been alluded to; this was a very remarkable demonstration. The principal results deduced from these observations may be briefly stated. That the temperature of the air does not decrease uniformly with height above the earth's surface, and that, consequently, more elucidation upon this point is required, particularly in its influence on the laws of refraction. That an aneroid barometer can be made to read correctly, certainly to the first place, and probably to the second place of decimals, to a pressure so low as 5 inches. That the humidity of the atmosphere does decrease with the height, with a wonderfully increasing rate, till at heights exceeding 5 miles, the amount of aqueous vapor in the atmosphere is very small indeed. That we now can answer the question I put in my opening remarks, and can say that observations up to 3 miles high, even of a delicate nature, can be made as comfortably in a balloon as on the earth; that at heights exceeding 4 miles they cannot be made quite so well, because of the personal distress of the observer; that at 5 miles high it requires the exercise of a strong will to make them at all. That up to 3 miles high any person may go in the car of a balloon who is possessed of an ordinary degree of self-possession. That no person with heart disease or pulmonary complaints should attempt 4 miles high. But, at the same time, it must be borne in mind that I am concluding that the balloon is properly handled. It has been fortunate for this Association and myself that we have had the assistance of Mr. Coxwell, who has the experience of more than 400 ascents, based upon knowledge of natural philosophy, and that he knows "the why and because" of all his operations; and it was this fact, which I saw immediately from the clearness of his explanation to me for each operation, that enabled me to dismiss from my mind all thoughts of my position, and to concentrate my whole energies upon my duties. In conclusion, I feel certain that if these experiments prove that the balloon is available for philosophical research, then one of the brightest links in the long chain of useful works, performed through the agency of the Association, will be the feeling that the balloon, in proper hands, may be made a powerful philosophic agent.
white and gray flaggy sandstones, alternating with red and olive-colored argillaceous shales. The beds of white and gray sandstones have been numbered by the drillers for oil on Oil Creek in the descending order Nos. 1, 2, 3, 4, and 5, commencing in the bottom land on Oil Creek below Titusville. This numbering answers very well along the margin of the streams in Venango County, but in the County of Crawford there is an important bed of sandstone to drillers laying above No. 1, and reposes immediately under the town of Titusville, which I shall name the Titusville bed, and another above this found back in the hills which I shall call the Quarry bed. There is also a group of beds of soft micaceous sandstones found overlaying the tops of the hills in the vicinity of Titusville, which I shall name the Top Group of Rocks of the Oil Bearing Strata. This group is capped in some places by the Vespertine Conglomerate Rocks of Prof. Rogers.

Here we have a mass of Oil Bearing Strata of about 1200 feet in thickness largely saturated with petroleum from the Vespertine Conglomerate down to the Genesee slates. A formation very little disturbed from its original nearly horizontal position, save the slight swells and depressions crossing the oil trough obliquely. The molten plutonic waves which broke up the crust of the earth in northern Pennsylvania appear to have died out and rounded out towards the lakes, for one does not find here the huge anticlinal and sinclinal axial lines as in central Pennsylvania, but instead, feeble lines of elevation and depression crossing an original trough or basin of the Devonian Sea. In proof of this, I find the Oil Bearing Strata broken up into huge cakes of sandstones and shales, having fissures or openings between the strata extending down to a great depth, and which are generally found filled with gravel and pebbles, the result of the Drift Formation. These openings are numerous in the valley of Oil Creek, and the cause of much perplexity to drillers in search of oil. Parties sinking test holes for oil have driven iron pipe (a process which obviates boring through sand and gravel to the rock) down into some of these openings to the surprising depth of 160 feet from the surface of the country before striking the permanent rock, whilst their neighbors only a few yards distant have reached the horizontal strata at a depth of 30 or 40 feet. On Samuel Machintire's farm, 1½ miles west of the Rynd farm, there may be seen one of these vertical fissures in the strata above water free, where a man may walk under ground for the distance of 170 feet and look up 100 feet high. Similar openings may be seen near the Pit Hole, one of the tributary streams of the Alleghany river. They seldom contain oil in quantity. I therefore infer that they are lines of elevation, and the oil in the rock flows from them.

The lowest members of the Oil Bearing Strata commence in the vicinity of the town of Waterford, in Erie County, Pennsylvania, and incline gently in a southerly direction to the town of Union, where they disappear beneath the range of hills south of that village. About 8 miles to the south of this, we find Chestnut Ridge, where the Oil Bearing Strata are complete, but incline at an angle of 10 degrees to
the south to Hidetown, so that the majority of the oil flows in the direction of Oil Creek. There is a sinclinal trough in the strata beneath the town of Titusville and an anticlinal roll crossing at the lower dam near the Stackpole farm, and from this point there are a series of small undulations and crimps in the strata all the way to the mouth of Oil Creek. The stream running step-like denuding its passage nearer and nearer to the great oil pool below, where a depth of 530 feet from the surface produce flowing wells for a distance of 7 miles near to the mouth of Oil Creek.

