have a very beautiful effect. It has been built nearly 400 years, and is still in the highest state of preservation and beauty.

## CATHEDRAL OF NOTRE DAME, AT PARIS. (9)

The present Cathedral, which dates between 1180 and 1223 as the period of its erection, was built upon the ruins of two churches, one of which may belong to late in the fourth century, and the other early in the fifth. The present Cathedral may be considered as uniting both these churches, and covering the whole space which they formerly occupied. The principal front is to the westward, and consists of three portals with a pillared gallery, over which are a central and two side windows, from which the light to the church is given; and over these is another gallery; from these last rise two towers, each 204 feet in height, and are, undoubtedly, more ponderous than beautiful. The front is richly adorned with florid ornaments and grotesque figures.

The walls of the church are immensely solid; the interior is 414 feet in length, 144 wide, and 102 feet high. The columns which support the arches are nearly 300 in number, and each is formed of one block of stone. At the Revolution it suffered considerably, and there are only 30 chapels which remain entire out of 48. Since the return of the Bourbons it has been repaired, and the choir, altar, and sanctuary, are all decorated in a style of extraordinary richness; there are several paintings of merit, but still the character of the building is that of heaviness and gloom. The regalia of Charlemagne is deposited here.

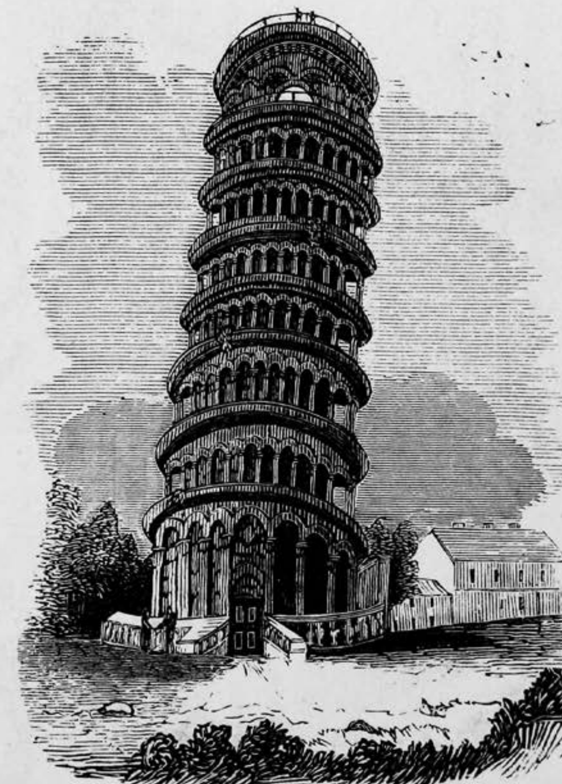
## THE MONUMENT—LONDON—(10)

Stands at the bottom of Fish Street Hill, near the New London Bridge, since the building of which the space around it has been thrown open, and is now a very beautiful object to the sight. It is a fluted Doric column, two hundred and two feet in height (or, as others reckon, two hundred and fifteen feet), the diameter of the shaft is fifteen feet; in the interior is a spiral staircase, having a gallery surrounded with an iron ballustrade, above which is a cippus or meta thirty-two feet high, supporting a blazing urn of brass gilt. It was begun by Sir Christopher Wren in 1671, and finished by him in 1677, to commemorate the rebuilding of the city after the great fire in 1666. That portion of the inscription which reflected on the Catholics has been, with very good taste, expunged by the City authorities.

## LEANING TOWER AT PISA. (11)

This celebrated *Campanile*, or leaning tower, is of a circular form, built entirely of white marble, and one hundred and eighty feet in height; there are two hundred and thirty steps by which you ascend to the summit; on the outside of each floor is a gallery, of which there are eight, and is open in the interior; it was finished in 1174. The tower was evidently intended as a belfry for the Duomo or Cathedral, close to

The Rialto, Venice.



Leaning Tower of Pisa.

which it stands. It is a beautiful piece of architecture, but its chief curiosity consists in its being fourteen feet out of the perpendicular although it has been thought to have been built in its present inclined position from eccentricity on the part of the architect, yet there can be no reasonable doubt, but that it is occasioned by the sinking of the earth on one side of it. The entrance is by two beautiful bronze doors, said to have been brought from Jerusalem. The view of the surrounding country from the top is extensive and beautiful.

## BRIDGE OF ALCANTARA—SPAIN. (12)

Alcantara is a small frontier city of great strength, in Spanish Estremadura, upon the banks of the Tagus; the town was originally built by the Moors, on account of the conveniences of a fine stone bridge, which is said to have an inscription that it was built in the reign of the Emperor Trajan, by the Lusitania, who were assessed to pay the expences. It was thus that the Moors gave to the town the name of Al-Cantara, which signifies *the bridge*. This bridge is thrown across the river at a place where it flows in a deep channel, between two high and steep rocks. It is elevated two hundred and eleven feet ten inches (some reckon it only one hundred and ninety-six feet) above the level of the water; although it consists but of six arches, it is five hundred and sixty-eight feet in length and twenty-seven feet six inches in breadth; of the six arches, the two in the centre are ninety-four feet wide. A triumphal arch in honor of Trajan, rises in the centre, and a Mausoleum, constructed by the Roman architect (Lacer), stands at the extremity towards the town. This mausoleum, which owes its preservation to the enormous stones with which it is constructed, has been changed into a chapel, dedicated to St. Julian, and is now an object of veneration both to the townspeople and the peasantry; there is nothing else remarakable about the town, except the strong walls, bastions, and other works, which its situation as a frontier town seems to demand.

## MOSQUE OF ST. SOPHIA, CONSTANTIOPLE. (13)

This Mosque has been most talked of because it was anciently a Christian temple, and was supposed to have suggested to the Turks the grand dome or cupola, and which predominates in all their religious edifices; if the Turks did borrow the dome from it, they have greatly improved upon the original, which is comparatively low and heavy, whilst their cupolas are lofty, light and elegant, but several of the other Mosques far exceed Santa Sophia in situation, boldness and beauty, particularly that of Sultan Achmet. The length of the Mosque of Saint Sophia is 114 paces; its breadth is 80, with a portico in front of 36 feet wide; this is supported by beautiful marble columns, and communicates with the interior by nine splendid folding doors, having some considerable remains of fine bas-reliefs and mosaic work; parallel to this is a second portico with five gates of brass, but the ornaments have been defaced. The top of the Mosque has a dome of beautiful structure, said to be 113 feet in diameter, and 189 feet in height, and is supported by immense pillars of white marble; it receives light from 24 wooden windows, and is wholly without interior ornaments, the Moslem faith not allowing of any statues or paintings.

## NAPOLEON'S TRIUMPHAL PILLAR, AT PARIS. (14)

In the centre of the place, Vendôme, and in the most splendid quarter of Paris, stands the famous triumphal pillar which Bonaparte erected to commemorate the success of his arms in Germany, in the campaign of 1805. Its total elevation is 135 feet, and the diameter of the shaft is 12 feet. It is in imitation of the pillar of Trajan, at Rome, and is built of stone, covered with bas-reliefs (representing the various victories of the French army), cast from twelve hundred pieces of cannon taken from the Russian and Austrian armies. The bronze employed in this monument was 360,000 pounds weight. The column is of the Doric order; the bas-reliefs of the pedestal represent the uniforms and the weapons of the conquered legions. Above the pedestal are festoons of oak, supported at the four angles by eagles, in bronze, each weighing five hundred pounds. The bas-reliefs of the shaft pursue a spiral direction, from the base to the capital, and display in chronological order the principal actions of the campaign, from the departure of the troops from Boulogne, to the battle of Austerlitz. The figures are three feet high; their number is said to be two thousand, and the length of the spiral band is 840 feet. Above the capital is a gallery, which is approached by a winding staircase within, of one hundred and seventy six steps. Upon the capital is the following inscription:—

Monument élevé a la gloire de la grande armée,
PAR NAPOLEON LE GRAND.
Commencé le XXV. Août 1806, terminé le XV. Août 1810, sous la direction de
D. V. DENON,
M. M. I. B. Lepere et L. Gondoin—Architectes.

Over the door leading to the staircase is a bas-relief, representing two figures of Fame supporting a tablet, upon which is the following inscription.

NEAPOLIO. IMP. AUG.,
MONUMENTUM BELLI GERMANICI.
ANNO M. D. C. C. C. V.
TRIMESTRI SPATIA. DUCTU. SUO
PROFLIGATI
EX. ÆRE. CAPTO.
GLORIÆ. EXERCITUS. MAXIMI
DICAVIT.

## TRAJAN'S COLUMN AT ROME.—(15.)

Foremost among the monuments of antiquity, which the hand of Time has left to mark the by-gone glory of imperial Rome, stands this beautiful column. By the description (which is still to be read) on its base, it was erected in the year 115, in honor of the victories of Trajan in his two expeditions against the Dacians; but he was destined never to see this testimony of his country's gratitude, for he died of dysentery at Seleucia, in 117, while engaged in his war with the Parthians. The column is entirely composed of white marble, having a base, a shaft in the Doric order, and a capital; it is one hundred and fifty-one feet in height, and consists of only thirty-three blocks of marble, of which eight compose the base, twenty-three the shaft, and two the capital; there is a spiral staircase in the interior, which is entirely cut out of the same stones, having forty-two loop holes to admit the light; it was anciently surmounted by a statue of the Emperor Trajan; but has now one of the apostle Peter. But the greatest beauty of the pillar consists in the bas-relief, which covers the whole of the shaft; this is in the form of an ascending spiral riband, which has twenty-two revolutions before it reaches the top; there are not less than three thousand figures beautifully sculptured, representing the victories over the Dacians, and two triumphal processions; the figures are each two feet in height at the bottom of the shaft, and double that size at the top; the figure of Trajan appears at least fifty times, and the bas-relief is highly prized, as indicating the actual costume, warlike instruments, pontoons, &c. of the period at which the column was erected.

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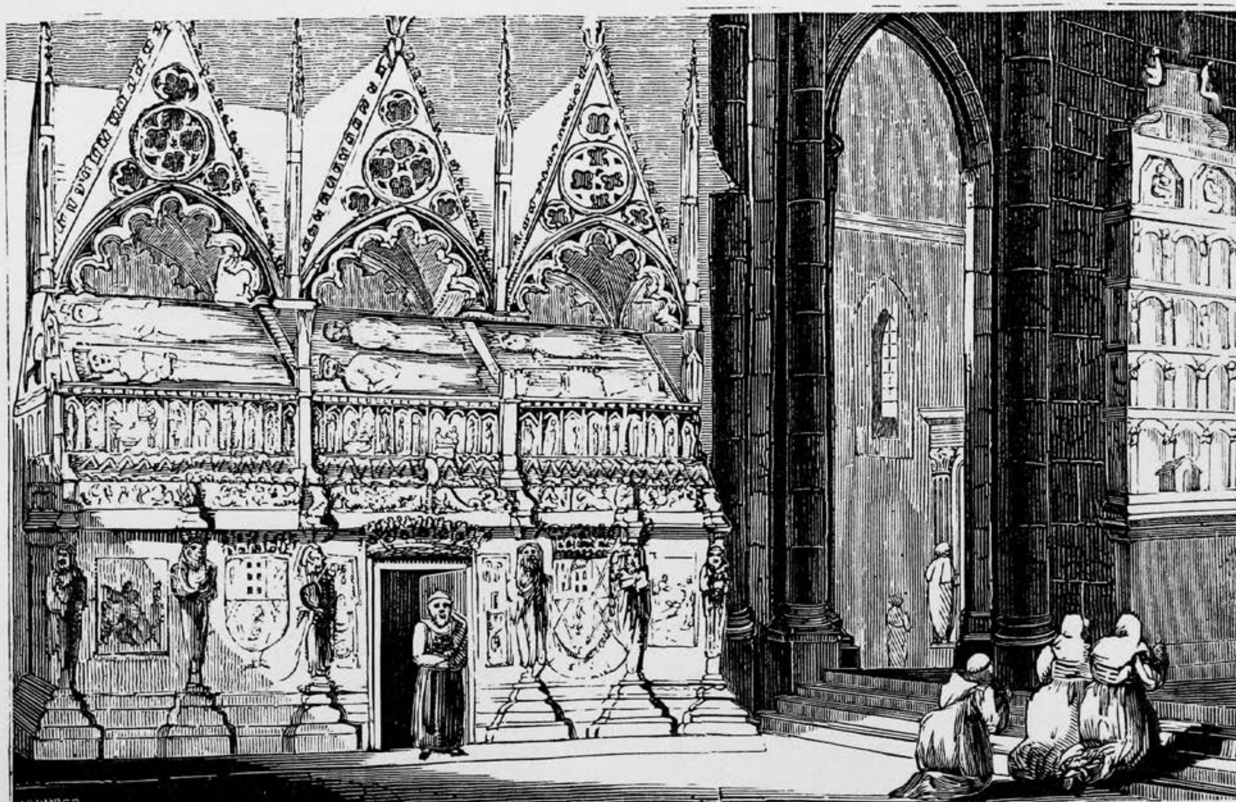
## MOSQUE OF OMAR AT JERUSALEM—(16.)

"When we returned to the city (Jerusalem, says Clarke, Vol. 2., p. 601.), we waited upon the governor to thank him for the civilities we had received. Upon this occasion we used all the interest we had with him, by means of Djezzar Pacha's own interpreter, to obtain admission into the Mosque of the Temple of Solomon, or Mosque erected upon the site of that temple by the Caliph Omar, in the seventh century (A. D. 637). He entreated us not to urge the request, saying his own life would certainly be required as the price of our admission. We were therefore compelled to rest satisfied with the interesting view it afforded from his own windows, which regarded the area of the temple. The sight was so grand, that we did not hesitate in pronouncing it the most magnificent piece of architecture in the Turkish empire, and, considered externally, far superior to the Mosque of Saint Sophia in Constantinople. By the side of the spacious area in which it stands, are certain vaulted remains; these plainly denote the masonry of the ancients, and evidences may be adduced to prove that they belonged to the foundations of Solomon's Temple. We observed also that reticulated stucco, which is commonly considered as an evidence of Roman work. Phocas believed the whole space surrounding this building to be the ancient area of the Temple, and Golius in his notes upon the astronomy of Alferganes, says, the whole foundation of the original edifice remained. As to the Mosque itself, there is no building at Jerusalem that can be compared with it, either in beauty or riches. The lofty Saracenic pomp, so nobly displayed in the style of the building, its numerous arcades, its capacious dome, with all the stately decorations of the place; its extensive area paved and variegated with the choicest marbles, the extreme neatness observed in every avenue towards it, and lastly, the sumptuous costume observable in the dresses of all the Eastern devotees passing to and from the sanctuary, make it altogether one of the finest sights Mahometans have to boast. Its supposed height is one hundred and twenty-five feet.




Tombs of the Kings of Arragon.

## THE LUXOR OBELISK, AT PARIS.—(17.)

This obelisk was the lesser of two which stood at the entrance of the Temple of Luxor, in ancient Thebes; it is of the red granite of Syene, and is in height seventy-five French feet, eight to ten feet wide at the base, and is calculated to weigh two hundred and forty tons; it was removed from the ruins of Thebes, which is one thousand two hundred feet from the Nile. All the monuments of Thebes belong to a period anterior to the Persian conquest, B. C. 525, and are beyond dispute the oldest and most genuine specimens of Egyptian architecture. Speaking of the magnitude of the ruins of Thebes, Belzoni says, "It appeared to me like entering a city of giants, who, after a long conflict were all destroyed, leaving the ruins of their various temples as the only proof their former existence." The French, by immense labor, ingenuity, and time, (from the 15th of April 1831, to the 5th of August 1833,) brought it to Paris; the whole distance performed in the voyage was one thousand four hundred leagues. It is richly ornamented with Hieroglyphic characters, and now forms one of the many beauties of Paris.

## THE AQUEDUCT OF SEGOVIA.—(18.)

This is supposed to have been built by the Romans, in the reign of the Emperor Vespasian. Its object was to convey the water brought from a great distance over a steep ravine, seven hundred feet wide and more than ninety deep, which divided one portion of the city from the other. To effect this, two ranges of arches were thrown one above another. The upper one is on a level with the high land on either side, and has one hundred and fifty-nine arches. Though the middle part of the aqueduct is ninety-four feet from the ground, yet the bases of the abutments are not more than eight feet wide; a fact which is the best comment upon the beauty, lightness, and perfection of the structure. Indeed it is even admitted, that though inferior in extent and magnificence to the Pont du Gard, the aqueduct of Segovia is yet the greater wonder. The stones used in the construction of this aqueduct are all of equal size, about two feet square, and are put together *without any cement*, depending solely upon each other to be maintained in their places. A very few have fallen; but the action of the weather has worn away the edges of all of them, until they now appear nearly round. This aqueduct is one hundred and two feet in height.

## THE SPHINX —(19.)

After innumerable difficulties and immense labor, by more than sixty men for seven months, Mr. Caviglia succeeded in laying open the whole of this extraordinary statue to its base; the huge paws were found to stretch out fifty feet in advance of the body, which is in a cumbent posture, fragments of an enormous beard were found resting beneath the chin, and there were seen all the appendages of a temple, granite table and altar, arranged on a regular platform immediately in front. On this pavement, and at an equal distance between the paws of the figure, was the large slab of granite just mentioned, being not less than fourteen feet high, seven broad, and two thick. The face of this stone, which fronted the east, was highly embellished with sculptures in bas-relief, the subject representing two sphinxes seated on pedestals, and priests holding out offerings, while there was a long inscription in hieroglyphics, most beautifully executed; the whole design being covered at the top with the sacred globe, the serpent and the wings. Two other tablets of calcareous stone similarly ornamented, were supposed to have constituted part of a miniature temple, by being placed one on each side of the latter, and at right angles to it. One of them, in fact, was still in its place; of the other, which was thrown down and broken, the fragments are now in the British Museum.

A small lion, couching in front of this edifice, had its eyes directed towards the Sphinx; this, and some other fragments, are all painted red; a color which, in Egypt, as well as in India, is appropriated to sacred purposes. "The breast, shoulders, and neck," says Dr. Richardson, "which are those of a human being, remain uncovered, as also the back, which is that of a lion; the neck is very much eroded, and, to a person near, the head seems as if it was too heavy for its support. The head dress has the appearance of an old fashioned wig, projecting out about the ears like the hair of the Barberi Arabs; the ears project considerably, the nose is broken, the whole face is painted red, which is the color assigned to all the deities, except Osiris; the features are Nubian or ancient Egyptian; the expression is particularly placid and benign; so much so that the worshipper of the Sphinx might hold up his God as superior to all other Gods of wood and stone, which the blinded nations worshipped." As to the dimensions of the figure, Pococke found the head and neck, all that were then above ground, twenty-seven feet high; the breast was thirty-three feet wide, and the entire length about one hundred and thirty. Pliny estimated it at one hundred and thirteen feet long by sixty-three in height. According to Dr. Richardson, the stretch of the back is about one hundred and twenty feet, and the elevation of the head above the sand from thirty to thirty-five feet.

According to some authors (says the Rev. Mr. Russel, from whose able work on Egypt we copy this), the countenance of a beautiful woman is combined with the body of a lion or other animal, intimating the alluring aspect with which vice at first assails the unwary, and the besotted monsters which she makes them when caught in her fangs. Others, again, have regarded them as astronomical symbols, marking the passage of the sun from the sign Leo into that of Virgo, and thereby shadowing forth the happy period when the overflowing of the Nile diffuses the blessings of health and plenty throughout the whole land.

## MAN—(20.)

Average height of five to six feet.

God spake; he look'd on Earth and Heaven
With mild and gracious eye:
In his own image man he made
And gave him dignity.

He springs from the dust,
The Lord of the earth,
The chorus of Heaven
Exult at his birth.

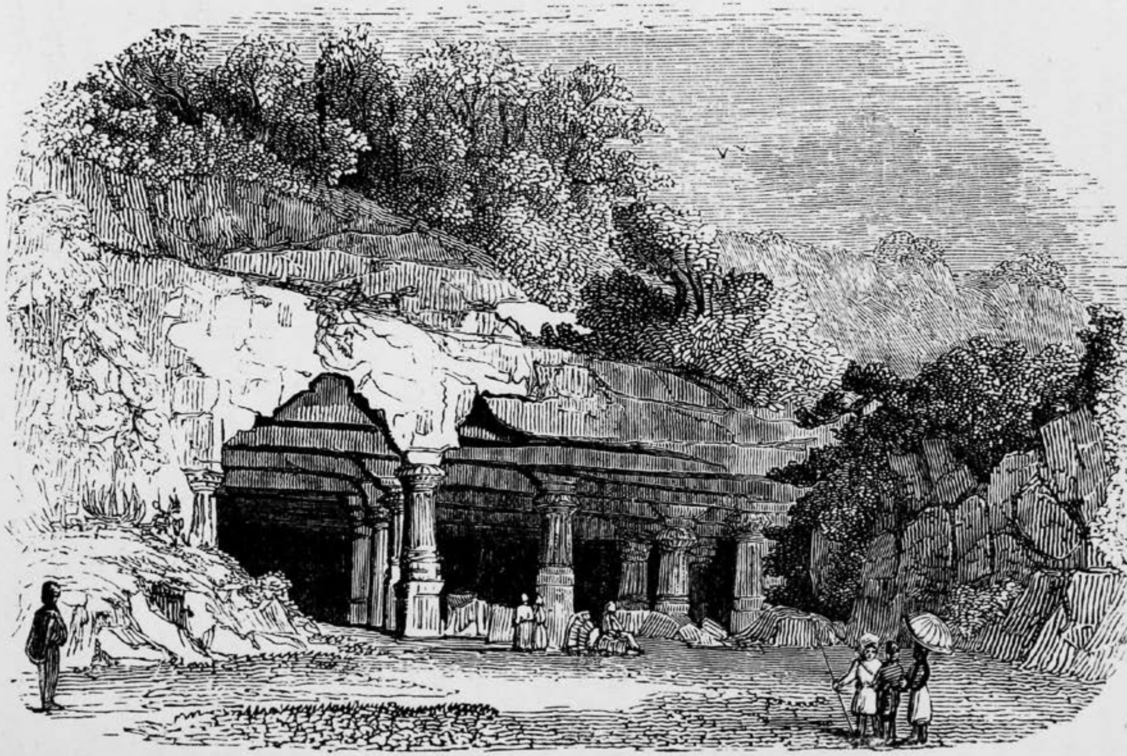
FROM THE GERMAN.

## TOMBS OF THE KINGS OF ARAGON.

Aragon is one of largest provinces of Spain; yet it is, at the same time, one of the least populous, and the least susceptible of improvement. It was formerly an important kingdom, and in the preamble to one of its ancient laws, it is declared, that "such was the barrenness of the country, and the poverty of the inhabitants, that were it not on account of the liberties by which they were distinguished from those of other nations, the people would abandon it and go in quest of a habitation to some more settled region." Mr. Hallam is of opinion that the origin of the kingdom of Aragon was contemporaneous with the Moorish conquests. "On both sides of the Pyrennees dwelt an aboriginal people, the last to under go the yoke, and who had never acquired the language of Rome." After passing from the dominion of the Romans to that of the Goths, in

470, the province fell into the power of the Moors, in 714, and was one of the last which was freed from them ; the inhabitants only escaping by parties, and at different times. A small district within it was the first place where the Christians re-established their power. The people are characterized as hardy mountaineers, but we know little of them in the dark period which elapsed under the Gothic dynasty. Charlemagne, in his conquest of Spain, the first war in which he engaged with the sole view to conquest, met with stout resistance here, for we find these people cutting off the rear-guard of the emperor, at Roncesvalles, and subsequently maintaining their independence. "The Tower of Jaca," says Mr. Hallam, "situated among long narrow ridges of the Pyrennees, was the capital of a little free-state, which afterwards expanded into the monarchy of Aragon; such was the germe of this afterwards important kingdom.

Twenty names figure in the historian's list of the Kings of Aragon, from Ramires, 1035, to Ferdinand II, 1481, by whose marriage with Isabella, and death of John II, in 1479, the two ancient and rival kingdoms of Castile and Aragon were for ever consolidated in the monarchy of Spain; of which Aragon then only became, as it continues to this day, a province. The natures of the Aragonese rulers were as various as their fortunes; and we find among their titles, the Chaste, the Conqueror, the Beneficent. the Just, the Great. Some of them played "fantastic tricks," for James I was made prisoner in his own palace without any communication, and kept in sight during every twenty days. These kings were buried at Saragossa; where, in the convent of Jeronomytes, called Sancta Engracia, are to be seen their escutcheons, or tombs. They occupy one side of a cloister, amidst a mixture of ancient and modern ornaments, in freestone, marble-stones, and plaster, and decorated with small marble columns, plain and twisted. It is a desolate building of great irregularity, which arose from Charles 1st (1516) having ordered this cloister to be built pursuant to the particular request of Ferdinand, his grandfather; but the money falling short, the ruins of an old cloister were used. Here also is buried Jerome Blancas, the highly esteemed historiographer of Aragon, who has not even a stone or inscription to indicate his resting place: although he wrote volumes to commemorate the glories of ancient Aragon. What is this but ingratitude; in short, what is the whole scene in its crumbling decay, but a lesson upon the vanity of power and wealth; and as the wind sighs through the prison-like windows and beneath the cracking arches of this desolate place, we may meditate a motto for each of the regal escutcheons. "How can you say to me, then, I am a king!'



Cave of Elephanta.

## THE CAVE OF ELEPHANTA

Is situate in a beautiful island in the Bay of Bombay; it is called by the natives, Goripura, or *Mountain City*; its common name of Elephanta is derived from a colossal figure of an elephant, cut out of a detached mass of blackish rock, unconnected with any stratum below; this figure has had another on its back, which has been sometimes called a young elephant, but there can be no reasonable doubt, from a close inspection of what remains, that it was a tiger. The head and neck of the elephant separated from the body in 1814; the length of this colossal figure is, from the forehead to the tail, 13 feet 2 inches, and the height is 7 feet 4 inches; this figure stands about 250 yards from the landing place, on the south of the island. After proceeding up a valley till the two mountains unite, there is a narrow path, ascending which you have a beautiful view of the island, and of the opposite shores of Salvette. "Advancing forward," says Mr. W. Erskine, "and keeping to the left along the bend of the hill, we gradually mount to an open space and come suddenly on the grand entrance of a magnificent temple, whose huge massy columns seem to give support to the whole mountain which rises above it. The entrance into this temple, which is entirely hewn out of a stone resembling porphyry, is by a spacious front supported by two massy pillars and two pilasters, forming three openings under a thick and steep rock, overhung by brushwood and wild shrubs. The long ranges of columns that appear closing in perspective on every side; the flat roof of solid rock that seems to be prevented from falling only by the massy pillars, whose capitals are pressed down and flattened, as if by the superincumbent weight; the darkness which obscures the interior of the temple, which is dimly lighted by the entrances, and the gloomy appearance of the gigantic stone figures ranged along the wall, and hewn like the whole temple out of the living rock; joined to the strange uncertainty that hangs over the history of this place,—carry the mind back to distant periods, and impress it with a kind of uncertain and religious awe, with which the grander works of ages of darkness are generally contemplated. The whole excavation consists of three principal parts; the great temple itself, which is in the centre, and two smaller chapels, one on each side of the great temple. These two chapels do not come forward into a straight line with the front of the chief temple, are not perceived on approaching the temple, and are considerably in recess, being approached by two narrow passes in the hill; one on each side of the grand entrance, but at some distance from it. After advancing to some way up these confined passes, we find each of them conduct to another front of the grand excavation, exactly like the principal front which is first seen; all the three fronts being hollowed out of the solid rock, and each consisting of two huge pillars with two pilasters. The two side fronts are precisely opposite to each other on the east and west, the grand entrance facing the north. The two wings of the temple are at the upper end of these passages, and are close by the grand excavation, but have no covered passage to connect them with it.

From the northern entrance to the extremity of this cave is about one hundred and thirty and a half feet, and from the eastern to the western side one hundred and thirty-three feet. Twenty-six pillars, of which eight are broken, and sixteen pilasters support the roof. Neither the floor nor the roof is in the same plane, and consequently the height varies; being in some parts seventeen and a half, in others fifteen feet. Two rows of pillars run parallel to one another from the northern entrance, and at right angles to the extremity of the cave; and the pilasters, one of which stands on each side of the two front pillars, are followed by other pilasters and pillars also, forming on each side of the two rows already described another row running parallel to them up the southern extremity of the cave. The pillars on the eastern and western front, which are like those on the northern side, are also continued across the temple from east to west.

Thus the ranges of pillars form a number of parallel lines, intersecting one another at right angles, the pillars of the central parts being considered as common to the two sets of intersecting lines. The pillars vary both in their size and decorations, though the difference is not sufficient to strike the eye at first. The walls are covered with reliefs, and all these refer to the Indian mythology. The deities of the Hindoo Pantheon amount to three hundred and thirty millions, yet all these gods and goddesses may be resolved into three principal ones, Vishnu, Sheva, and Brahma, the elements, and the three females, Doorgo, Lukshumu, and Surnswutu, of which, together with some inferior deities, we shall give a brief account. Brahma is likewise styled the great one. The Hindoo mythology states that the world was all darkness when the self-existent god, Bramhu, who was desirous of forming different creatures by an emanation of his own glory, first created the waters and impressed them with a power of motion. By that motion was produced a golden egg, "blazing like a thousand suns," from which was born Brahma, the parent of all rational beings. He is represented with four heads and as many arms. His name signifies knowledge, in allusion to his creative power. He is the god of fate, master of life and death, and, in conjunction with Vishnu and Sheva, armed with almighty power, pursues throughout the whole creation the rebellious Deutahs or malignant spirits, who are led astray by Mahasoor, their chief, hurling upon them the Aguyastra, or fiery bolts of vengeance. Brahma is considered as the author of the Vedas; he is also the great lawgiver and teacher of India. The Hindoo mythology resembles in many respects that of the Scythians, Persians, Egyptians, and Greeks. Vishnu is represented as a black man, with four arms; in one a club, in the other a shell, in the third a chukru, and in the fourth a water-lily. He rides on a Guroorn, an animal half-bird half-man; the Shasters give an account of ten incarnations in the character of a preserver, and he is said to have brought up the sacred books from the bottom of the sea: his character is beneficent, and his appearance is gentle and pleasing. He may be said to counteract the evil produced by Maha Deo and his unamiable consort. Sheva, Seva, or Shiva, is represented as a silver-colored man, and many points of resemblance may be traced in his character to the Bacchus of classical mythology. Sheva is called the destroyer, and well does he merit the epithet; the sacrifices offered at his shrine, and to placate his wrath, are beyond every idea sanguinary and bloody: they are the most cruel of all the Hindoo rites. When the poor victim, a sharp hook drawn through his back, is suspended high in mid-air and swung round with a dizzying vehemence, the object is to honour Sheva; when the deluded fanatic, from some towering eminence, throws himself on hundreds of pikes lying concealed beneath heaps of lightly strewed straw, Sheva is supposed to be well pleased and to smile; when the fakir lies on an iron bed of spikes, or is seated for years upon a monument, exposed to cold, storm, and blast, with his hands and arms elevated, until the course of the blood be changed, and the nails of the fingers protrude into the flesh, Sheva looks down with a complacent and benignant smile, and when the old man dies, he is sure to be received to the crown of paradise.

The rock-cut temples of India are generally supposed to be of higher antiquity than pagodas or temples built on the surface of the earth.

## WONDERFUL CAVE AT ADELSBERG,

### IN CARNIOLA.

After scrambling for two hours up and down many a dangerous cliff, and along the brink of many a frightful precipice, we entered a nearly impenetrable forest, from which we only emerged to behold a repetition of the same savage scenery, which accompanied us to the wonderful grotto; around which nature seemed to concentrate all her terrors, so as to render it a perfect Tartarus. A tremendous pile of rocks reared their giddy heights to the clouds; upon one of those lesser peaks, the majestic ruins of a castle threatened to crush us with its crumbling walls. The river Poick in one place was tearing a passage through a perfect chaos of shattered crags; in another turning a mill, till at length it rushed in a torrent through the contracted glen beneath, and such was the violence of its current, that the frail bridge thrown from rock to rock, over which we passed, trembled beneath us. In general we see rivers tumbling down from tops of mountains, and then fertilize a valley; but in this wild country, as if every thing in it were to border on the marvellous, we see a river, after its descent, enter the earth and entirely disappear.

The entrance to the grotto is secured by a door, which, being opened, we were met by flocks of owls and bats, scared by the pine torches of the guides. We proceeded through a long spacious gallery of about a hundred paces, when it suddenly opened into an immense cavern of the most colossal height, but this was merely the vestibule to the most magnificent of nature's temples; for at length we arrived beneath a vast dome, whose altitude, by torch light, seemed immeasurable! This splendid hall was fifty-feet broad, seventy feet long, and encrusted with stalactites of the most surpassing beauty, sparkling like diamonds, and appeared worthy of being the palace of the Gnome King himself. The floor is quite level, and a few wooden benches and rustic chandeliers, told that this was the hall in which the peasants, by a merry dance, celebrated annually the festival of their patron saint. From hence the caverns branch off in different directions; not in long galleries, but in a succession of grottos. Those to the left are numerous, spacious, and lofty; while the others, though smaller, are more varied in their fantastic forms. As we advanced they became more elevated, and the columns more majestic, till, after traversing two leagues in the heart of the

Barcelona Gate.

earth, our progress was terminated by deep subterranean lake. It would be impossible to describe with any degree of accuracy, the varied, natural architecture of this city of stalactites (spars like icicles). In one place we appeared to wander through the aisles of a gothic cathedral, supported by columns of the most gigantic height, sometimes uniform and sometimes clustered together, as if fluted. Some of the smaller grottos are entirely inlaid with stalactites, and as they reflected the burning torches, appeared one blaze of light. The sparry masses exhibited every form which the invention of the guides could devise; in one place we had crystal cascades of the most dazzling brightness; in another, rows of pillars, ornamented with festoons; here triumphal arches, and there the Emperor's throne surmounted by a crown. In short, the whole range appears as if real objects had been metamorphosed into crystal, by the power of some mighty magician. However, it is not only the beauty of the stalactites, and their innumerable forms that arrest our attention, but the foaming river Poick, which here again makes its appearance, roaring in the horrible abyss beneath, by the side of whose frightful gorge, and across whose rocky ridges, we frequently bent our course. Here the unbroken solitude that reigned, the unearthly stillness, save the crash of the mighty flood, the supernatural appearance of every object around, might impress even the least imaginative with a sort of superstitious terror.

On our return, the guides set fire to a bundle of straw, part of which they threw into the abyss beneath, when a scene of grandeur ensued perfectly indescribable. The whole intermediate space, from the almost fathomless gulf in which the river is rushing, to the loftiest above, was instantly illuminated by the bright glare, forming a lively representation of the infernal regions. The grottos at Muggendorf, in Franconia, however interesting, are mere mouse holes compared with this, which equals in colossal grandeur its own gigantic Alps.

## GATE OF BARCELONA.

Barcelona is of very great antiquity, having been founded more than two centuries, B. C., by Hamilcar Barcas, father of the great Hannibal, from whom it derives its name. It made no great figure under Roman domination, having been eclipsed by the immense city of Tarroco, now Tarragona. When the Saracens overran Spain, Barcelona shared the common fate, and yielded to the dominion of Mahomet. Its remoteness, however, from Cordova, the seat of the Saracen empire, rendered its tenure very precarious, and accordingly, in the ninth century, it was recovered by Louis le Dèbonnaire, son of the great Charlemagne. He created it into a county palatinate, and vested it in the family of Bernard, a French noble. The Counts of Barcelona continued to yield allegiance to the French crown, until it voluntarily relinquished its sovereignty in the thirteenth century. The county became annexed to Aragon by marriage, as the latter afterwards blended itself with Castile, to form the present Spanish monarchy, whose kings still use the title of Counts of Barcelona. After the discovery of America, Barcelona became a vast magazine where goods of wool, silk, fire arms, cutlery, with almost every other species of manufacture, were prepared for the distant colonies of Spain. Such was Barcelona's former state; her present is a very different one. Her manufactures of cutlery and fire arms are ruined and forgotten, the wines and brandies of Catalonia, the cotton and woollen goods which used formerly to be carried to every corner of America, are now either shipped away by stealth, or consumed only in Spain; and in place of the ships and brigs whose tall masts once looked like a forest within the mole of Barcelona, there are now to be seen only a paltry assemblage of fishing boats and felleucas, and one of its chief exports is the celebrated Barcelona nut, of which to England it was, in 1836, thirty thousand bags; the value of which was forty-five thousand pounds.

Barcelona yields only to Madrid and Valencia in extent and population. Antillon estimates the latter at one hundred and forty thousand. The greater part of the city is ill-built, with streets so narrow that many of them are impassable for carriages. This is especially the case in the centre, where the old Roman town is supposed to have stood, from the ruins found there; arches and columns of temples, incorporated with the squalid constructions of modern times. Here the public square, or *Plaza*, is formed with arcades and balconies; the scene of many an *auto-de-fé*, and many a bull fight. It has, however, witnessed one redeeming spectacle; for it was here that Ferdinand and Isabella, attended by a wondering and proud array of cavaliers and courtiers, received from Columbus the tribute of the new found world. The churches of Barcelona are not remarkable for beauty, but the custom-house is a noble edifice, and so is the exchange. In the latter, public schools are established, for teaching the sciences connected with navigation and the arts of architecture, painting, and statuary. These noble institutions are maintained at the expense of the city, and all, whether natives or strangers, children or adults, may attend the classes gratuitously, and receive instruction from able masters. The other public edifices are, the palace where the Counts of Barcelona resided, and in which the ancient Cortes held their sittings; convents and the cathedral: this was begun in the thirteenth century, but is not yet completed. There are also thirty-four fountains in Barcelona, in the various squares and public places. Barcelonetta is a suburb of Barcelona, inhabited principally by sailors.

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## THE LOGAN STONE—CORNWALL.

This extraordinary stone is situated at Castle Treryn, about two miles distant from the Land's End. The name of Castle Treryn is derived from the supposition of its having been the site of an ancient British fortress, of which there are still some obscure traces, although the wild and rugged appearance of the rocks indicate nothing like art.

The foundation of the whole is a stupendous group of gigantic rocks, which rise in pyramidal clusters to a prodigious altitude, and overhang the sea. On one of these pyramids is situated the celebrated *Logan Stone*, which is an immense block of granite, weighing above sixty tons. The surface in contact with under rock is of very small extent, and the whole mass is so nicely balanced, that, notwithstanding its magnitude, the strength of a single man applied to its under edge is sufficient to change its centre of gravity, and though at first, in a degree, scarcely perceptible, yet the repetition of such impulses at each return of the stone produces at length a very sensible oscillation! As soon as the astonishment, which this phenomenon excites, has in some measure subsided, the stranger anxiously enquires how and whence the stone originated? was it elevated by human means, or was it produced by the agency of natural causes? Those who are in the habit of viewing mountain masses with geological eyes, will readily discover that the only chisel ever employed has been the tooth of time; the only artists engaged, the elements. Granite usually disintegrates into rhomboidal and tabular masses, which by the farther operation of air and moisture gradually loose their solid angles, and approach the spheroidal form. De Luc observed in the giant mountains of Silesia, spheroids of this description so piled upon each other, as to resemble Dutch cheeses. Although the Druidical origin of the stone, for which so many zealous antiquarians have contended, may fairly be denied, still we by no means intend to deny that the Druids employed it as an engine of superstition; it is, indeed, very probable, that having observed so uncommon a property, they dexterously contrived to make it answer the purpose of an ordeal, and by regarding it as the *touch stone of truth*, acquitted or condemned the accused by its motions. Mason alludes to this supposed property in the following lines—

> ————————" Behold yon huge
> And unknown sphere of living adamant,
> Which pois'd by magic, rests its central weight
> On yonder pointed rock : firm as it seems,
> Such is its strange and virtuous property,
> It moves obsequious to the gentlest touch
> Of him whose heart is pure ; but to a traitor,
> Tho' e'en a giant's prowess nerved his arm,
> It stands as fix'd as Snowden."

The rocks are covered with a species of byssus, long and rough to the touch, forming a kind of hoary beard. In many places they are deeply furrowed, carrying with them a singular air of antiquity, which combines with the whole of the romantic scenery to awaken in the minds of the poet and enthusiast the recollection of the Druidical ages.

An act of wanton mischief was committed in 1824, by a Lieutenant Goldsmith, of the preventive service, who, with his men, threw down, for a *lark*, the Logan Stone from its time-honored seat! However, the *gentleman* was obliged by the Board of Admiralty to replace it *at his own expense*, which was a task of no ordinary difficulty.

The process of its restoration was thus described by an eye witness:

" *Penzance, Nov.* 6, 1824.

" The Logan rock is replaced, and rocks as before: it was put up on Tuesday last, after three days' labor, by the help of three pair of large sheers, six capstans, worked by eight men each, and a variety of pulleys. Large chain cables were fastened round the rock, and attached to the blocks by which it was lifted. Altogether there were about sixty men employed. The weight of the rock has been variously computed by different persons, at from seventy to ninety tons. On the first day, when the rock was first swung in the air, in the presence of about two thousand persons, much anxiety was felt by those who were present, as to the success of the undertaking; the ropes were much stretched; the pulleys, the sheers, and the capstans, all screeched and groaned; and the noise of the machinery was audible at some distance. Many were very apprehensive lest so vast a weight might snap all the ropes, and tumble over the precipice, bearing the sheers and scaffolding away with it; however, the whole has gone off with great success. The materials

Monastery of the Grande Chartreuse.

(which were all furnished *gratis*, from the dock-yard at Plymouth) were excellent, and ingeniously managed; and though a rope or two broke, and a link of one of the chains tore away a small piece of an angle of the rock, which was thrown with much velocity into the sea, yet the rock was safely supported by its complicated tackling, and stands once more in precisely its former position! Lieutenant Goldsmith, who threw it down, was the engineer in replacing it; and, in the opinion of many of the gentlemen of this town and neighbourhood, he has, by his skill and personal labor and attention, in some degree wiped away the disgrace to which he was exposed by throwing it down.

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## THE CORAL REEFS AND ISLANDS OF AUSTRALASIA AND POLYNESIA.

Throughout the whole range of the Polynesian and Australasian Islands, there is scarcely a league of sea unoccupied by a coral reef, or a coral island; the former springing up to the surface of the water, perpendicularly from the fathomless bottom, "deeper than did ever plummet sound," and the latter in various stages, from the low and naked rock, with the water rippling over it, to an uninterrupted forest of tall trees. "I have seen," says Dalrymple, in his inquiry into the formation of islands, "the coral banks in all their stages; some in deep water; others with a few rocks appearing above the surface; some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part; and lastly, such as are covered with large timber, with a bottomless sea, at a pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed, and others in the several stages of their progressive creation, Torres' Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs, which give food to paroquets, pigeons, and other birds, to whose ancestors, it is probable, the island was originally indebted for this vegetation. The time will come—it may be ten thousand, or ten millions of years, but come it must—when New Holland, and New Guinea, and all the little groups of islets, and reefs, to the north and north-west of them will either be united in one great continent, or be separated only with deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant, but most efficacious laborers.

A barrier reef of coral runs along the whole of the eastern coast of New Holland, "among which," says Captain Flinders, "we sought fourteen days, and sailed more than five hundred miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. Having landed on one of these new creations, he says, "we had wheat-sheaves, mushrooms, stag's-horns, cabbage leaves, and a variety of other forms, glowing under water, with vivid tints of every shade betwixt green, purple, brown and white." "It seems to me," he adds, "that when the animalcules, which form the coral at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate this monument of their wonderful labors." He says, that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea-birds; salt-plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore; land-birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind add something to the bank; the form of an island is gradually assumed, and, last of all, comes man to take possession.

## THE MONASTERY OF THE GRANDE CHARTREUSE.

It has been truly observed, "that there are few things finer in Europe than this monastery;" it is situate in the lowest western chain of the Alps, which divides France from Savoy; it is sixteen miles from Grenoble and twelve from Les Echelles in Savoy, which is on the great road from France to Italy, by Mount Cenis and Turin. Proceeding from Les Echelles to the Grande Chartreuse, you cross the Guiers Vif and enter France immediately, for this little river here divides the two countries of France and Savoy; your way is then along the plain, for three or four miles towards the mountains which surround it, and which rise so high, and so steep, and so without any apparent opening, that you cannot fancy where the road will lead to. At last when you come close under them, you find that an enormous notch, as it were, has been cut down into them from top to bottom, just wide enough to leave room for a roaring mountain torrent, which comes hurrying down, and presently falls into the Guiers Vif.

This torrent is called the Guiers Mort (dead Guiers), as the name of the other means living Guiers. Up the banks of the former you must make your way in the deep notch before mentioned; so deep, indeed, that in winter the sun can hardly be seen over the tops of the cliffs, and so narrow that there is only room for the chafing torrent and a narrow road, or rather track, cut through the wood along its side. The trees all the way are magnificent, chiefly pines and beech, and they grow to an enormous size. You proceed through this sort of scenery for seven or eight miles, ascending all the way, and in some places the track is very steep, and is cut in zig zags, to render the ascent more easy; for you are now going up towards the source of the dead Guiers, and the ground appears to rise to you, and so rapidly, that the stream comes down in a succession of waterfalls, and the track is now extremely steep. At last, when you have ascended to a great height, you find an opening in the mountains on your left hand, where another little torrent comes down into the Guiers, and this is not such a mere notch as the glen up which you have been toiling; but is wide enough to have some pasture in it, and the green open fields look quite refreshing amidst the dark masses of wood around them. Along this opening you ascend some distance, and then, just at the head of this little valley, under high walls of cliff rising abruptly out of the pines, is the Monastery of the Grande Chartreuse. It is a very large pile of buildings, like one of our colleges, enclosing an oblong square, or rather cloister, the length of which is six hundred and seventy-two French feet. You first are shown into a large out building, where you leave your horses, and where you are met by a lay brother, who conducts you to the stranger's room of the monastery. Here you may have any sort of needful refreshment except meat, for the monks are of the Carthusian order, which is very strict, and forbids the use of meat. The lay brother then attends you round the building. The cells of the monks are ranged along the sides of the great cloister, with little mottos from scripture, or from some religious book, painted outside the doors. Each cell includes two rooms and a sort of closet for books, besides a lumber or wood room, opening into a little garden enclosed within four walls; but when you look beyond the walls, or rather up into the sky, you see the magnificent boundary wall of cliff crowned with pines on its summit, and a cross affixed on the highest peak of all. By each cell door is a small hole in the wall, at which the father's provisions are given in to him; for they only dine in the hall on Sundays and holidays, and even then they do not speak to one another; for the rule of the Carthusians is one of the strictest of all the monastic orders, and they may not speak either to one another or to strangers without the leave of their superior.

Before the French revolution the monks had a very considerable property in the forests which surround their monastery. But at the revolution they were deprived both of their forests and their monastery; the former were sold to different individuals, but the latter could never find a purchaser; its remote situation rendering it unfit for any other purpose than that for which it had been originally designed. Accordingly, when the Bourbons came back in 1814, the monks returned to the Grande Chartreuse, and to the possession of the meadows immediately around it, with the liberty of getting their fuel from the adjoining forests. In 1830, there were about two hundred and fifty persons belonging to the monastery, including the fathers and the lay brothers. They visit the sick, and perform spiritual duties in the small chapels and churches scattered over the surrounding mountains. For eight months in the year the snow lies round the monastery, and, of course, the climate is too cold either for corn or fruit, but in the summer months, when strangers commonly visit it, the bright green of the pastures, and the magnificent size of the buildings, like a little habitable and humanized spot in the midst of the forests and cliffs, form a scene not only most sublime, but even cheerful and delightful.

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## THEBES.

The ancient city extended from the ridge of mountains which skirt the Arabian Desert, to the similar elevation which bounds the valley of the Nile on the west, being in circumference not less than twenty-seven miles. The modern Egyptians, either with the view of obtaining materials at little expense of labor, or in order that their hovels might be secure from the periodical inundations of the river, are commonly found to have built their villages on the ruins of an ancient temple or palace, even on the very summit of the roof, and most elevated part of the walls. Hence the grandeur of Thebes must be traced in four small towns or hamlets, Luxor, Karnac, Medinet Abou, and Gornoo: and first, of the

RUINS OF LUXOR.

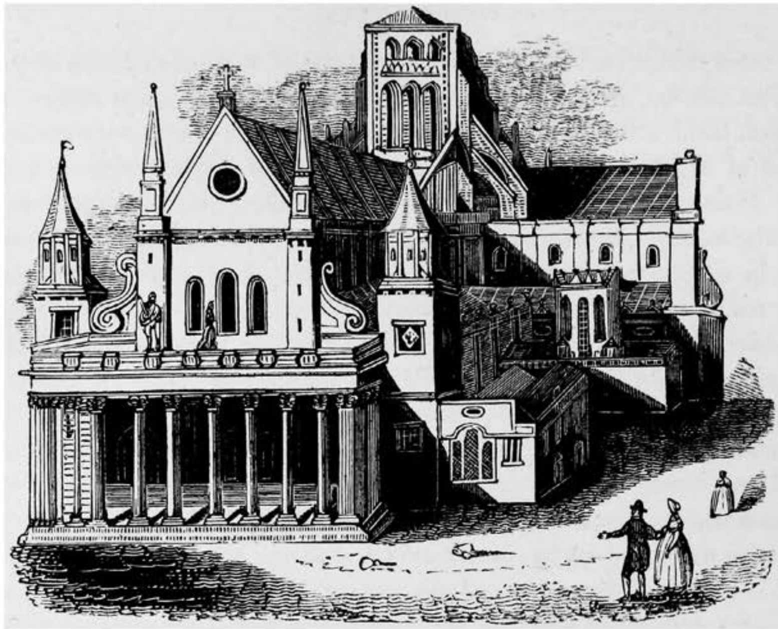
In approaching this temple from the north the first object that one sees is a magnificent gateway, which is two hundred feet in length, and the top of it, fifty-seven feet above the present level of the soil. In front of the entrance are two of the most perfect obelisks in the world (one of these has been removed to Paris, and which we have described before), each consisting of a single block of red granite. Between these obelisks and the propylon, are two colossal statues also of red granite; they are nearly of equal size, but, from the difference of the dress, it is inferred that the one was a male and the other a female figure. Though buried in the ground to the chest, they still measure about twenty-two feet from thence to the top of their mitres. On the eastern wing of the north front of the propylon or gateway there is sculptured a very animated description of a remarkable event in the campaigns of some Egyptian conqueror. The disposition of the figures, and the execution of the whole picture are equally admirable, and far surpass all ideas that have ever been formed of the state of the arts in Egypt, at the era to which they must be attributed. The moment chosen for the representation of this battle is that when the troops of the enemy are driven back upon their fortress, and the Egyptians in the full career of victory are about becoming masters of the citadel. Our space forbids a full description of this wonderful picture, of which Mr. Hamilton says, in concluding his remarks upon it, "It is impossible to view, and to reflect upon a picture so copious and so detailed as this, without fancying that I saw here the original of many of Homer's battles, the portrait of some of the historical narratives of Herodotus, and one of the principal groundworks of the description of Diodorus. And to complete the gratification, we felt that, had the artist been better acquainted with the rules of perspective, the performance might have done credit to the genius of a Michael Angelo or a Julio Romano. To add to the effect, in front of this wall had been erected a row of colossal figures of granite; fragments of some of them, still there, sufficiently attest their size, their character, and the exquisite polish of the stone." All this magnificence is lavished on a gateway! On passing it, the traveller enters a ruined portico of very large dimensions, and from this double row of seven columns, with lotus capitals twenty-two feet in circumference, conducts him to a court one hundred and sixty feet long, and one hundred and forty wide, terminated at each end by a row of colnmns, beyond which is another portico of thirty-two columns, and then the adytum or interior part of the building. It is conjectured, with much plausibility, that this is the edifice to which the description of Diodorus applies, as the palace or tomb of the great Osymandias; allowance being made for his embellishments, in which he has introduced some of the more striking features that distinguish the largest buildings of Thebes. The whole length of this temple is about eight hundred feet.

## OBELISK OF CONSTANTIUS AT ROME.

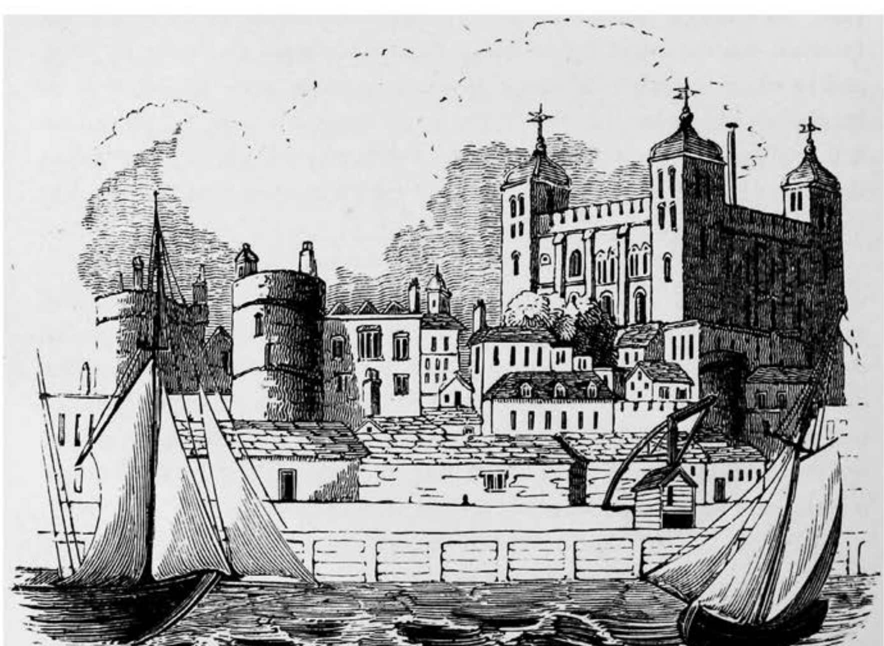
This is the largest now at Rome, and perhaps in the world; it stands in front of the Lateran Church. It was originally erected by the Emperor Constantius, in the Circus Maximus, after being brought from Egypt in a ship built expressly for the purpose. Pope Sextus the fifth set it up in its present place, in 1588, after it had lain on the ground, broken in three places, for several centuries. Though the shaft has sustained some damage at the base, it is still one hundred and five feet long, the width of the two larger sides at the base is nine feet eight inches and three fifths, and of the smaller nine feet. It now stands on a kind of pedestal, quite unsuited to the simple character of the genuine Egyptian supports. The whole height at present, with its pedestal and ornaments on the top, is about one hundred and fifty English feet, and the weight of the obelisk itself may probably be about four hundred and forty tons. It is made of the red granite of Syene.

## OLD ST. PAUL'S.

Tradition has invested the site of the Cathedral with an antiquity which does not belong it. According to such erroneous idea, it is said to have been originally a temple, consecrated to the Goddess Diana by the Romans, very shortly after their invasion of Britain. Mr. Wren, the son of the great Architect, in his *Parentalia*, completely overturns this notion, and proves that the first religious temple built on this spot was in 610, by Ethelbert, king of Kent, the first of the Saxon princes who was converted to Christianity by St. Augustine. It is true, indeed, that when the excavations were made for the foundation of the present Cathedral, there was found many Roman funeral vases, lacrymatories,



Old St. Paul's.



Tower of London.

and other things used in sepulture; next to these, rows of skeletons of the ancient Britons, and immediately above them Saxons in stone coffins or graves, lined with chalk; but this proves only that it was a very ancient place of sepulture, and nothing more. The original church we find was dedicated to St. Paul, and the old chronicles tell us that it was greatly indebted for its beauty of structure to St. Erkenwald, who was bishop of the diocese in 675. It was destroyed by fire in 961, and restored in one year, so that its dimensions could not have been very considerable. Fire again destroyed the church in 1,087, at which time Mamki, the Norman bishop, rebuilt it on an enlarged scale at his own expense. In 1135, while this building was in progress, a fire partially consumed it. According to ancient writers this church was six hundred and ninety feet in length, by one hundred and thirty in breadth, surmounted by a spire five hundred and twenty feet in height; this building was repaired by De Belmeis, but it was not finished until the time of bishop Niger, who held the see in 1,240. Some considerable additions were made after this, and the church was not completed until 1,315, in the reign of Edward the Second, who was the ninth king from the laying of the first stone. This was the building which is called "Old St. Paul's," and the immediate predecessor of the present splendid pile. It was said to have been the largest Cathedral in the world, and before it was deformed by the many repairs rendered necessary by time, and in which a variety of incongruous ornaments were added, a most handsome and imposing structure; but it became a heap of inelegance and confusion. In 1315, the spire (which was of timber) was taken down and a new one erected, and a *ball with a cross* was for the first time fixed upon it.

The great storm of February 1, 1444 (unparalleled in this country), did the building immense injury, lightning setting fire to the wooden spire, and it was not until 1,462, that the gilded ball again ornamented the summit. On the 4th of June, 1561, it was again exposed to another dreadful conflagration. A plumber, who was repairing the spire, left his pan of coals there while he went to dinner; the coals by some means ignited the wood, and the fire raged with such force, that in a few hours nothing was left of the immense pile but blackened walls.

Although it was again rebuilt by public subscription of Queen Elizabeth, and all classes of her subjects, and opened for public worship in five years, yet it was greatly shorn of its original beauty, and the spire was not rebuilt. So slight, indeed, was the whole structure (from the haste with which it was rebuilt), that before the end of the Queen's reign it had so fallen into decay, that the cost of repairing it was estimated at £20,000, and, for want of necessary funds, the repairs were not commenced until 1,608, when it was become so ruinous that one hundred thousand pounds was raised for the purpose, and the reparations of the Cathedral were entrusted to the celebrated Inigo Jones; but these were stopped by the civil wars in 1,642, and the Parliament seized upon the remainder of the funds raised, sold the unused buildings to pay the troops, and it is said that even the scaffolding was sold to discharge the arrears of pay due to Colonel Jephson's regiment. During this period, although a part of the interior of the Cathedral was desecrated by the erection of barracks for troops, shops, &c., still divine service was performed at the east end. In this state it remained until the Restoration, when it was again put under repair by a public subscription, raised in August, 1,663, and was progressing rapidly until September, 1,666, when the Great Fire of London reduced it to ashes, and the present magnificent Cathedral rose in its place; a glorious proof of Sir Christopher Wren's taste and genius. An encouraging omen is said to have occurred at the commencement of the present Cathedral. When Sir Christopher was laying down his plan for the great Cupola, it is related, that upon his desiring a workman to bring him a flat stone, to use as a station, the man obeyed him, and brought one—the fragment of a tombstone, upon which was the single word "*Resurgam.*"

## THE TOWER OF LONDON.

Tradition, which loves to cling to the marvellous, has also given greater antiquity to this building (or rather incongruous mass of erections) than it has any claim to. Leaving to the more curious the question of its Roman origin, the most reasonable conclusion is, that of Messrs. Britton and Brayley, who say "that the *Londinium* of the Romans, was at once a fortress, a fort, and a municipium, is attested by the best informed historians and antiquarians, and that the site of the present Tower would be the most likely spot to be chosen for a place of defence is deducible from its situation. It is a tract of land gently raised above the river, the Essex marshes, and those on the opposite side of the Thames, where a fortification was afterwards formed by the Saxons, and called Southwark;" and the latter adds, "that no historian who can be relied on, furnishes us with the slightest ground for supposing that any fortification of importance ever did exist here, until the erection of the Citadel or Keep, called the White Tower. This was built by command of the Conqueror, by a celebrated military architect, Gundulph, Bishop of Rochester; but whether there were any outer works does not appear"

A great tempest having injured this tower in 1092, it was repaired by order of William Rufus, but was not finished until the reign of Henry the First. The moat was not added until the time of Richard the First; this was done by Longchamp, Bishop of Ely, who was Regent during the absence of Richard in the Crusades.

Henry the Third made it his almost constant residence during his troublesome reign, and added greatly to the Tower as a place of security and defence; and many of the buildings now extant may be dated from this reign (viz. 1240); such as the stone gate and bulwark to the west entrance. He also repaired and whitened it (hence the name of the *White Tower* which it now bears) the large tower built by the Conqueror, and extended the fortress by a mud wall on the west part of Tower Hill. Edward the First also added mnch to its strength. Edward the Fourth surrounded it by a brick wall. The church of St. Peter *ad vincula,* was rebuilt by Edward the First and Third. It is only remarkable as containing the earthly remains of Anne Boleyn, and Katharine Howard, Queen's of Henry the Eighth; Cromwell, the favorite and victim of that monarch; Lady Jane Grey, Earl of Essex, &c. Of the other principal buildings within the walls of the Tower, the grand store house was begun by James the Second and finished by William the Third, and the small armory was entirely built in the latter reign. From the reign of Henry the Eighth it has ceased to be a Royal residence, and has only a bad eminence as a state prison since that period; the wise and good here felt the power and the tyranny of the Tudors and the Stuarts. Until the time of James the Second a court was held in the Tower, and the monarch proceeded from thence to be crowned at Westminster. In 1792 the moat was cleansed, and sluices opened to admit the water from the Thames. The horse armory was, in 1825, chronologically arranged by Dr. Merrick, and contains many figures of ancient warriors (twelve of which only are authenticated), and is a very beautiful sight; there is also the Jewel office, which contains the "Regalia," the small armory, where the arms are numerous and well arranged, and a small menagerie of wild animals.

The extent of the Tower within the walls is twelve acres and five rods; the exterior circuit of the ditch is three thousand one hundred and fifty-six feet. The ditch on the side of Tower Hill is broad and deep, but on the side next to the river it is narrower. On the wharf is a platform, where sixty-one nine-pounders are mounted; these are fired on great occasions, such as the Queen's Birthday, Proclamation of Peace, &c. The principal entrance is on the west side over a stone bridge; this is for carriages; there is another entrance over a draw bridge near the south west angle, and a water entrance called *Traitor's Gate;* state prisoners being formerly conveyed through this gate.

## RUINS OF EDFOU.

The Appollinopolis Magna of the Greeks is one amongst the wonders of Egypt. There are now two temples in a state of great preservation; one of them consisting of high pyramidal propyla, a prondos, portico, and sekos, the form most generally used in Egypt: the other peripteral, and is at the same time distinguished by having on its several columns the appalling figure of Typhon, the emblem of the Evil Principle.

The pyramidal propylon, which forms the principal entrance to the greater temple, is one the most imposing monuments extant of Egyptian architecture. Each of the sides is one hundred feet in length, thirty wide, and one hundred high. Many of the figures sculptured on it are thirty feet in height, and are executed in so masterly and spirited a style, as to add considerably to the grand effect of the building. In each division there is a staircase of one hundred and fifty or one hundred and sixty steps, which conduct the visitor into spacious apartments at different elevations. The horizontal sections of each wing diminish gradually from one hundred feet by thirty to eighty-three by twenty, as appears to the eye; although the solidity and height of the propylon give it more the aspect of a fortress or place of defence than of the approach to a religious edifice. As an explanation of this peculiarity we are told that the addition of these gateways to a temple, was permitted as a favor to such of the ancient kings of Egypt as, for their pious and beneficent actions, became entitled to perpetuate their names in the mansions of their gods. The Ptolemies, who claimed the right of sovereignty from conquest, indulged in the same magnificence, and built porticos, propyla, and even temples. Cleopatra in her misfortunes, is said to have removed with the most valuable part of her property to an edifice of very extraordinary size and structure, which she had formerly erected near the fane of Isis. Most probably, as Mr. Hamilton thinks, it was a propylon of the kind just described. Nothing could be better adapted for her purpose; inasmuch as the variety of apartments offered every convenience that could be desired, and when a small door at the bottom of the staircase was closed, it was perfectly inaccessible.

In no part of Egypt are more colossal sculptures seen on the walls of a public building, than on the larger temple at Edfou. These we are told, are extremely well executed, and in some places the colors are still completely unchanged. Priests are seen paying divine honors to the Scarabœus, or beetle, placed upon an altar; an insect which is said to have been typical of the sun, either because it changes its appearance or place of abode every six months, or because it is wonderfully productive. Dr. Russell, of whose account of these ruins we have availed ourselves, laments that both these temples, though well preserved, are almost concealed amongst the heaps of dirt and rubbish; indeed, the entrance of the larger one is occupied by several mud cottages belonging to the villagers, and the interior chambers of the sekos are indiscriminately used as sinks, granaries, or stables.

"To what base uses may we come, Horatio?"

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## ASTRONOMY.

The Heavens afford the most sublime subject of study which can be derived from science. The magnitude and splendour of the objects, the inconceivable rapidity with which they move, and the enormous distances between them, impress the mind with some notion of the energy which maintains them in their motions, with a durability to which we can see no limit. Equally conspicuous is the goodness of the great First Cause, in having endowed man with faculties, by which he can not only appreciate the magnificence of His works, but trace with precision the operation of His laws, use the globe which he inhabits, as a base wherewith to measure the magnitude and distance of the sun and planets, and make the diameter of the earth's orbit the first step of a scale by which he may ascend to the starry firmament.

Such pursuits will enable the mind at the same time to inculcate humility, by showing that there is a barrier which no energy, mental or physical, can ever enable us to pass; that however profoundly we may penetrate the depths of space, there still remains innumerable systems compared with which those apparently so vast must dwindle into insignificance, or even become invisible; and that, not only man, but the globe—nay, the whole system of which it forms so small a part—might be annihilated, and its extinction be unperceived in the immensity of creation. If such be the subjects contemplated by this beautiful science (and who can doubt it), how delightful the means by which we can arrive at this great consummation! The Copernican or Newtonian philosophy being admitted to be the only accurate system by which we can be guided in pursuing our study of Astronomy, we shall pass over all the speculative theories of the Assyrians, Chaldeans, and Egyptians (the first cultivators of the science of which we have any authentic account), by merely observing that after ages of philosophic dispute whether the *Ptolemaic*, the *Tychonic*, the *Cartesian*, and *Copernican* was the true one, and when

——— " Nature's laws lay hid in night,
God said, let Newton be, and all was light."

For he it was who laid down the laws of nature and motion; and comparing all the phenomena in the Heavens, discovered *the true system of the universe*; his discoveries confirmed the accuracy of the Corpernican system of astronomy, and demonstrated, by irrefutable arguments, that it was impossible to be otherwise, without subverting all the beautiful regularity of the laws of Nature.

## THE SOLAR SYSTEM.

The sun is placed nearly in the centre of the orbits of all the planets, and in those orbits they move round the sun, each in its periodical time. The sun keeps always in or near the same place, but has a central motion on his own axis from *east to west*, once in twenty-five days and a half, which is evident from the *maculæ* or spots on his disk, which are always observed to move in the same manner; but as the sun has *no circular motion* he can have no orbit.

The *orbits* of all the planets are nearly circular, having the sun for their centre; but to speak more accurately they are *ellipses*, having the sun in the focus of each. These orbits are not all of them alike; although they do not vary much, they intersect one another in lines that pass through the centre of the sun; and the places of the orbits where they intersect are called the *Nodes*.

All the planets move round the sun in the same way, which is from *west to east*, and are called *primary planets*.

The number of planets at present known is eleven. They are Mercury, Venus, Mars, Jupiter, Saturn, Herschel or Uranus, Ceres, Pallas, Juno, Vesta. The first five are visible tot he naked eye, and have been known from the earliest periods. Herschel is also visible to the eye without the aid of a glass on a very clear night; the remaining four can only be seen by a telescope. By the Newtonian system, Mercury is placed nearest to the Sun, and then in succession, Venus, the Earth, Mars, Jupiter, Saturn, &c., and to these succeed the fixed stars, supposed to be the centres of other systems.

Mercury and Venus, moving within the orbit of the earth, are called *inferior planets*, and as Mars, Jupiter, Saturn, &c., revolve in larger orbits than the Earth they bear the names of *superior planets.* The Earth has *one*, Jupiter *four*, Saturn *seven*, and Uranus *six* moons; these are called *Satellites*, and they are denominated *secondary planets.* At the same time that the Planets perform their revolutions round the Sun (by which the period of their year is regulated), they also revolve round their own axis, and by these means they have a succession of day and night.

*The following will show the mean distance, &c., of the planets from their common centre.*

| Mean distances of the Planets from the Sun. | | Times of the Sideral Revolutions of the Planets, | | Diameter of the Sun and Planets. | |
|---|---|---|---|---|---|
| *Distance in English Miles.* | Millions. | | Days. | *Real diameter in English miles.* | |
| | | | | Sun . . . . . . | 883,246 |
| Mercury . . . . . . | 36 | Mercury . . . | 87·97 | Mercury . . . . | 3,123 |
| Venus . . . . . . | 68 | Venus . . . . | 224·70 | Venus . . . . . | 7,702 |
| The Earth . . . . . | 93 | The Earth . . | 365·25 | Earth . . . . . | 7,916 |
| Mars . . . . . . . | 142 | Mars . . . . . | 686·98 | Mars . . . . . | 4,398 |
| Vesta . . . . . . . | 223 | Vesta . . . . . | 1,334·20 | Vesta | Not known, but supposed from 100 miles the less to 400 the greatest |
| Juno . . . . . . . | 253 | Juno . . . . . | 1,591·00 | Juno | |
| Pallas . . . . . . | 263 | Pallas . . . . . | 1,681·71 | Pallas | |
| Ceres . . . . . . | 263 | Ceres . . . . . | 1,681·54 | Ceres | |
| Jupiter . . . . . . | 485 | Jupiter . . . . | 4,332·60 | Jupiter . . . . . | 91,522 |
| Saturn . . . . . . | 890 | Saturn . . . . | 10,759·00 | Saturn . . . . . | 76,018 |
| Uranus . . . . . . | 1,800 | Uranus . . . | 30,668 70 | Uranus . . . . . | 35,100 |
| The Moon is distant from the Earth 237,000 miles. | | The Moon revolves about the Earth in 27 days, 7·716 hours. | | The Moon. . . . | 2,160 |

## THE SUN.

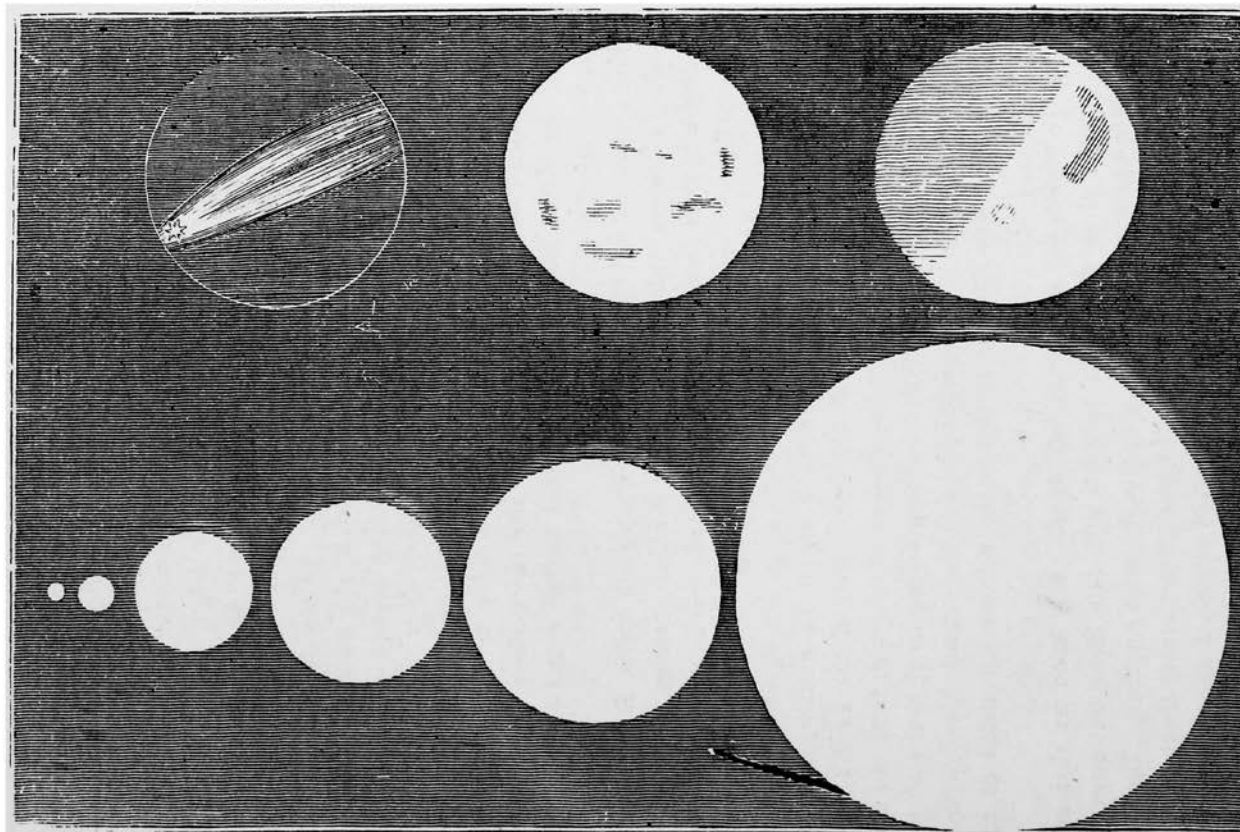
"Mighty being! brightest image and representative of the Almighty! supreme of the corporeal world! Unperishing in grace and of undecaying youth!"

Astronomical calculation proves to us the immense magnitude of this luminary, which, to the eye, appears little larger than the earth's attendant moon; but its diameter is reckoned to be five hundred and thirty-nine times larger than all the planets put together! It is the source of light and heat to all the planets. Of the Malculæ or dark spots, they are supposed to be occasioned by the smoke and opaque matter, thrown out by volcanoes or burning mountains of immense magnitude, and that when the eruption is nearly over and the smoke is dissipated, then the fierce flames are exposed, and they appear like *feculæ* or luminous spots. Though the sun is the central body of the system, yet it has been well ascertained that the various attractions of the circumvolving planets, give it a partial motion round the centre of gravity of the system.

The degrees of *light* and *heat* which the planets derive from the sun, are always communicated in greater or smaller portions, not only in proportion to their distance from it, but according as its position is more or less oblique to any given part of the planets' surface. This is the reason that we, who live at such a distance from the equator, have the coldest weather when the sun is nearest to us, viz. in *winter;* and the reason of this is obvious; for as the eccentricity of the earth's orbit bears but a trifling proportion to the *distance* of the earth from the sun, and therefore, of itself, can occasion no great difference of heat and cold to us in the different seasons, it follows that the remarkable difference which we experience must be owing to the relative directions of the solar rays.

Thus in winter, the sun's rays fall so obliquely upon us that any given number of them will not only fall with less force, but must be spread over a greater portion of our part of the earth's surface. Besides, the sun's continuance above the horizon being considerably shorter in the winter, and the nights much longer, must of course, further contribute to increase the cold.

Some may imagine from this, that as the sun always gives most heat when his rays are the most perpendicular, the hottest part of our summer should be when the sun is in the first degrees of Cancer; *i. e.*, Comet of 1811. Sun and Spots. Venus.



Saturn, Jupiter, Mars. Earth. Venus. Mercury.

towards the end of July. But our experience tells us that the heat is generally greatest in the latter part of the summer. This may be attributed to the following cause. When any part of the earth's surface has been fairly heated, it will retain the heat for some time; and as the nights, which in the middle of summer are very short, increase but slowly, and the days are proportionately long, the heat of the earth must be continually augmented in the day-time more than it is diminished in the night, till the sun has declined considerably from the tropic, in its return to the equinoctial.

For this reason, the month of July and the greater part of August will be hotter than June, unless during the former months a great deal of rain should fall; in the same manner we find it hotter in the afternoon than in the forenoon. By the contrary rule, places which have been thoroughly cooled, will require some time to recover their heat; thus the weather will be colder a month or two after the winter solstice than before it.

It is to be observed, that the sun's rays are so much refracted towards the earth by the atmosphere at its rising and setting, as to bring it in sight every clear day before it reaches the horizon, and keep it in view for some minutes after it has descended below it in the evening. *Twilight* is thus caused; when the sun has withdrawn from our sight it still continues to shine upon the atmosphere above us, from which the light is reflected upon us, till it is eighteen degrees below the horizon, after which, the part of the atmosphere above us, which is dense enough to reflect its rays, loses them entirely, and it becomes dark.

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## MERCURY

Is the nearest planet to the sun, and performs his annual revolution in eighty-eight days of our time. He is supposed to be thirty-seven millions of miles distant from the sun, and that his own diameter is three thousand miles; he is computed to move at the rate of one hundred and nine thousand miles an hour. His proximity to the sun prevents the Astronomer from making accurate observations; but he is supposed to be peopled, although his light and heat are seven times greater than those of our own earth; at his greatest distance, he is only twenty-seven and a half degrees from the sun, and at other times is so near as to rise and set at almost the same moment.

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## VENUS

Is distant from the sun nearly sixty nine millions of miles, she revolves round him in two hundred and twenty-four days and seventeen hours; and on her own axis in twenty-three hours and twenty-three minutes. She is seven thousand seven hundred and forty-three miles in diameter, moves in her orbit at the rate of eight thousand two hundred and ninety-five miles per hour, and her diurnal rotation is one thousand nine hundred and forty-three miles in the same space of time. Her greatest distance from the sun is never more than forty-eight degrees, so that she never appears in the east when the sun is in the west, nor in the west when the sun is in the east. When Venus is observable in the morning before the rising of the sun, she is called by astronomers *Phosphorus*, or the morning star, and sometimes, after the sun's setting, when she is termed *Hesperus*, or the evening star. Venus is, of all planets, the most beautiful, and emits the brightest rays; she is the second planet from the sun.

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## THE EARTH,

Like other planets, is not a perfect sphere, its equatorial diameter being seven thousand nine hundred and sixty-four miles, while its axis is seven thousand nine hundred and thirty miles; showing a difference of rather more than thirty miles. Her distance from the sun is ninety-five millions one hundred and seventy-three thousand miles, and she makes her revolution round him in three hundred and sixty-five days six hours nine minutes and a quarter, which is her year. The axis of the earth is not perpendicular to the plane of her ecliptic, but inclined to it at an angle of twenty-three degrees twenty-eight minutes; round this axis she revolves in twenty-three hours fifty-six minutes and four seconds, which is the length of the astronomical day.

The inclination of the earth's axis (says Mr. Pinnock), is the principal cause of the variety or change of seasons; for as the axis of the earth always preserves its parallelism in her revolution round the *sun*, at one part of her orbit she receives most of the light and heat on her northern hemisphere, and at another part on her southern, according as her north or south pole is turned towards the sun; while in two points of her orbit both hemispheres are equally enlightened. That the earth is a globular form may be inferred by analogy; as all the other heavenly bodies which are visible to us are globes, there is little reason to doub that the earth is so likewise.

About two thirds of the earth are covered with water, whose surface is rounded to conform with the general shape of the earth. On this surface we can sail round the earth in all parts of it, and in all directions; this has been proved repeatedly by navigators. Our own experience also proves this; for example, when one leaves the coast in a ship, mountains, edifices, all prominent objects sink by degrees, and at length disappear as if they had sank into the ocean. Now this effect is not to be attributed to *distance*, which only causes objects to appear smaller, but when we lose sight of land from the deck we perceive it again by ascending the masts. The same is observed when a ship leaves the shore. It declines by little and little, and finally disappears, descending below the horizon like the sun at its setting. These phenomena, which are observed continually, and in all directions, prove that the surface of the sea is *convex*, and that it is by its interposition that distant objects are concealed.

The motion of the earth in her orbit round the sun, is called her *annual motion*, and that round her own axis, her *diurnal motion*, which at the equator is about one thousand and forty-two miles an hour. The earth is surrounded by a compound fluid substance, called the *atmosphere*, which consists of air mingled with *aqueous* vapours, and other exhalations from her surface. It has been stated before, that the orbit of the earth is not a perfect circle, but inclines to the *Elipse*, and that the sun is not exactly in its centre. From this cause the earth is some days longer in passing one half of her orbit than she is in traversing the other.

## THE MOON

Is the satellite of the earth, and while she revolves round, her primary revolves also round her common centre, the sun; and by her thus occupying the earth in her course round the sun, she is called a secondary planet, or *satellite*. The diameter of the moon is only two thousand one hundred and seventy miles, and her distance from the earth is two hundred and forty thousand miles. Her period of revolution round the sun is, of course, the same as that of the earth. That the moon is an opaque body, shining only with reflected light, is evident from the different appearances which she assumes, for if she shone by her own native light she would always appear full; but as she shines only by reflecting the light of the sun, her luminous parts put on different shapes, according to her situation as respects the earth. The time that elapses between one new moon and another, is greater than the moon's revolution in her orbit; the first, which is called a *lunation*, being twenty-nine days and a half, and the second, which is denominated a periodic month, only twenty-seven days and a half; the reason for this is obvious, for as the earth during the moon's revolution must have passed through nearly one twelfth part of her orbit, the moon must traverse more than the circumference of her's before she can be in conjunction so as to become a *new moon*. The moon's orbit is inclined to that of the earth about five degrees, and the two points where they cross each other are called her *nodes*. If the moon is in one of these at the time of her conjunction, she directly interposes between the earth and sun, and occasions a total eclipse of the latter. If she be full in one of her *nodes*, she passes through the earth's shadow, and is herself totally eclipsed.

The moon revolves on her axis in twenty-nine days and a quarter, which being exactly the time from one *new moon* to another, occasions her to present always the same part of her surface to the earth. In consequence of this, the earth is now seen from one half of the moon, while to the other half it is visible in exactly the reverse order of the moon to the earth. The motion of the moon in her orbit is irregular, in consequence of the *attraction of gravitation*; for not only is she acted upon by the *earth* and *sun*, but also by the other planets; and as this attraction varies in proportion as they approach to or recede from her, the accurate calculation of her motion is a matter of great difficulty. The moon when viewed through a telescope, presents an appearance which indicates that its surface is made up of hills, valleys, &c. Her axis is nearly perpendicular to the plane of the *Ecliptic*; that the sun never removes sensibly from her equator, consequently her days and nights must be equal, each more than fourteen times as long as ours, and there can be no variety of seasons. The light emitted by the moon (beautiful as it is) produces no heat; for if her rays, concentrated by a powerful mirror, be thrown on the bulb of a thermometer, no effect is perceptible. Indeed, experiments have shown that the light of the full moon is three hundred thousand times less than that of the sun. Of the moon's influence on the weather, the tides, and the human constitution, is perhaps doubtful, although it has the authority of great names. Madmen are called lunatics, from the moon's Latin name *Luna*. Shakspear many times alludes to its influence. " Being governed as the sea is—by the moon," again,

> ———— ————" It is the very error of the *moon*,
> She comes nearer to the earth than she is wont,
> And drives men *mad*."

## MARS

Is the first of the superior planets; his orbit is immediately above that of the earth, and revolves round the sun at the nearer distance of one hundred and forty-five millions of miles; this planet is chiefly remarkable for his dull red light, which is supposed to have occasioned his being considered by the ancients as the *God of battle.*

Mars is much smaller than the earth, being only four thousand two hundred and twenty-nine miles in diameter. He makes his revolution round the sun in six hundred and eighty-six of our days twenty-three hours and a half, with the velocity of fifty-five thousand two hundred and eighty-seven miles per hour. He revolves on his own axis in twenty-four hours and forty minutes, at the rate of five hundred and fifty-six miles per hour, at his equator. Mars changes like the moon, but never forms a crescent as the inferior planets do. From his dull light, it is conjectured that he is surrounded by a thick, cloudy atmosphere; his light is much less brilliant than Venus, though he is sometimes, from his position, nearly equal to her in magnitude. The analogy between Mars and the Earth is closer than that of any other planet, except in relation to his atmosphere, which is denser than ours.

## JUPITER.

This is the largest of all the planets, being eighty-nine thousand one hundred and seventy miles in diameter, about one thousand four hundred times larger than the Earth. His distance from the Sun is reckoned to be four hundred and ninety millions of miles, and he moves in his orbit at the rate of twenty-five thousand miles an hour, or about one fourth of the velocity of Mercury ; this he does in eleven years three hundred and fifteen days and fourteen hours; but his astronomical day is not half so long as ours. The diurnal rotation on his own axis is amazing, being at the rate of twenty-six thousand miles per hour! Jupiter, when viewed through a good glass, appears to have a luminous atmosphere, in which spots and streaks are seen, the latter of which are called *Belts*. That these are formed in some fluid substance is evident, from their frequently varying their form, number, and their direction. Sometimes several belts are seen across the body of the planet, sometimes these are joined in one broad belt, and sometimes (but very rarely) they appear to be in a diagonal direction. The form of Jupiter is that of an oblute spheroid, his equatorial diameter exceeding his axis by six thousand miles; this, however, is so small in comparison with his bulk, as to detach but little from his rotundity. The axis of Jupiter is nearly perpendicular to the plane of his orbit, so that he has no variety of seasons—and here is another proof of INFINITE WISDOM; for had his axis been much inclined, vast tracts round the Pole would have been deprived of the Sun's influence for six of our years together. This planet is attended by four satellites, which revolve round him as their primary, and with him round the Sun; these satellites were discovered by *Galileo*, in 1610, who called them *Medicean* stars, in compliment to the family of Medici, who were his patrons.

## SATURN

Is next to Jupiter: this is the most stupendous planet of our system, and, except *Uranus*, the most distant; and in consequence of his remoteness, his light is but pale and feeble. Saturn is distant from the Sun nine hundred million of miles, and as his motion in his orbit is only twenty-two thousand one hundred miles an hour, he is consequently twenty-nine years one hundred and seventy-four days two hours in completing his annual revolution. The diameter of Saturn is seventy-nine thousand six hundred miles, so that he is about one thousand times as large as the Earth; for globular bodies are to each other as the cubes of their diameters. The inclination of his axis to the planes of his orbit is very small, no doubt for the same wise reason which occasioned Jupiter's to be so; because, were it otherwise, each of Saturn's poles would be immersed alternately, in fifteen years, in partial darkness; at least it would be that period without the influence, and even the sight of the Sun.

As Saturn is more than twice the distance of Jupiter from the Sun, the light which he receives from him must be proportionably small, but this deficiency is made up by his having an atmosphere resembling that of Jupiter, and with seven attendant satellites, but with two luminous rings, which encompass his body at a considerable distance from it, and shines with reflected light. Many conjectures have been formed respecting these rings, but from their immense magnitude, and their appearing to be opaque, shining only from reflected light, they are probably solid, habitable, bodies. Besides these rings, Saturn has *seven satellites* revolving round him at different distances.

Saturn turns on his axis in ten hours and fifteen minutes, at the rate of twenty-two thousand four hundred miles per hour at his equator; belts similar to those of Jupiter are frequently seen on his surface, which probably proceed from the same causes.

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Four new planets have been discovered within the present century; their orbits are between Mars and Jupiter; they are named

## VESTA,

Which is considered to be nearest to the Sun, and her mean distance from him is computed at two hundred and twenty-two millions of miles. She is very small, but no accurate estimate has yet been formed of her, some saying that her diameter is only eighty, while others reckon four thousand miles. She performs her revolution round the Sun in five years and twenty-three days; the length of her day and night is unknown.

## CERES

Is two hundred and sixty-five millions of miles from the Sun; she performs her revolution round him in four years twenty-one days and a half. Her diameter is estimated at one hundred and sixty miles.

## PALLAS

Is two hundred and sixty-five millions of miles from the Sun, and makes her circuit in the same time as Ceres. Herschel estimates her diameter at thirty miles, but others at one hundred and ten miles.

## JUNO

Is two hundred and ninety millions of miles from the Sun, and is five years one hundred and eighty-two days and a half in performing her course. She appears like a star of the eighth magnitude; the measure of her diameter is not known. Her orbit lies between Mars and Ceres.

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## CELESTIAL GLOBE.

The whole starry firmament contains ninety-four constellations, and is commonly described in three chief parts, as follows:—

First—The zodiac, which contains twelve constellations, commonly called the twelve signs of the zodiac. The zodiac is sixteen degrees broad.

Second—All that space between the zodiac and the North Pole, containing the thirty-five northern constellations.

Third—The regions south of the zodiac, containing forty-seven constellations.

A constellation is a convenient portion or number of stars, whichlie contiguous to one another, and for the purpose of distinction is named after some animal or object, which if there delineated, would fill up that space as it appears to the eye. By this decision, the STARS are so distinguished from one another, that any particular star may readily be found in the heavens by means of a celestial globe, or map, on which the constellations are so delienated, that the most remarkable stars are placed in such parts of the figures as are most easily distinguished.

The magnitude of the stars in the constellations is distinguished chiefly by the letters of the Greek alphabet, that is, the first letter *(alpha,)* is placed by the largest star in the constellation, whether of the first magnitude or not; the second letter *(beta)* is placed by the second in lustre; continuing in this manner to the least star in the constellation; and if there are more stars than there are letters in the Greek alphabet, the letters of the common alphabet are introduced, and afterwards, if necessary, the numbers 1, 2, 3, 4, &c., are added.

Some of the stars have, besides their rays and Greek letters, also names; as Castor, &c.

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## COMETS.

(If any thing were needed beyond the language of ridicule to dissipate fear in relation to these phenomena—the following able remarks from Mrs. Somerville must convince the most sceptical.)

" Only comets with retrograde motions can come into direct collision with the earth, and if the momentum were great the event might be fatal; but in general the substance of comets is so rare, that it is likely



CELESTIAL GLOBES.

they would not do much harm if they were to impinge; and even then the mischief would probably be local, and the equilibrium would be soon restored, provided the nucleus were gaseous, or very small. It is, however, more probable that the earth would only be deflected a little from its course by the approach of a comet, without being touched by it. The comets that have come nearest to the earth were that of the year 837, which remained four days within less than one million two hundred and forty thousand leagues from our orbit; that of 1770, which approached within about six times the distance of the moon. The celebrated comet of 1680 also came very near to us; and the comet whose period is six years and three quarters, was ten times nearer the earth in 1805 than in 1832, when it caused so much alarm. Comets in or near their perihelion move with prodigious velocity. That of 1680 appears to have gone half round the sun in ten hours and a half, moving at the rate of eight hundred and eighty thousand miles an hour. If its enormous centrifugal force had ceased when passing its perihelion, it would have fallen to the sun in about three minutes, as it was then only one hundred and forty-seven thousand miles from his surface. A body of such tenuity as the comet, moving with such velocity, must have met with great resistance from the dense atmosphere of the sun, while passing so near his surface at its perihelion. The centrifugal force must consequently have been diminished, and the sun's attraction proportionally augmented, so that it must have come nearer to the sun in 1680 than in its preceding revolution, and would subsequently describe a smaller orbit. As this diminution of its orbit will be repeated at each revolution, the comet will infallibly end by falling on the surface of the sun, unless its course be changed by the disturbing influence of some large body in the unknown expanse of creation. Our ignorance of the actual density of the sun's atmosphere, of the density of the comet, and of the period of its revolution, renders it impossible to form any idea of the number of centuries which must elapse before this event takes place. But this is not the only comet threatened with such a catastrophe; Encke's, and that discovered by M. Biela, are both slowly tending to the same fate. By the resistance of the other, they will perform each revolution nearer and nearer to the sun, till at last they will be precipitated on his surface. The same cause may effect the motion of the planets, and ultimately be the means of destroying the solar system. But, as Sir John Herschel observes, they could hardly all revolve in the same direction round the sun for so many ages without impressing a corresponding motion on the etherial fluid, which may preserve them from the accumulated effects of its resistance. Should this material fluid revolve about the sun like a vortex, it accelerates the revolution of each comet as have direct motions, and retard those that have retrograde motions."

## ECLIPSES.

"All uniformed persons regard eclipses with some degree of terror, and among savages it is customary to make a great noise during the occurrence of the phenomena, in order to prevent the evil which they suppose would otherwise inevitably result. A late writer has very truly remarked, that in times of ignorance, men are alarmed at all celestial pnenomena, the recurrence of which takes place at periods too remote to be readily calculated, and which accordingly appear to be guided by no fixed laws; whilst more important and obvious appearances excite no surprise because they are frequent, and because they occur at well-known periods: thus the changes of the moon are observed without alarm, while the less obvious occurrence of an eclipse has scattered dismay over an army or a nation. An incidental and considerable assistance has been derived to chronology from this superstitious feeling. Eclipses were thought to be connected, in some secret manner, with the destinies of nations, and have been carefully recorded, when near the time of some great battle or other political event, of whose epoch we should otherwise remain in ignorance. Astronomical science shows how to determine with the greatest exactness the hour of any given eclipse; and we are thus enabled to fix with precision the date of any event which may have been thus accompanied, to confirm the statement of an historian, or to correct his errors. But as the computation of eclipses is attended with considerable difficulty, a few only of the readers of history are able to carry on these researches for themselves. On this account catalogues of eclipses have been calculated by astronomers for many thousand years, by a reference to which any chronological point connected with these phenomena may at once be determined.

"Eclipses take place every half year, and at each period there may be one, two, or three eclipses; if one only, it must be an eclipse of the sun; if two, there will be one of each luminary; and if three, there will be two of the sun, with one of the moon between them.

"The sun is eclipsed whenever the moon comes between it and the earth, so that the eye of a spectator on the earth is in a straight line with the centres of the sun and moon. Sometimes what is called our annular eclipse takes place, such as that of the 15th May, 1836, when a ray of light appears around the disk of the moon. This is in consequence of the apparent diameter of the moon being less than that of the sun; at other times it is greater, and then a total eclipse takes place.

"The moon is eclipsed whenever the earth comes between it and the sun: in consequence of which it is deprived of the light of that luminary. As the moon revolves round the earth once in every twenty-eight days, it might at first be supposed that an eclipse would take place once in every month, as the moon must during that period pass between the earth and the sun. This would be the case, only the moon does not pass in an exact line between the earth and the sun: the inclination of the orbit of the moon to the plane of the eliptic prevents this occurrence taking place so often; but whenever the moon passes the earth in an exact line with the sun, that is, whenever the three bodies are in an exact line with each other, the moon is eclipsed.

"Every eighteen years and ten or eleven days the order in which eclipses occur, is the same as that of the previous eighteen years. It might therefore be imagined that a correct list of eclipses for eighteen years would be sufficient for all purposes; as by adding the eliptic period as many times as required, the period of an eclipse might be known at any distance of time. This would be correct if every eclipse appeared under precisely the same circumstance as its corresponding eclipse in the preceding or following period; but this is not the case. An eclipse of the moon, which, in the year 565, for example, was of six digits, was in the year 583 of seven digits, and in 901 nearly eight. In 908 the eclipse became total, and it remained so for about twelve periods, or until the year 1088; this eclipse continued to diminish until the commencement of the fifteenth century, when it totally disappeared in the year 1413. In like manner an eclipse of the sun, which first appeared at the North Pole in June 1295. proceeded more southerly at each period. On the 7th August, 1367, it made its first appearance in the north of Europe; in 1439 it was visible all over Europe; in 1601, which was its nineteenth appearance, it was central in London; in 1818, on the 5th of May, it was visible in London, and was again central nearly in the same place on the 16th of May, 1836. At its thirty-ninth appearance, August 10th, 1980, the moon's shadow will have passed the equator, and as the eclipse will take place nearly at midnight, it will be invisible in Europe, Africa, and Asia. At every subsequent period the eclipse will go more and more towards the south, until, finally, on the 30th September, 2665, which will be its seventy-eighth appearance, it will go off at the South Pole of the earth, and disappear altogether."

Columbus is said to have frightened the Aborigines of America into supplying provisions, &c. for his crew, by foretelling an eclipse of the Sun, which he knew from his calculations would take place at a particular time. An account was read during the last year at the Royal Astronomical Society, of some computations, agreeing with the time of an eclipse of the sun, observed in China, October 13, no less than two thousand one hundred and twenty-eight years before Christ, or four thousand years since. The time of the greatest obscuration has been computed by Mr. Rothman, to be from the solar tables of Delambre, and the lunar elements of Damoiseaa to have happened at eight minutes forty-seven seconds past noon, with ten and a half digits eclipsed, according entirely with the indications of the Chinese chronicles. For not predicting this eclipse the two astronomers Ho and Hi were put to death.

The great eclipse of the sun which took place on Sunday, May 15th, 1836, was visible over the whole of Europe, and North America, part of Columbia, and Africa: in the West Indies, Denmark, Germany, and the northern parts of the British Isles, tunular or ring like. The eclipse began at Greenwich fifty-one minutes twelve seconds after one o'clock, arrived at its greatest obscuration at nineteen minutes six seconds past three, and terminated thirty-nine minutes six seconds after four o'clock, p.m.

## THE ATMOSPHERE.

The Atmosphere is highly important, as being the cause of many of the phenomena we witness, in modifying the influence of others, and in its essential character as the supporter of animal and vegetable life. It is described as a thin, invisible, elastic fluid, surrounding the earth to the extent of fifty miles in height from its surface: it is the element in which we live and breathe, which contains the principles of life, and constitutes the power of vegetation. All the displays of beauty, so well adapted to cheer the spirits, to enliven the sensibilities, and to excite the adoration of man, would have been formed in vain, if the atmosphere had not been a transparent fluid. The specific gravity of air is eight hundred and fifty times less than that of water, so that one gallon of air will weigh a little less than one seventh of an ounce. This air we are constantly inhaling by the action of the lungs, which air expanding by the vital heat is expelled, and the vacuum supplied by a fresh inhalation. It is therefore evident, that air too much rarified is not proper to sustain animal existence, and that air too much condensed is alike unsuited for that purpose; therefore, any effluvia raised or imbibed, that tends to impregnate the air with vapours, or atoms of a strange or unusual kind, even though of an odoriferous and agreeable scent, is unwholesome; plants as well as animals will decline under the influence of vitiated air. The whole expanse filled with the fluid called air, or which we denominate the atmosphere, is the region or reservoir of the winds; those winds being the floating streams that run in currents from the surcharged, towards the exhausted parts of the spacious void. Wherever the air becomes rarified, or the moisture of its composition diminished, to that part will it rush with a force equal to the weight by which it is impelled, and that weight will be in exact preponderancy of the circumambient element over the specific gravity of the space rarified. Heat, as has been just observed, is the cause of this phenomenon; for, in fact, heat engenders motion, and motion excites heat, so that there is a perfect reciprocity of influence.

The component parts of air, or the atmosphere, cannot be positively defined, because we cannot describe that which is invisible; we discover fire and water as the chief ingredients, but what other elements of nature more subtile than fire may exist we do not know; the electric fluid, though acting on combustible bodies, is perhaps only the agent that provokes the flame, and carries with it, or collects the fire that invests the surrounding space; but there is a magnetic quality in the electric fluid, that indicates something of nature yet undiscovered; there may be a distant element in this irresistible force of motion. Fire will not naturally adhere to indurated bodies, it requires violent and continued motion to infuse its particles, and to make it separate the atoms of iron; but lightning instantly decomposes that substance, and reduces it to a state of *fusion*. It seems likely from this experimental process, that an element more penetrating and keener than fire prevades the universe, and another still on *ad infinitum*. Air is indestructible: that is, you cannot change its nature, it will still be air under whatever process you may place it,—you cannot make it any thing else; but its quality may alter, and it is subject to perpetual changes, such as *hot*, *cold*, *moist*, and *dry*; these are variations, but only in the effect that it produces according to circumstances, for it loses nothing of its substance, nor transforms into another element. This peculiarity also excludes the possibility of analysis, or divisions of its parts. The elasticity of the air which gives it transparency, is that quality which enables us to see objects distinctly; the light passes through it to the organ of sight, and penetrating to the optic nerve, pictures the form of substances, by reflection, upon the visual tablets. Again, the atmosphere is most admirably adapted to sustain our existence, by the power it possesses of purification, and the exact adaptation of its substance for animal respiration; were it more dense than it is, we should be in continual darkness; were it more thin and rarified, we could not breathe in it, but must soon expire. The atmospheric air is composed of two gases, oxygen and nitrogen, with a very small proportion of carbonic acid, and water in a state of vapour. The two last are considered as accidental ingredients, and not constituent parts, as well as on account of the smallness of their quantity, as because they occur in different proportions at different times.

## THEORY OF WINDS.

Heat is the principal cause of winds. It must be evident, that as the rays of the sun descend *perpendicularly* on the earth under the torrid zone, that in those regions a much greater quantity of heat must be communicated than in the more *oblique* countries towards the Poles. The heat thus acquired, rarifies the air, and causing it to ascend; the vacuum which follows is immediately filled from the north and south, which being of a cold nature, the fierce heats of the equatorial regions are so modified as to become bearable. Thus two winds, north and south, would be generated; but these would be afterwards modified and changed. For example; the diurnal motion of the earth gradually lessens to the Poles from the equator, where the motion is communicated to the atmosphere in an equal degree; it is evident that if part of it was conveyed suddenly from a temperate latitude, it would not directly acquire the velocity of that at the equator, consequently the earth would outstrip it in speed, and as she moves from west to east, the mountainous ridges would strike against it, and, driving it forward, an *east* wind would be the result. Land and sea breezes, trade winds, regular and variable winds, are all accountable for on the above principle, modified, however, by various other influences, such as the motions of the sea under the guidance of the moon, chemical changes in the elementary constituents of the atmosphere, &c. &c. The prevailing winds in this country, as they were ascertained on a comparison of many years by the Royal Society of London, at London are, south-west winds, one hundred and twelve days; north-east winds, fifty-eight days; north-west winds, fifty days; west winds, fifty-three days; south-east winds, thirty-two days; east winds, twenty-six days; south winds, eighteen days; north winds, sixteen days; making altogether three hundred and sixty-five days.

## CLOUDS

Are masses of condensed vapour, more or less opaque, formed and sustained by different agencies, at various heights in the atmosphere. They are named and classified as follows:

### 1. SIMPLE FORMS.

First—*Cirrus*, or *cure clouds*, consisting either of white parallel lines, faintly pencilled on the azure sky, or of bending spreading fibres, starting from central points in all directions, and commonly called mare's tails.

Second—*Cumulus*, or *stacken cloud*, a spreading roundish kind of cloud, full of conical lumps, increasing upwards from a horizontal base.

Third—*Stratus*, or *fall cloud*, is of a foggy, misty character, consisting of an extended, unbroken, horizontal sheet of vapour, encreasing from below.

### INTERMEDIATE FORMS.

Fourth—*Cirro-cumulue*, or *sonder cloud*, a series of small, well defined, roundish masses, in close horizontal arrangement.

Fifth—*Cirro-stratus*, or *wane cloud*, usually horizontal masses, forming a low spreading cloud, thin towards its circumference.

### 3. COMPOUND FORMS.

Sixth—*Cumolo-stratus*, or *twain cloud*, round headed and mountainous in appearance, and seem to be a combination of the cirro-stratus with the cumulus.

Seventh—*Cumulo-cirro-stratus*, or *nimbus*—the RAIN CLOUD, that form into which the other clouds revolve previously to rain. It is an horizontal sheet, above which the cirrus spreads while the cumulus enters it sideways, or from beneath.

The *cirrus* appears low and thick before a storm, and is usually in a quarter opposite to that in which the storm arises. Steady, high winds, are also preceded, and attended by cirrous streaks of a torn and scattered character, and sometimes in the direction of the wind quite across the sky.

The *cumulus* has the densest structure, is formed in lower atmosphere, and moves with the current next the earth. In fair weather they will sometimes begin with a small lump at sunrise, increasing through the day and dispersing at sunset. It is a sign of rain, and encreases rapidly before a storm.

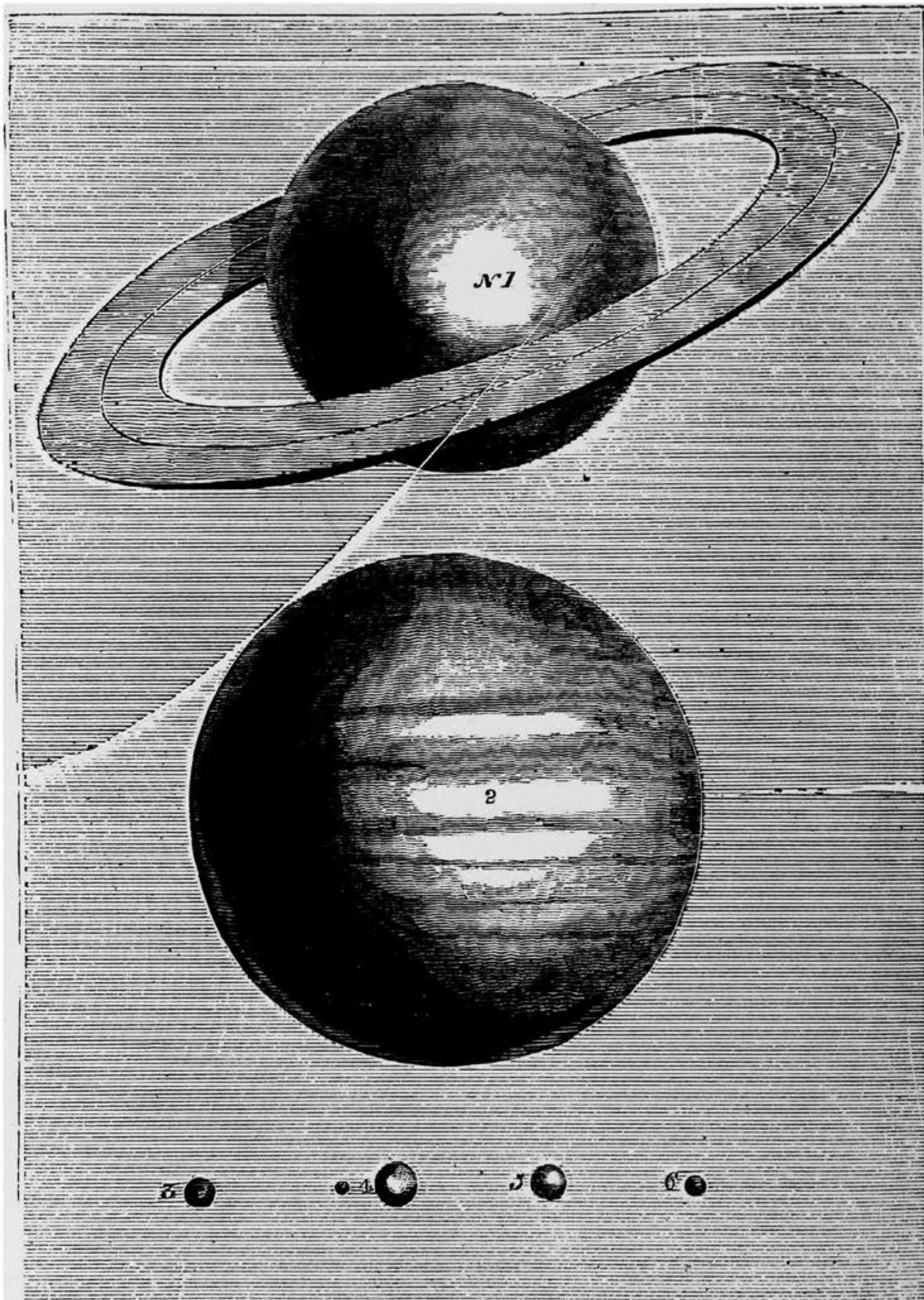
The *stratus* is the lowest of clouds, its lower surface commonly resting on the earth. It is, properly, the cloud of night, appearing about sunset, and comprehends all those morning mists which are usually the precursors of fine weather. A constant intermixture of these forms takes place in the dull season, and if they are studied carefully, will soon enable a person to judge with tolerable accuracy of the nature of the coming weather. The final prevalence of a particular form will decide the weather. The cumulo-stratus precedes and the nimbus accompanies rain.

## CAUSE OF RAIN.

There is one topic of conversation in this country which appears never to lose its interest. Every body can say something upon it, and it generally takes precedence of every thing else—we mean, of course, the weather. In a country like this, where it is subject to such sudden changes, it is rather surprising so many vague and incorrect opinions should exist respecting it. One person considers the influence of the moon the grand power which regulates the state of the weather; another is equally confident that all its changes are occasioned by the wind, and so on. Yet very few can tell why so apparently simple a phenomena as rains occurs. The fact is, "doctors differ" considerably on this subject, and numberless theories have been propounded to explain it. The most probable, we think, hasbeen proposed by Dr. Hutton, which may be explained in the following manner:—

If we leave a little water in an open vessel, we shall find, at the end of that period, that the water has dried up; or, in other words, has evaporated. To explain the cause of this, many reasons have been assigned; but it is unnecessary to enter upon a consideration of them at present. It is

Comparative Size of the Planets.




1. Saturn. 2. Jupiter. 3. Mars. 4. Earth and Moon. 5. Venus. 6. Mercury.

sufficient to state, that the atmosphere has the power of absorbing, and holding in solution, great quantities of water. It has been calculated, that assuming the surface of all the water on the earth to be 130,000,000 geographical miles, that about 60,000 cubit miles of water will be changed into vapour every year. Now, the whole of the water is precipitated to the earth again in the form of rain, and the cause of this, according to Dr. Hutton, will, perhaps, be understood by describing a simple experiment, which every one can perform himself.

Take two beer tumblers, and into one put a little water, just enough to wet the sides, then hold the glass near the fire, till the air in it, having become heated, has absorbed the water. If the edges of the other tumbler, which has been kept cool, be placed upon the one that has been warmed, the sides of the latter will become covered with moisture. Dr. Hutton explains this as follows:—"According," says he, "to the temperature of the atmosphere so is its power of containing fluids in a state of vapour. A warm atmosphere will absorb a greater quantity of water than a cool atmosphere; and if, therefore, a current of warm air mixes with a current of cold air, a part of the vapour held in solution by the former will be precipitated to the earth in the form of rain; because the temperature of the warm air will be reduced by its mixture with the cold, and its capacity or power of containing vapour be thereby diminished. When, therefore, in the experiment above described, we place the tumbler containing cold air upon that containing warm air, holding water in solution, the temperature of the air is reduced, its power of holding so much water in solution is diminished; and hence the water is precipated, and forms a moisture on the sides of the glass."

Some philosophers have imagined that rain is the result of an electrical action of the clouds upon each other; and there is very probably some truth in this theory, because we know how suddenly, and with what violence, rain is generally precipitated during a thunder storm. But there can be no doubt but that it is principally to the changes in the temperature of the atmosphere we must attribute the cause of rain.

## DEW AND HOAR FROST.

The phenomena of dew were first satisfactorily explained by the late Dr. Wells; who showed, by the most decisive experiments, that, apparently, all these phenomena were owing to the effects of the radiation of heat from the earth's surface during the absence of the sun. It is admitted that, when the direct influence of the sun is removed in the evening, and the surface of the earth thus no longer continues to acquire heat, at that instant, from the ceaseless activity of heat to obtain an equilibrium, the surface of the earth being the warmer body, radiates a portion of its superfluous temperature into the surrounding space; and thus the air, immediately in contact with the surface, becomes cooled below the point of saturation, and gives off a portion of its water in the form of dew. It is known, that the radiating power of bodies differ exceedingly according to their composition, the nature of their surface, their colour, &c. These differences, of course, produce corresponding effects on the deposition of dew; and, as beautifully demonstrated by Dr. Wells, explains its greater or less deposition under certain circumstances, or its entire absence under others. Thus, what formerly appeared so extraordinary, viz. why, in the self-same state of the atmosphere, &c. one portion of herbage should be covered with dew, while another in the immediate neighbourhood should remain dry, is no longer a mystery; but is perfectly explicable, on the supposition of their different radiating powers. The deposition of dew is always most abundant during calm and cloudless nights, and in situations freely exposed to the atmosphere. Whatever interferes in any way with the process of radiation, as might be expected, has a great effect on the deposition of dew. Hence the radiation of heat, and consequently the deposition of dew, are obviated, not only by the slighted covering or shelter, as by thin matting, or even muslin; by the neighbourhood of buildings, and innumerable other impediments near the earth's surface; but matters interposed at a great distance from the earth's surface have precisely the same effect. Thus clouds effectually prevent the radiation of heat from the earth's surface; so that cloudy nights are always warmer than those which are clear, and in consequence there is usually on such nights little or no deposition of dew. From dew there is an insensible transition to hoar frost; hoar frost being, in fact, only frozen dew, and indicative of greater cold. We observe, therefore, that frosty nights, like simply dewy nights, are generally still and clear. The influence of radiation in producing cold at the earth's surface would scarcely be believed by inattentive observers. Often on a calm night the temperature of a grass plot is 10 or 15 degress less than that of the air a few feet above it. Hence, as Mr. Daniell has remarked, vegetables in our climate are, during ten months of the year, liable to be exposed at night to a freezing temperature; and, even in July and August, to a temperature only two or three degrees warmer.

## THE AURORA BOREALIS.

In northern countries the aurora borealis is constantly visible during the winter evenings, and is frequently termed, from this circumstance, the northern lights. When they appear in this country, it is generally during the spring and autumn, but very rarely with that splendour which distinguishes them, when seen near the North Pole. The most remarkable appearance of them in England took place about thirty years ago, of which a very accurate description has been given by Dr. Dalton; and as this will give our readers a very good idea of the phenomena, we qoute from it. He says, his attention was first excited by a remarkable red appearance of the clouds, which afforded sufficient light to read by at eight o'clock in the evening, though there was no moon;—

"From half-past nine o'clock till ten P.M., there was a large, luminous, horizontal arch to the southward, almost exactly like those we see in the north; and there was one or more concentric arches northward. It was particularly noticed, that all the arches seemed exactly bisected by the plane of the magnetic meridian. At half-past ten o'clock, streamers appeared very low in the S.E., running to and fro, from W. to E.; they increased in number, and began to approach the zenith, apparently with an accelerated velocity; when all on a sudden the whole hemisphere was covered with them, and exhibited such an appearance as surpasses all description. The intensity of the light, the prodigious number and volatility of the beams, the grand intermixture of all the prismatic colours in their utmost splendour, variegating the glowing canopy with the most luxuriant and enchanting scenery, affording an awful, but at the same time the most pleasing and sublime spectacle in nature. Every one gazed with astonishment; but the uncommon grandeur of the scene only lasted about one minute; the variety of colours disappeared, and the beams lost their lateral motion, and were converted, as usual, into the flashing radiations, buteven then itsurpassed all other appearances of the aurora, in that the whole hemisphere was covered with it. Notwithstanding the suddenness of the effulgenceat the breaking out of the aurora, there was a remarkable regularity in the manner. Apparently a ball of fire ran along from east to west, and the contrary, with a velocity so great as to be barely distinguishable from one continued train, which kindled up the several rows of beams one after another; these rows were situate before each other with the exactest order, so that the bases of each row formed a circle crossing the magnetic meridian at right angles; the several circles rose one above another in such sort, that those near the zenith appeared more distant from each other than those near the horizon, a certain indication that the real distances of the rows were either partly or exactly the same. And it was farther observable, that during the rapid lateral motion of the beams, their direction in every two nearest rows was alternate, so that whilst the motion of the one row was from east to west, that of the next was from west to east.

The cause of the northern lights is unknown. It is supposed, and there are some facts which apparently support the hypothesis, that they are to be attributed to the passage of electricity throughout the higher regions of the atmosphere. At present, however, the subject is involved in much obscurity; and from the very few opportunities that philosophers have of seeing the aurora, it is extremely difficult to obtain accurate data to reason upon.

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## CAUSES OF WHIRLWINDS, MOVING PILLARS OF SAND, AND WATERSPOUTS.

To the principle of electricity we refer a class of remarkable phenomena not usually ranked together—whirlwinds, pillars of sand, and waterspouts —the appearance of which being very well known from frequent description, we shall at once proceed to consider their nature. In the explanations generally given it is assumed that there are currents of air blowing in different directions, the oblique meeting of which causes an eddy or vortex, having a vacuum in its interior. Against this hypothesis it may be objected that, in the greater number of instances recorded, the air has been either calm or with a wind moderate and steady without any cross currents. If these meteors had a mechanical origin of this kind, they ought to abound most where variable winds and storms prevail, as on sea-coasts, near headlands, and among hills. On the contrary, they are most rare in such cases, rather affecting climates and seasons of hot still atmosphere, in desert plains or tropical seas. Besides, in order to form a vortex, it is necessary that a coherent body be present to deflect the current into the tangential motion producing the whirl. A vortex cannot be formed in the free atmosphere, whatever be the respective velocities or angle of meeting of currents, and, according to all experience, a shift of wind is preceded by a calm, lasting until one of the currents has obtained predominance. That waterspouts and whirlwinds are independent of motion in the air, is made evident by their having often a rapid progression although the air around them be still, and by their having been seen even to advance against a wind then blowing; and when several waterspouts have been in sight at once, some have been stationary, others running about without any common direction.

In assigning these phenomena to the agency of electricity, there are no conditions assumed, the existence of which can be disproved ; and it cannot be denied that the cause is adequate to the effect attributed to it. We may distinguish two kinds of them, according as the electricity has accumulated in the earth, and discharges itself into the air, or, as the electricity is emitted from a charged cloud, exercising a powerful induction upon the surface of the earth beneath, but without exploding. In the former case, which is peculiar to land, the resulting action constitutes the whirlwind or the pillar of sand, the different appearance of which is owing to the nature of the soil from which they rise. Whirlwinds are of most frequent occurrence in those countries not free from earthquakes, and dry hot seasons during a limited time of the year, such as the wide valley of the Mississippi. Compared with the pillars of sand they are more terrible in their destructive energies, but they are more casual, and are generally single. Pillars of sand are confined to the deserts of Africa and Hindostan ; they are individually less dangerous, but they are not to be despised if it be true that each of them may deposit a quantity of suffocating dusts, forming a hillock of greater height than a man, and that countless numbers may be stalking across the arid plain with inevitable speed.

The electricity, which we believe to be the prime mover of these extraordinary spectacles, may possibly have different sources, and, we are inclined to suspect, a less superficial excitation of that in the whirlwind. But, however, the charge may be derived, when it has accumulated to such intensity that the electrical inertia of the air is unable to repress it, it will rush upwards in a stream, communicating an ascending motion to the air, and bearing along with it whatever light mobile particles may be within its influence.

If there were in the superincumbent atmosphere a sufficient mass to supply by induction the requisite quantity of the opposite electricity, then the accumulation might have been discharged in the ordinary manner by explosion. In the absence of this, the electricity, taking the direction in which it meets with least resistance, tends to dissipate itself in a stream through the air so long as it can force a passage. The stream expands in its progress by its own elasticity, so that its diameter is greater as it recedes from the earth, often describing very exactly an inverted cone. While the stream continues, the opposite kind of electricity is induced into the air along its path, and flows downwards towards the point of emission, or apex of the cone, where the primary charge is most concentrated. Now, it has been proved by experiment, that every electric current contains within itself a revolving action, the consequence of the attraction of the opposite electric surface. To this property of an electric we may therefore assign the origin of the spiral motion of the whirlwind, conceiving that it results from the longitudinal or ascending motion of the stream, influenced by the circular or revolving motion of the two electricities round each other. The velocity of the spi al motion is too great to be followed by the eye, and its mechanical effects, exhibited in the lifting of loaded waggons, the levelling of stone-walls, the cutting through fences, trees, and huts, as if with an edged tool, are ascribable to no other physical cause than electro-dynamic.

Waterspouts have the same principles of action, but in them the accumulation exists in a low heavy cloud, which has induced the opposite electricity into the earth beneath, without finding a prominent point to facilitate an explosion. The charge is gradually neutralised by combination with that rushing in a stream from below, and carrying with it dust from the plain, and vapour, or rather a mist from waters. The watery particles being again aggregated into drops, sometimes as large as cherries, descend in torrents, and a circulation is thus established while the accumulation exists.

The spouts or tubes, apparently let down from the cloud, are formed by the vapour or mist attracted by the electricity which has elongated itself into a protrusion by an effort to discharge itself.

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## FLAKES OF SNOW AS SEEN THROUGH A MICROSCOPE.

" When icicles hang by the wall,  
And Dick, the ploughman, blows his nail,  
And Tom bears logs into the hall,  
And milk comes frozen home in pail."

SHAKSPEARE.

In this, our climate, we have a *very liberal* acquaintance with snow, and though to the "unfed sides, and loop'd and window'd raggedness" of many, it is felt as no flattery, yet the value and beauty of its construction is as little known to others as if it were only seen in Kamschatka. By the examination of a flake of snow with the assistance of a microscope, we are enabled to judge of its beauty and wonderful structure.

It is almost trite to say, that where water is frozen the product is ICE; a tnick, solid, and slim, transparent substance. A comparison between a piece of ice, however small, and a flake of snow, will speedily convince the observer of the very great difference between the substances of hich they consist; and the difference is owing to the influence of intense old upon the particles in a different state of cohesion. When aqueous particles are closely cohered in the form of water, the influence of intense cold upon them produces a solid and ponderous body, viz. *ice;* but when this description of particles is dispersed in vapours, and greatly rarified, they are changed by intense cold into frozen particles of a less dense coherence. The difference between the density of those particles which, when acted upon by cold, yield ice, and those which, exposed to the same influence, yield snow, is this, the latter are just twenty-four times lighter, bulk for bulk, than the former. The particles are not only exceedingly rarified as to their bulk, but the bulk is also exceedingly small; so small indeed is it, that one such particle would present but a very minute object, even when viewed with the powerful aid of the microscope. And the process by which this is brought about is exceedingly curious. Millions of minute drops or points of vapour are floating in the upper atmosphere; acted upon by intense cold, each of these drops or points is converted into a solid substance, as fine as one of those little motes which we can sometimes see floating in the sun beams. As these descend lower and lower in the atmosphere, they attract each other, and each flake of snow which we see glistening in virgin whiteness upon the ground, consists of a multitude of those minute atoms of frozen matter, cohering together with the most perfect and beautiful uniformity! Snow is one of the many things the usefulness of which men in general are apt to take small or no account of, and many even of those who do take the trouble to reflect on its effect upon the ground form a very incorrect notion of it. Judging from its nature and appearance, those persons infer that snow must necessarily be injurious to the earth, by reason of its dampness and intense cold; but the very contrary of this is the fact. The thick covering of snow which lies upon the ground in winter, is far from making the earth cold, but in truth, prevents it from being so. Were the clay exposed to the action of the bitter and piercing winds of winter, it would be utterly deprived of that genial warmth, without which the seed sown within it would not germinate. It is by the close and flaky covering of the shining snow, that a remnant of genial heat is preserved in the bosom of the earth. In vain do the piercing winds howl above; they cannot penetrate that mantle with which God has clothed the face of nature!

Some overwise people are in the habit of sprinkling salt upon snow before their doors; they could not do a more silly or injurious thing. The result is to change dry snow or ice at thirty-two degrees to brine at no degree.

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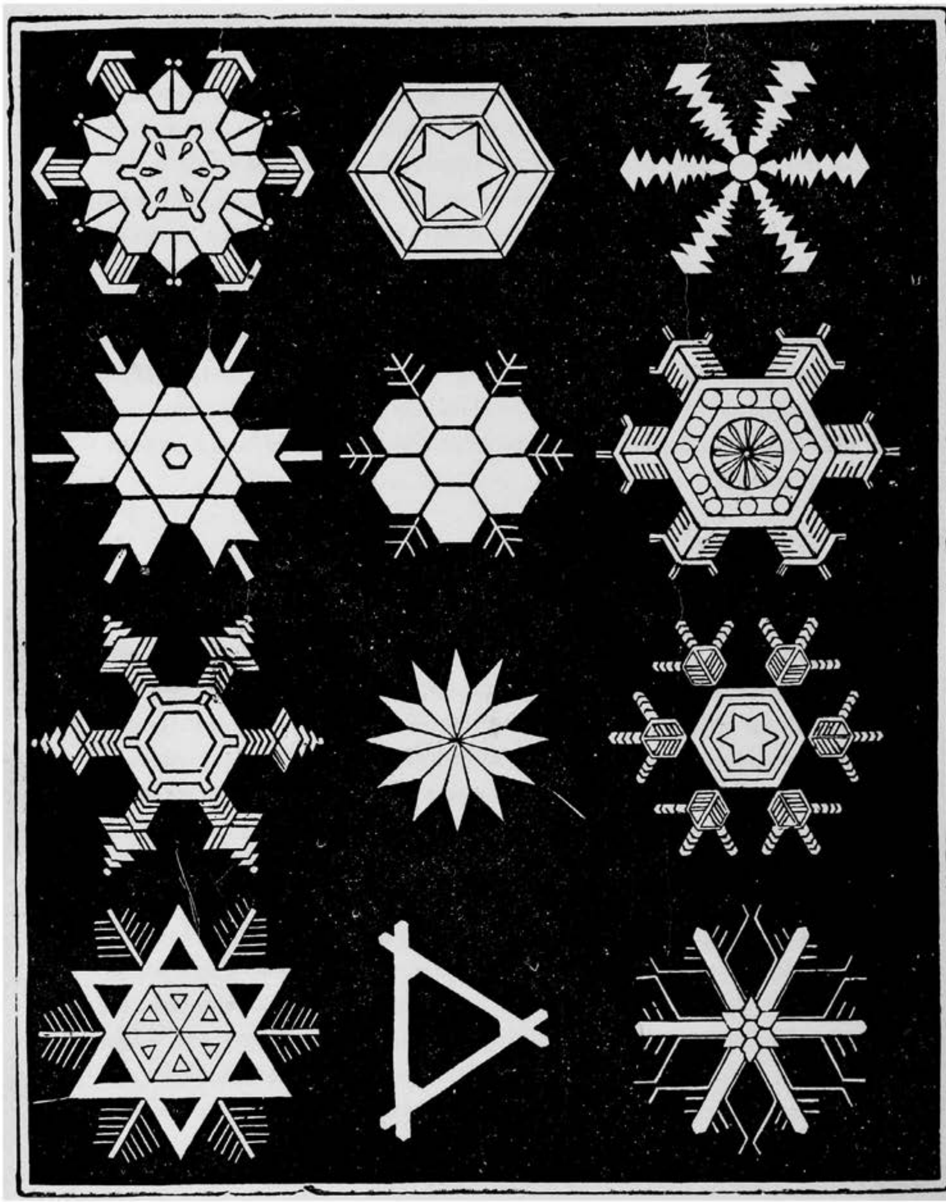
## SNOW SELLERS OF ITALY.

Snow is an article of absolute necessity in Italy, particulary in Sicily and at Naples; to supply the latter, one of the largest capitals of Europe, which has a population of four hundred thousand souls, all snow consumers, a very extensive mountain range is put in requisition. From the Apennines, and from all the nearer branches of those mountains, Snow during the summer months is constantly being brought into the city by land and by sea, and the quantity is immense. Hundreds of men and boys are employed exclusively on this business.

The chief supply for the city of Naples comes from Monte St. Angelo, the loftiest point of the bold promontory that separates the Bay of Naples from the Bay of Salemo, and is situate about twelve miles from the former; it is brought in row boats by night to Naples, and is there received by a number of *facelimi* or porters, regularly appointed to that service. These porters deposit their loads in the snow custom house, a building called "La Dogana della neve." To this general depôt, the retail dealers come to furnish themselves from all parts of the town, for there is scarcely a street in Naples, however miserable, but has its snow shop. Indeed, there is an old law by which these shops are never allowed to be shut in hot weather, by night or by day, and if the owner absents himself he must leave some one in his shop, ready to serve the snow should it be called for. The snow trade of Naples is a government monopoly, and produces a considerable revenue. Of the mountains of snow brought daily into Naples, some finds its way to private families, who use it at their meals, some to coffee houses and sorbettieri, where it is used in sherbet, lemonade, &c.; but the principal part supplies the inferior venders of *gelati* and the *acquaioli*, or water sellers, who cool with it the plain beverage they sell to passengers at the corner of almost every street. In domestic use, snow not merely does its duty in the wine cooler, but is served up at table in an open vessel, out of which each person helps himself to a piece as he prepares to drink his wine. That



Flakes of Snow.

great luxury, an icy cold draught, is produced by covering the mouth of the glass tumbler with snow, and pouring the wine through it, and then it is truly delicious.

While the rich are thus supplied with this luxury, the itinerant venders supply the poorer classes. Every summer evening, on the long mole, by the port, and all frequented places, these eloquent and noisy dealers ply their trade. Their wares of course are not so good, but then they are much cheaper, and they are always cold! There for three or four grains the sailor, the fisherman, the thirsty calassiero, or other labouring man, can obtain that *ne plus ultra* of luxury—a long mouthful of something cold and sweet. On the evenings of church festivals and holidays, the trade carried on in this way is very extensive indeed, and on such occasions the flying snow sellers are found in every crowded place, maintaining a deafening rivalry with the venders of water melons and other luxuries.

## SNOW HOUSES OF THE ESQUIMAUX.

Sir John Franklin, in his visit to the Polar Sea, says, "I saw one of these constructed by Augustus to-day. Having selected a spot on the river where the snow was about two feet deep, and sufficiently compact, he commenced by tracing a circle, twelve feet in diameter. The snow in the interior of the circle was next divided with a broad knife having a long handle, into slabs three feet long, six inches thick and two deep, being the thickness of the layer of snow. These slabs were tenacious enough to admit of being moved about without breaking, or even losing the sharpness of their angles, and they had a slight degree of curvature, corresponding with that of the circle from which they were cut. They were piled upon each other exactly like courses of hewn stone, around the circle, which was traced out, and care was taken to smooth the beds of the different courses with the knife, and to cut them so as to give the wall a slight inclination inwards. The dome was closed somewhat suddenly and flatly, by cutting the upper slabs in a wedge form, instead of the more rectangular shape of those below. The roof was about eight feet high, and the last aperture was shut up by a small conical piece. The whole was built from within, and each slab was cut so that it retained its position without requiring support until another was placed beside it, the lightness of the slabs greatly facilitating the operation. When the building was covered in, a little loose snow was thrown over it to close up every chink, and a low door was cut through the walls with a knife. A bed-place was next formed, and neatly faced up with slabs of snow, which were then covered with a thin layer of fine branches, to prevent them from being melted by the heat of the body. At each end of the bed, a pillar of snow is erected to place a lamp upon; and lastly, a porch was built before the door, and a piece of clear ice was placed in an aperture cut in the wall for a window. The purity of the material of which the house was formed, the elegance of its construction, and the translucency of its walls, which transmitted a very pleasant light, gave it an appearance far superior to a marble building, and one might survey it with feelings somewhat akin to those produced by the contemplation of a Grecian temple raised by Phidias; both are temples of art, inimitable in their kinds."

## THE THERMOMETER.

In general, when heat is imparted to a body, an enlargement of bulk will be the immediate consequence, and at the same time the body will become warmer to the touch. These two effects of expansion and increase of warmth going on always together, the one has been taken as a measure of the other; and upon this principle the common thermometer is constructed. That instrument consists of a tube of glass, terminated in a bulb, the magnitude of which is considerable, compared with the bore of the tube. The bulb and part of the tube are filled with mercury, or some other liquid. When the bulb is exposed to any source of heat, the mercury contained in it, being warmed or increased in temperature, is at the same time increased in bulk, expanded or dilated, as it is called. The bulb not having sufficent capacity to contain the increased bulk of mercury, the liquid is forced up in the tube, and the quantity of expansion is dertermined by observing the ascent of the column in the tube.

An instrument of this kind, exposed to heat or cold, will fluctuate accordingly, the mercury rising as the heat to which it is exposed is increased, and falling by exposure to cold. In order, however, to render it an accurate measure of temperature, it is necessary to connect with it a scale by which the elevation or depression of mercury in the tube may be measured. Such a scale is constructed for thermometers in this country in the following manner:—Let us suppose the instrument immersed in a vessel of melting ice: the column of mercury in the tube will be observed to fall at a certain point, and there maintain its position unaltered: let that point be marked upon the tube. Let the instrument be now transferred to a vessel of boiling water at the time when the barometer stands at the altitude of 30 inches: the mercury in the tube will be observed to rise until it attain a certain elevation, and will there maintain its position. It will be found, that though the water continue to boil, the mercury in the tube will not continue to rise, but will maintain a fixed position: let the point to which the mercury has risen in this case, be likewise marked upon the tube.

The two points thus determined, are called the *Freezing* and the *Boiling* points. If the distance upon the tube between these two points be divided into one hundred and eighty equal parts, each of these parts is called a *Degree*; and if this division be continued, by taking equal divisions below the freezing point, until thirty-two divisions be taken, the last division is called the *Zero*, or *nought* of the thermometer. It is the point to which the mercury would fall if the thermometer were immersed in a certain mixture of snow and salt. When thermometers were first invented, this point was taken as the zero point, from an erroneous supposition that the temperature of such a mixture was the lowest possible temperature.

The degrees upon the instrument thus divided are counted upwards from the zero, and are expressed, like the degrees of a circle, by placing a small (•) over the number. Thus it will be perceived that the freezing point is thirty-two degrees of our thermometer, and the boiling point will be found by adding one hundred and eighty to thirty-two degrees; it is therefore two hundred and twelve degrees.

The temperature of a body, then is that elevation to which the thermometer would rise when completely immersed in the component matter of the body. Thus, if we should immerse the thermometer, and should find that the mercury would rise to the division marked one hundred degrees, we should then affirm that the temperature of the water was one hundred degrees.

The dilation which attends an increase of temperature is one of the most universal effects of heat. It varies, however, in different bodies; it is least in solid bodies; greater in liquids; and greatest of all in bodies in the aeriform state. Again, different solids are differently susceptible of this expansion. Metals are the most susceptible of it; but metals of different kinds are differently expansible.

As an increase of temperature causes an increase of bulk, so a diminution of temperature causes a corresponding diminution of bulk; and the same body always has the same bulk at the same temperature.

## THE BAROMETER.

AMONGST the ancient philosophers there was a physical dogma adopted, viz., nature abhors a vacuum. This arose from their observing, that the moment a solid or a liquid was by any means removed, immediately the surrounding air rushed in and filled the space which the solid or liquid had previously occupied. It is said that for two thousand years the ascent of water in pipes, pumps, &c., was all accounted for by this supposition of nature's abhorrence of a vacuum, when it happened that some engineers employed at Florence to raise water from what at that time was considered an unusually great depth, found that the water would rise no higher than about thirty two feet above the surface of water in the well. It is said that Galileo, the most celebrated philosopher of that day, was consulted in this difficulty, and that his answer was, that "Nature's abhorrence of a vacuum extended only to the height of thirty two feet, but that beyond this her disinclination to an empty space did not extend." Some writers, however, deny this statement; while, on the other hand, others admit it, but think it to have been ironical. It is certain, however, that Galileo directed his attention to the point, experimented on it greatly, and soon saw the absurdity of the maxim, that "nature abhors a vacuum." The problem was successfully solved by Torrecelli, the pupil of Galileo; he argued thus:—Whatever be the cause which sustains a column of water in a common pump, the measure and the energy of that power must be the weight of the column of water, and, consequently, if another liquid be used heavier or lighter, bulk for bulk, than water, then the same force must sustain a lesser or greater column of such liquid. Upon this reasoning, he tried experiments upon various liquids, and, amongst others, mercury, which is the heaviest liquid known, being about 13½ times heavier than water; it follows, therefore, that the height of a column of mercury must be 13½ times less than a column of water which would be sustained by the same cause. Hence he computed that the height of the column of mercury would be about 18 inches. To prove this, he procured a glass tube upwards of 30 inches in length, and closed at one end, and having filled it with mercury and placed his finger on the open end, he plunged it into a vessel containing mercury; instantly, on the removal of his finger, the mercury gradually fell in the tube, and finally stood at the height of about 28 inches This experiment immediately showed the absurdity of the supposition of nature's abhorrence of a vacuum extending to the height of 32 feet, and the true cause was soon observed. The atmospheric pressure acting upon the mercury contained in the cistern, while the surface of the mercury contained within the tube was protected from that pressure, supported the weight of that column; and by the principles of hydrostatics, we know that the height of the column of mercury will be the same whatever be the bore of the tube; and it stands to reason, that as the atmospheric pressure varies, so will the weight which that pressure supports. The rising and falling, therefore, of the column of mercury within the tube will indicate the atmospheric pressure. We therefore now have a barometer, a term derived from two Greek words, signifying *baros*, weight, and *metron*, measure.

A column of mercury the height of the barometer, and whose base is a square inch, will weigh about 15lbs. avoirdupois; therefore when the barometer stands at 30 inches, the atmosphere exerts a pressure equivalent to 15 lbs. on every square inch of mercury in the cistern; taking, therefore, the barometric column at thirty inches, it follows that all bodies at the surface of the earth sustain a pressure of 15 lbs. on every square inch of surface; and, consequently, if the body of a man contains 1500 square inches, he sustains the enormous pressure of 22, 500 pounds.

## MUSICAL BAROMETER.

A GENTLEMAN at Burkli, by the name of Ventain, not far from Basle, in Switzerland, invented, some years ago, a sort of musical barometer, which has been called in German, *wetter harfe*, weather harp; or *riesen harfe*, giant harp, which possesses the singular property of indicating changes of the weather by musical tones. This gentleman was in the habit of amusing himself by shooting at a mark from his window, and that he might not be obliged to go after the mark at every shot, he fixed a piece of iron wire to it, so as to be able to draw it to him at pleasure. He frequently remarked that this wire gave musical tones, sounding exactly an octave, and he found that any iron wire, extended in a direction parallel to the meridian, gave this tone every time the weather changed. A piece of brass wire gave no sound, nor did an iron wire extended east and west. In consequence of these observations a musical barometer was constructed. In the year 1787, Captain Haas, of Basle, made one in the following manner; thirteen peices of iron wire, each 320 feet long, were extended from his summer house to the outer court, crossing a garden. They were laced about two inches apart; the largest were two lines in diameter, the smallest only one, and the others were about one and a half. They were on the south side of the house, and made an angle of twenty or thirty degrees with the horizon. They were stretched and kept tight by wheels for the purpose. Every time the weather changed, these wires made so much noise that it was impossible to continue concerts in the parlour, and the sound sometimes resembled that of a tea-urn when boiling, sometimes that of an harmonica, a distant bell, or an organ. In the opinion of the celebrated chemist M. Dobereiner, as stated in the *Bulletin Technologique*, this is an electro-magnetical phenomenon.

## THEORY OF LIGHT.

The nature of light has ever been a subject of controversy. It was Newton's explanation, that luminous objects give out particles of inconceivable minuteness, and move with extreme velocity. "What mere assertion," says Sir John Herschel, "will make any man believe, that in one second of time, in one beat of the pendulum of the clock, a ray of light travels over 192,000 miles; and would therefore perform the tour of the world in less time than a swift runner would make one stride?" In short, there is nothing like it but the influence of attraction; which is so instantaneous as to admit of no calculation of time at all. A different theory from that of Newton was suggested by Huyghens, who supposed a highly elastic fluid to fill all the space, and which, when moved, produced the effects ascribed to light. Instead of minute particles diverging from the luminous body, he substituted waves of vibrations, propagated through this elastic ether. The late Dr. Young, and some Continental philosophers, more recently, took up this hypothesis and supported it by ingenious experiments. But notwithstanding that it is the favourite theory of the day, difficulties appear still to encumber it. The theory of undulations implies the advance and recoil of the elastic medium, and that gives the idea of retardation. The supposition of light being the effect of the motion of an ether, does not fall in with our conceptions of the manner in which it enters into the composition of bodies, or influences chemical combinations, or effects the living power of animals and vegetables. The merits of the two theories, however, need not be discussed here. It will be sufficient for our purpose to enter on the explanation of a few of the laws which influence a ray of light in passing through transparent media.

When the ray of light passes perpendicularly from a rarer into a denser medium, as from air into water, it suffers no change in its direction; but when it passes obliquely, it takes a new direction towards the perpendicular, making a sudden angle, as if broken,—and this is refraction. Two circumstances, therefore, influence the ray of light;—the angle at which it falls, and the density of the body into which it passes. When the ray passes from the denser medium into the rarer, it is again refracted, but away from the perpendicular, and takes its original course, provided the surface at which it goes out is parallel to the surface at which it entered. When a ray strikes upon a body that is not transparent, or only imperfectly so, it is in part reflected, that is, struck off again, bent back, or reflected, and enters the eye, conveying to us the impression of the form and colour of that object. But the expression which we have used requires explanation; for how is it that the reflected rays should convey the idea of colour? The prism is a piece of glass so formed that the rays must fall obliquely on one or both of the surfaces, and suffer refraction. Thus a ray striking into the prism is refracted; but all its parts are not equally refracted, and as the light consists of parts differing in colours, and which are differently refracted, it is divided or dissected into several colours, called the prismatic colours. The spectrum, as it is termed, thus formed, consists of seven colours; that which is least refracted being red, and in succession orange, yellow, green, blue, indigo, and violet. If these rays be re-compounded by passing through a convex lens, which, owing to the obliquity with which they fall, draws them to a point, the focus of the light will be again colourless. Some modern philosophers have reduced these prismatic colours of Newton to three primary colours, red, yellow and blue; contriving, by the super-position of these, to produce the seven tints; while others have, on considerations not easy to be disproved, held that there is not any definite number of colours, but a gradation of tints from the extreme red to the extreme violet. We may now understand the reason of the colour of objects. When light strikes upon a body, even upon the most transparent, part penetrates, part is reflected, and some part is lost. A dye is a disposition given to the surface of cloth to repel some of the rays of light more than the others; and the colour will be according to the ray, or the combination of rays, thus cast back and sent into the eye.

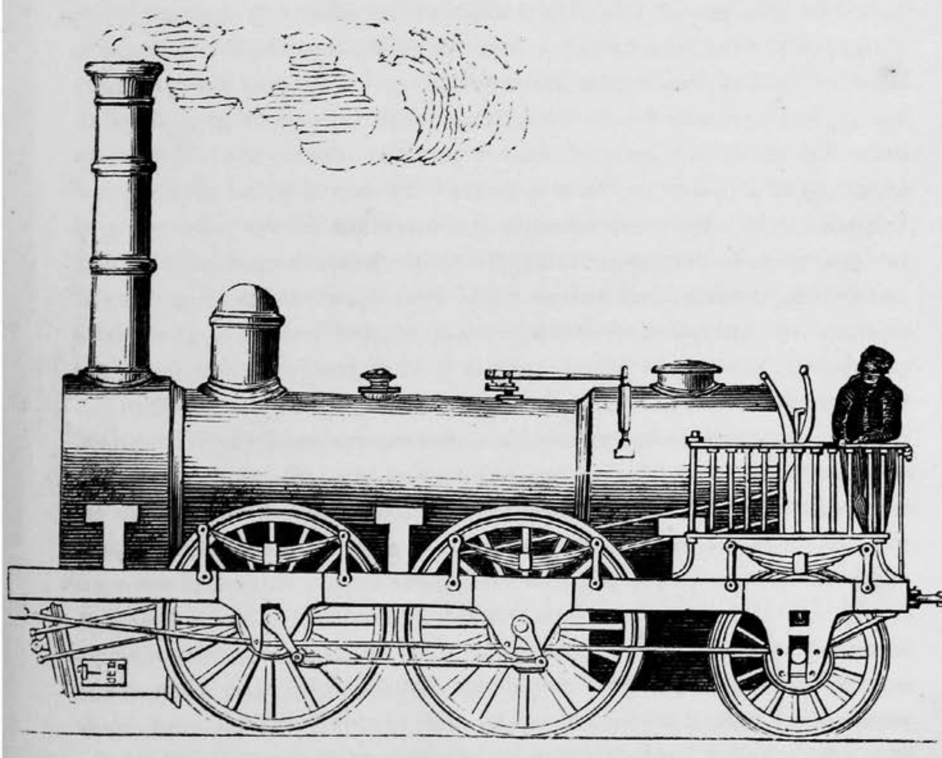
And here it is natural to reflect on the variety and beauty everywhere bestowed through this property of the beam of light. What a dulness would have pervaded the surface of the earth if there had been only a white light! The beauties of the garden and of the landscape would have been lost to us. How is the beauty of the latter enhanced by the almost infinite variety of colour, yet still within that range which is agreeable and soothing to the eye, as well as consonant to our feelings! The human countenance, too, although capable of exciting our warmest sympathies by form and motion alone, has that beauty perfected by colour, varying under the influence of emotion.

It remains, in order that we may apply these facts to the explanation of the structure of the eye, to show how the rays proceeding from a body and falling upon a convex glass suffer refraction. The ray that strikes upon the centre, being perpendicular to the glass, passes on undeviatingly. But each ray as it strikes a point removed from the centre must impinge with more obliquity, in consequence of the curved surface; and as the refraction of all the rays will be in proportion to the obliquity of their incidence, they will converge towards the central direct ray.

### THE EYE COMPARED WITH OPTICAL INSTRUMENTS.

It is surprising that the structure of an animal body should so seldom be taken as a model. In the history of inventions, it appears quite extraordinary that the telescope and the microscope should be modern, when, as it should seem, the fine transparent convexity of the eye might have given rise to imitation, as soon as man learned to give shape to natural or artificial glass. It reminds us of the observation of Locke, in speaking of a discovery, that it proved the world to be of no great antiquity. Yet we must estimate the invention of the telescope and microscope as by far the most important in their consequences of either ancient or modern discoveries. The first opens to us an unlimited expanse, not only of new worlds, but systems of worlds, and new laws evinced in the forces which propel and attract these; since in the heavenly bodies we find no material contact, nor pressure, nor impulse, nor transfer of power—nor effect of heat, nor expansion of gases—nothing, in short, which can be illustrated by mechanism. By the microscope, we contemplate the minute structure of animals and things but for its aid invisible: the balance of the cohesive and repulsive force as they order the changes in the material of the world, and in that of our own frames. Yet these instruments are not in contrast with the eye; but through the comparison of them we discover the wonderful adaptations of that organ; of which it has long ago been said, that it can at one time extend our contemplations to the heavenly bodies and their revolutions, and at another limit its exercise to things at hand, to the sympathies and affections of our nature visible in the countenance. If

Railway Tunnel.



Railway Steam Engine.

we put aside the consideration of the living properties of the organ, as the extraordinary variety and degrees of sensibility in the nerve of vision, and confine ourselves to points easily comprehended, as, for example, the mechanism of the eye, and the laws of optiets as applicable to the humours, we shall find enough to admire. When we look upon the optician's lens, however perfect its polish may be, we can see its convex surface; that is to say, the rays of light which strike upon that surface do not all penetrate it, but are in part reflected to our eye, which is the occasion of our seeing it. We do not see the surface of the corner of the human eye. Here, then, is an obvious superiority, since it implies that all the rays of light which strike the corner enter it and are refracted, and none are returned to our eye. If we take the optician's lens between our fingers and hold it under water, we can no longer see it, however transparent the water. The reason of this is, that the rays of light are reflected when entering from a rare medium into a denser, more abundantly in proportion to the difference of the density. When the ray of light has penetrated the water, it also penetrates the glass, because there is not that difference of density between the water and the glass which there is between the atmosphere and the glass. From this we may estimate the importance of the surface of the cornea being moistened by the tears; for however thinly the water may be spread over the surface of the eye, it is sufficient to make those rays that would otherwise be reflected penetrate the cornea. The whole humours of the eye are constituted with a regard to this law. There is nowhere an abrupt transition from a rare to a dense humour. The ray is transmitted from the cornea into the aqueous humour, and through that humour into the lens or crystalline humour. Were this latter humour uniform and of the density of its central part throughout, the ray would be in part reflected back from its surface. But it is not uniform, like a mass of glass: it consists of concentric layers increasing in density from the surface to the centre. If we first look at the entire lens, and then take off its concentric layers, we shall see the surface of the internal nucleus more distinctly than the exterior and natural surface. The reason is obvious: the nucleus is so much more dense than the atmosphere, that the reflection of the rays from it is more abundant. We now comprehend how finely it is provided that the crystalline lens should be surrounded with the *liquor Morgagni*, a fluid which is but in a slight degree more dense than the aqueous humour. The exterior surface of the lens itself is only a little more dense than the surrounding fluid, and each successive layer, from the surface to the centre, is of gradually increasing density: so that if we were to describe the course of the ray, it would not, as we see in the ordinary diagrams, pass like a straight line of the pen, but in a curved line, showing the gradual manner in which the ray is refracted through successive transparent layers. As it enters in the anterior half of its passage, it encounters media of increasing density: but as it passes out behind, it is transmitted through media diminishing in density. The ray is nowhere opposed by that sudden increase of density which gives a disposition to reflection; and it passes through the vitreous humour still refracted, the density of that humour having a just correspondence with the posterior surface of the lens. In the atmosphere there is a similar arrangement for receiving the light proceeding from the sun or stars: for as the density of the air diminishes as the height above the earth increases, the surface of our atmosphere, from its rarity, must almost resemble free space; consequently the light falling into it will penetrate more abundantly than if the air were compressed as it is near the earth, and were of uniform density. We thus see the obvious superiority in the structure of the eye to any thing that can be composed of glass, which is of uniform density throughout, and must therefore present a succession of surfaces where rare and dense media are abruptly opposed to the rays transmitted. We may observe another happy result from the peculiar structure of the lens. A magnifying glass is never true: an aberation of the rays takes place in the pencil of light, as the rays are drawn to a focus. The rays which penetrate near the centre are projected, so as to be drawn to their focus beyond those rays which pierce through nearer the edge. The rays penetrating this double centre of the convex glass will project the image to a greater distance then those penetrating nearer the circumference, and consequently falling more obliquely will form a focus nearer the lens. But in the crystalline humour of the eye, which corresponds with the optician's lens, the exterior layer having less density, and therefore a diminished property of refracting the ray, the image is carried farther off; and by this means it is ordered that wherever the ray penetrates, it shall be drawn to an accurate focus. Some modern philosophers have asserted that the eye is not perfectly achromatic in every adjustment. The term implies the property of the instrument to represent an image divested of the prismatic colours; those false colours which attends the refraction of the rays of light. If the statement be correct, it is nothing against our argument; nor have those inquiries advanced in any such view. We know that in all the ordinary exercises of the eye the image is perfect, having neither penumbra nor prismatic colours. This property of the eye results from the different media through which the rays are transmitted, and the gradual transmission which we have just mentioned. Dolland's achromatic glasses, a great improvement on the telescope, were made on this principle. He composed the object-glass of the telescope of crown-glass and flint-glass, so that while, by the combined effect of their convexities, they drew the rays of the focus, the dispersive power of the one was counteracted by that of the other. Let us endeavour to explain this. A beam of light, being composed of the different coloured rays, passes through a prism. Instead of passing onward in a straight line, it is refracted in distinct, and, consequently, colored rays. Whilst the whole of them are bent or refracted at an angle, they are also diverging from one another. Their deviation from the straight line is their *refraction*: their diverging from each other is their *dispersion*. These properties being distinct, it is conceivable that glass of a different chemical composition may affect the one to a greater degree than the other, and, therefore, that a lens may be composed of different kinds of glass (crown-glass and flint-glass, for example), so that the convergence of the rays into a focus may be obtained without the dispersion of the rays, and the consequent production of false colours round the image. This is what Dolland nearly accomplished, and upon these principles. That the effect of this very artificial arrangement is attained in the eye is a remarkable proof of the perfection of its adaption to the properties of light. The last circumstance which we may mention in continuing the comparison, is the drawing out of the tube in the telescope to accommodate the foci of the glasses to the distance of the object. It is sufficent to say, that the eye possesses this property of accommodation. That we do not understand how the operation is performed, only strengthens the argument in favour of the perfection of the eye: since the power exists, and is exercised with an ease which hardly permits us to be sensible of it.

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## THE ADMIRALTY TELEGRAPH

Is the invention (or rather the improvement of the French semaphore, of M. Chappe) by the late Sir Home Popham; it consists of an upright post with two indicators, which move upon centres one above another; the mast is made to turn round upon its axis, so as to present its arm successively to all quarters as may be required. The movements are very simple; they are effected by iron spindles and endless screws, so that the indices below are certain to accompany the indicators exactly in their movements, and place them precisely in their required positions, which cannot be done by the old machinery with cords, because these are liable to expand or contract, by wet or dry weather. The machinery for the set of telegraphs at the Admiralty, was constructed in the most substantial manner by Maudolay, in 1816. The following is an exact description: L. M. is a tall mast of an hexagonal form, framed up from six fir planks put together at the angles, and bound by iron hoops at different places, so as to be hollow within. The lower end, L., terminates in a pivot, and the mast is retained in a vertical position by a circular collar at O., which embraces it, and is supported in the roof of the building. The two arms P. M. and Q. R., are moveable upon centres, one at the top of the mast and the other half way down. When the arms are placed in a vertical position, they shut up in the hollow of the mast so as to be entirely concealed;, and for this purpose two of the six sides are cut away at the upper part, so as to leave an opening through the mast of sufficient width to allow the two arms to work into it.

To communicate motion to the arms, a small toothed wheel is fixed upon each at the centre of motion, and close to its side. The teeth of those wheels are actuated by endless screws or worms, formed on the upper ends of the long spindles *d. e.* and *f. g.*, which descend to the bottom of the hollow mast, and have small levelled wheels upon them. These again are acted on by wheels of similar size, fixed on the ends of short horizontal spindles, which have handles, *p. q.*, applied at the extremities. By turning the latter, motion is given to the vertical handles *d.* and *f.*, and by means of the endless screws upon the ends of them, the wheels at M. and R., on the centres of the arms, are turned, and the arms are put into any required position. But in order that the people below may at all times know exactly what positions the arms stand in, two dials, *m.* and *n.*, are placed on the lower part of the mast, each of which turns round with a motion exactly corresponding to that of the arms. Each arm, therefore, has four positions in which it will express different signals; and these positions are all made with the pointer at an inclination of forty-five degrees from the horizontal line. These signals either express the letters of the alphabet or the numerical characters, according to previous arrangement, which must be made known by exhibiting a preparatory signal before the communication is begun. The signal to prepare for receiving letters, is by extending the lower arm horizontally to the right; and for the numerals, both arms are extended horizontally to the left. The arms are made with boards like Venetian blinds, and each has a piece of cast iron at the opposite end to counterpoise the weight, and make it move freely into all positions. Now it is easy to conceive, that by repeating all those positions with both arms extended together instead of one singly, various combinations may be made, sufficient to express all the remaining letters, and some other necessary signals.

The first figure in the cut exhibits the whole telegraph from its foundation to its top, together with a section of the roof of the Admiralty in which it is fixed. The second figure shows the internal machinery on an enlarged scale; the third exhibits the seven different positions which the two arms (the only parts used in communicating information) are made to take, and the extreme simplicity of the contrivance becomes the more manifest from observing that the arms are always extended in right lines. The remaining thirty figures, numbered from one to *fin* (which latter indicates that the communication is completed), it will be seen are all combinations of some two of the seven previously explained, and for facility of reference are numbered to correspond; the figure twenty-seven for example, consisting of those marked 2-7 in the smaller engraving. The figure *pausa*, indicates the completion of a sentence. Several telegraphic dictionaries have been compiled, but Sir Home Popham's is the one in general use in the navy; it consists of thirteen thousand words and sentences. Our cut exhibits all the signals used at the Admiralty; but their various interpretations are frequently changed, and known only to the officers engaged in that service.

## DAVY'S ELECTRICAL TELEGRAPH.

This beautiful invention is one of the first and most useful applications of that most extraordinary and subtle fluid, *electricity*.

If a piece of zinc, and another of copper, be placed near and opposite each other without touching, in a vessel containing acid, such as oil of vitriol, diluted with water, the two metals will acquire opposite states of electricity. If now a metalic wire of some length be connected by solder, or any very perfect metallic contract with each metal, a current of what is called *voltaic electricity*, or *galvanism*, will constantly flow along each wire, from one end of it to the other.

This electric current possesses magnetic properties, and if the conducting wire be brought close over the needle of a mariner's compass, which points north and south, it will turn it out of its direction, and cause it to point east and west, or vice versa. The wire connecting the zinc and copper may be of very great length, for instance, many miles, and yet it will produce the same effects at any part of it.

If 26 magnetic needles, each bearing a letter of the alphabet, be fixed in as many coils of 26 wires, then on passing the galvanism to any one or other of these wires, the corresponding letter will be given as the signal, and letters may be signalled in succession, so as to form complete words and sentences. This is the elementary form of the apparatus described by a French philosopher many years ago; and a similar imperfect apparatus has recently been exhibiting publicly under a different name. The objections are the vibrations of the needles, and the loss of time and liability to mistake, and also the length of space which the needles occupy, and the not having them all at once under view; besides the multiplicity of wires, and the expence. The plan has of course been considered as no way adapted for practice.

Mr. Davy has, by the application of some not generally-known principles, brought the invention to the greatest perfection, as may be believed from the following description;—Instead of 26 wires, Mr. Davy employs only six; and with these he can give upwards of 200 signals, including the 26 letters of the alphabet. Nothing whatever is seen of magnetic needles; there is a small dark screen, on which the letters (either singly, or combined into words, or arbitraries) start into view the instant the key at the opposite end is touched; and this would be the case as instantaneously, even though the wires extended from London to Portsmouth—the length of distance, according to Mr. Davy's plan, making absolutely no difference whatever. The coming of a communication is always preceded by a sound or alarum; and a bell, struck by the action of a magnet, moved by electricity, separates the letters into words; the bell being rung at any distance by the electricity. The readiness, rapidity, and certainty of this apparatus surpasses all expectation.

## HISTORY OF STEAM.

That power which can "engrave a seal and crush a mass of obdurate metal like wax before it; draw out, without breaking, a thread as fine as gossamer, and lift a ship of war, like a bubble in the air; or embroider muslin, forge anchors, cut steel in ribbands, and impel itself against the opposition of the very tempest."

One of the properties of heat is its power of expanding all bodies into which it enters. Thus a piece of iron made red hot, will be found on examination to have increased in bulk; and the same effect takes place in all other bodies, with one or two exceptions, for which no explanation can be given. Now, when water is exposed to the action of heat, it also expands and assumes a gaseous state—and this is *steam*. In such condition it is very elastic, and, like the atmosphere, invisible. This conversion takes place at all temperatures, from the surface of liquids; but the vaporisation, or formation of vapor, is slow, and the vapor produced is prevented from rising by the pressure of the atmosphere, which checks its further formation; but a current of air, by removing the vapor previously formed, allows the formation of more, which, in its turn is removed, and so the process goes on until all the liquid is evaporated. This explains why, on a windy day, or in a situation exposed to a current of air, vaporisation proceeds so rapidly.

If, however, the water be heated in an open vessel, till it attains a heat of two hundred and twelve degrees of Farenheit's Thermometer, it is said to have reached the boiling point, and it cannot be made hotter; all subsequent additions of heat going to form steam, which rises from that part of the vessel nearest the source of heat, and escapes from the surface of the water, producing that agitation commonly called *boiling*. About one thousand degrees of heat are necessary to convert boiling water into steam; but this accession of heat not being indicated by the Thermometer, is called *latent heat*. At two hundred and twelve degrees the elastic power of steam is equal to that of the atmosphere, and at four hundred and nineteen degrees, is one thousand and fifty times greater; it then exerts a pressure of nearly fifteen thousand pounds on every square inch of the inside of the vessel in which it may be confined. It has been found by repeated experience, that steam at the temperature of two hundred and ten degrees, occupies about one thousand eight hundred times the space of the water from which it is formed. But till the commencement of the present century this fact was not generally known. It was thought that the expansion was fourteen thousand times greater than the water which produced it; this has, however, since been proved erroneous. It must not be forgotten that steam can be suddenly condensed, however great may be its *state of expansion*, into the same quantity of water that it formed before the application of heat had changed its condition, and it was for the purpose of making available the force so generated, that many of the first invented steam engines were constructed: it is the *expansive force* of steam, however, that is the prime mover of the engines of the present day.

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## INVENTION OF THE STEAM ENGINE.

Dr. Lardner has very justly observed, that the steam engine, as it now exists, is not the exclusive invention of any one individual, it is a combination of inventions, which for the last two centuries have been accumulating. The first person of whom we have any record as having a notion of steam as a moving power, was *Hiero* or *Hero*, an Alexandrian mathematician, about one hundred and thirty years B. C., in a work written by him, and in which he describes three several methods of applying steam as a *motive* power; first to elevate water by its elasticity, secondly, to raise water by its expansive force, and thirdly, to produce a rotary motion by its re-action on the atmosphere, the last only was applicable to any useful purpose. The next in order was *Solomon de Caus*, a Frenchman, who in 1615 employed the elastic force of steam as a means of raising water.

The third attempt to apply steam as a moving power was by Giovanni Branca, an Italian mathematician, who formed a boiler in the shape of the human head and breast; from the mouth of the figure proceeded a pipe, through which the steam issued, and striking against the vanes of a float wheel (similar to a common water wheel or paddle), caused its revolution, and a pinion being attached, motion by this means was given to machinery, which was employed in a drug or pounding mill.

The next person whose name is associated with the steam engine is the Marquis of Worcester, who in the reign of Charles the Second (1663), published his "Century of Inventions," all of which he claimed as his own. Among which is "an admirable and forcible way to drive up water by fire," and this is supposed by some to have given the first idea of many great improvements of the steam engine; others deny that he suggested any beneficial alteration, and it is certain that engines have been made upon his principle and have altogether failed. Sir Samuel Moreland a few years after is known to have constructed an apparatus, of which the moving power was steam; it was exhibited before the King of France; but of which no drawing or description is extant. His estimate of the expansive power of steam, although denied by Desaguliers and others, was proved by Watt to be the only correct one. Dr. Papin, a Frenchman, was the next improver of the steam engine, by the introduction of the *safety valve* for the boiler; this was in 1690.

In 1699, Captain Savery introduced his engine for raising water by steam; this was, in fact, the first useful application of the power, and this discovery is said to have been made by accident. The story runs that the Captain having partaken of "potations deep," threw the wine bottle into the fire; this, however, happened to have a small portion of wine left in it, which was immediately converted into steam by the heat; on perceiving which, he immediately thought of trying what effect would be produced by immersing the neck in water; and having some ready before (brought, it is said, for washing his hands), he forthwith tried the experiment, and that the steam which filled the flask was condensed, and that the water rushed up into the flask to supply the vacuum caused by this condensation. This casual experiment is said to have given to Savery the idea of constructing an apparatus on this plan for raising water. Savery by this perceived that he had only to form a vacuum, by means of condensing steam he could then raise water thirty-four feet. It also occurred to him, that he might employ the expansive power of steam as used in De Caus's engine, and thus force the water still higher.

All this Savery effected, and by so doing led the way for the brilliant inventions that were afterwards made in the construction of the steam engine; this invention was principally devoted to raising water from mines, and bore the name of the "miner's friend." With all its advantages, however, this engine did not perform well, and in 1750 Thomas Newcomen, a smith, and John Crawley, a plumber, both of Dartmouth, took out a patent, which they shared with Savery. The next improvement was made by Humphrey Potter, when a boy; who, it is said, from an idle feeling to save himself a little trouble, made an improvement in the uniform mode of the opening and shutting the cocks, by making the engine work its own. In 1718, Mr. Henry Beighton improved upon the idea of Potter, by the application of a piece of mechanism called a "hand gear;" this is a rod suspended from the beam of the Engine, having projecting pins, which act upon a number of levers, and thus effected what had been previously done by hand, or by Potter's rude contrivance. Such was the state in which the steam engine was found by the great James Watt; he was at this time a mathematical instrument maker at Glasgow, who being employed by the University of that city to repair a model of Newcomen and Crawley's engine, perceived the great loss occasioned by the injection of the condensation water into the cylinder, by which it was considerably reduced in temperature, and when the steam was again admitted, a great portion of it was condensed by the cold cylinder, which caused a great expenditure of fuel. This suggested to him the condensing of the steam in a separate vessel, by which the cylinder would always be maintained at an elevated temperature, while by having the condensing vessel (called a *condenser)* totally immersed in water, the condensation would be much more perfectly performed ; this he succeeded in, and hence the mighty power of steam has been to the present age what the invention of printing was to a former one. It needs not a monument in Westminster Abbey, however costly, nor an epitaph, however elegant, to tell us that neither are wanting

> ———————" To perpetuate a name
> " Which must endure while the peaceful arts flourish."

Or that he

> " Enlarged the resources of the country,
> " Increased the power of man,
> " And rose to an eminent place
> " Among the most illustrious followers of science."

## STEAM AS A LOCOMOTIVE POWER.

Richard Trevithick and Andrew Vivian, two Cornish engineers, the inventors of the high pressure steam engine, were the first who applied steam as a locomotive power; and certainly long before even Watt, who in 1784 first conceived the idea that two persons might probably be carried by an engine having a cylinder seven inches in diameter, and a foot stroke, the piston moving at the rate of one hundred and twenty feet, or sixty strokes per minute. Watt never put into practice his scheme, which perhaps would have failed, as low pressure engines were to be employed, and even his *great mind* had its prejudices against high pressure engines, from an idea of their danger. Trevithick and his clever partner took out a patent in 1802 for their invention, and began running their carriages upon common turnpike roads in 1804; but they did not receive the encouragement they deserved, and their carriages were solely confined to run on rail, or rather tram roads at that time, exclusively used in the iron and coal districts. The form and arrangement of their rail road carriage was somewhat different from those employed on common roads, and although many improvements have been made since the invention of Messrs. Trevithick and Vivian, yet the principle is closely followed in those used now so extensively.

## STEAM BOATS.

Numerous have been the claimants for the honor of being the first to apply the steam engine for the purposes of navigation; America claims it for Fitch and Fulton—England for Bell, Miller, Hulls, James Taylor and Symington—France for Papin, and Spain for Blascoe de Gary; but the question of priority of invention rests between John Fitch and Symington; the former is said to have taken out a patent in New York in 1788, having previously explained his invention in print, 1786, while Symington in 1788 made his first experiment in a double keeled vessel at Dalswinton—Hulls is said to have written a discription of a steam vessel in 1736. However, the honor of building a vessel, which was propelled by steam, is due to Symington, who constructed the first steam boat in this country. In 1789 a second was built by the same gentleman, on a larger scale, which was tried on the Forth and Clyde canal. For want of pecuniary means, Symington did not pursue his labors for more than 10 years. In 1800 he built one for the Forth and Clyde Canal Company; but this was abandoned by them in 1803, because the action of the paddles injured the banks of their Canal. The difficulties which Fulton had to contend with in 1806 at New York are familiar to every one. His vessel, the "*Clermont*," was nicknamed "the Fulton Folly." After a trifling stoppage she glided along so beautifully on the bosom of the Hudson, that those

"Who came to laugh—remained to praise."

She was 133 feet long, 7 deep, and 18 feet broad—the boiler was 20 feet long, 7 deep and 8 broad; the cylinder was 2 feet diameter, her burden was 160 tons, and she performed the voyage, 150 miles, in 32 hours; nearly at the rate of 5 miles an hour. The alarm which she created to seamen and landsmen during her first voyage was ludicrous in the extreme. To Fulton, therefore, we are indebted for that machine of which the waters of half the world are now covered with its models, and by means of which the journey between the old and new worlds is made a pleasure trip of a few days.

In England the annexed table will show the giant strides made since 1813, in this speedy and commodious description of transit.

## PROGRESS OF STEAM VESSELS.

The following is an authentic account of the number and tonnage of steam vessels, belonging to the British Empire (including the plantations), from 1814 to 1836 inclusive.

| Year. | No. of Vessels. | Amount of Tonnage. |
|---|---|---|
| 1813-14 | 2 | 456 |
| 1815 | 10 | 1,633 |
| 1816 | 15 | 2,612 |
| 1817 | 19 | 3,950 |
| 1818 | 27 | 6,441 |
| 1819 | 32 | 6,657 |
| 1820 | 43 | 7,243 |
| 1821 | 69 | 10,534 |
| 1822 | 96 | 13,125 |
| 1823 | 111 | 14,153 |
| 1824 | 126 | 15,739 |
| 1825 | 168 | 20,287 |
| 1826 | 248 | 28,958 |
| 1827 | 275 | 30,490 |
| 1828 | 293 | 32,032 |
| 1829 | 304 | 32,283 |
| 1830 | 315 | 33,444 |
| 1831 | 347 | 37,445 |
| 1832 | 380 | 41,669 |
| 1833 | 415 | 45,017 |
| 1834 | 462 | 50,736 |
| 1835 | 538 | 60,520 |
| 1836 | 600 | 67,969 |

In 1813, *one* steam boat of sixty-nine tons, floated in solitude on the British waters; and in 1839, from eight hundred and fifty to nine hundred vessels belonging to Britain, comprising above one hundred and seventy thousand tons, seventy thousand horse power—the capital invested in which exceeds *three millions sterling!* and the number that *now* sail, the tonnage and amount *invested*, exceeds all calculation.

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T. H. Shore, Printer, 30, Old Street, St. Luke's.