The out-croppings of the lowest members of the Oil Bearing Strata are quarried at points along the line of the "Philadelphia and Erie Railroad," in Erie County, Pennsylvania, and the stones taken out are used for building purposes. The foundation walls of Mr. Riley's Hotel in the town of Union was built altogether of stone from one of these quarries, and the petroleum oozes out, staining the face of the walls to a great extent.

The Academy in Waterford, Erie County, Pennsylvania, was built 41 years ago with stones quarried on Big French Creek from fourth sand rock (so called); the petroleum still oozes out from the walls and trickles down the front and sides of the building, disfiguring its front so much up to the present day that the Academy commissioners resort to painting to conceal the petroleum stains. The north side of the building which I examined closely with a magnifying glass (to ascertain if I could discover any marks or impressions of fossil remains to produce oil in the rock) is very much disfigured, and portions of it so much so that it has the surface appearance of an old oily iron pot.

Such facts as the foregoing led me to a course of reasoning that the oil must exist in the rock, and the cause of its being there must have arisen from a buried vegetable growth which took place prior to the so-called carboniferous clay. For the petroleum to have flowed from the coal fields up hill in a northerly direction against the inclination of the strata, and found to exist in these particular beds of sandstone and shale, and not in the overlaying rocks, is an impossibility. And for the oil to have flowed from the true carboniferous deposite, before its elevation or subsidence of the waters, to points where the towns of Union and Waterford now stand, is poor reasoning, for the oil would have raised to the surface of the waters before running so far to settle in the Devonian Formation far below the carboniferous strata.

Knowing that the lowest coal beds of our coal fields are generally found to be the thickest, and were produced from a rank growth of vegetation, I supposed that there may have been a great mass of marine plants washed into the trough of the Devonian Sea immediately above the Genesee slate far below the valley of Oil Creek at the time the sand was laid down to form sand rock, and by their decomposition produced the rock oil; hence I kept a steady eye on each layer of rock as it presented itself to me in exposed places in hopes that the Stony Book of God, whose pages might be the true authorities in the case, should reveal to me in a suit of fossils the true cause of rock oil so deep
and so far from the coal fields. And I am pleased to state that the result of my investigations has far exceeded my anticipations, by the discovery of a great profusion of impressions of marine plants of the fucoid family in micaceous slabby sandstones along the edge of the base of the hills from the Stackpole farm 2½ miles below Titusville to the mouth of Cherry Tree Run. This encouraged me to make a thorough examination of the out-croppings of the Oil Bearing Formation. I proceeded at once to Big French and Le Bocuff Creeks in Erie County, where I found above the Genesee slates a bed of siliceous mud filled with impressions of marine plants and possessing a strong bituminous odor.

The following diagram is a geological column taken on the spot, September, 1861, about 5 miles from the town of Union on Big French Creek:

A, Genesee slates in bed of stream; B, slabby sandstones 16 feet thick; C, soft argillaceous shale, yellow color, 20 ft. thick; D, gray sandstone 2½ ft. thick; E, bed of free pebble rock 18 inches; F, gray sandstone, bituminous, 2 feet thick; G, compressed siliceous mud, containing impressions of marine plants, highly bituminous, 2 feet thick; H, micaceous sandstone, bituminous, 1 foot; I, hard sandstone, bituminous, 10 inches; J, soft olive-colored shale, bituminous, 2 feet; K, soft slabby sandstone, bituminous, 6 ft.; L, hard sandstone, embracing irregular seams of quartz pebbles, bituminous, 4 feet; M, argillaceous shale, light color, bituminous, 2 ft.; N, gray sandstone, containing thin bands of hard sandstone, bituminous, 45 feet thick.

On examining the slopes of the hills in this vicinity I saw petroleum oozing out from their sides above the bed of free pebble rock, E; but below this stratum there was not the least indication of petroleum issuing from their slopes, and no bituminous odor arising from any of the rocks below this point when struck with a hammer. Now, if one could follow the bed of siliceous mud, G, to its deep pool below the valley of Oil Creek, he no doubt would behold a sheet of oil, the result of fermentation of a large mass of marine plants that at one time grew upon the floor of the Devonian Sea, many of which may have been washed into this sinclinal trough by currents of salt water or by its oscillatory motion, for ripple washings may be distinctly seen upon the Oil Creek flags.
The plants which produced the oil in the rock existed and flourished at a long period of time before the vegetation which now forms coal beds; they are unlike the vegetable impressions found in the accompanying shales and clays associated with beds of coal, and grew when the flagstones and shales of Oil Creek were laid down by salt water currents, the sand rock then being sand and the shale mud, which caught and filled away in the secret chambers of the deep every new vegetable growth from the pebble rock, & beneath the oil pool up to the top of the Oil Bearing Strata.

The climate was so hot during this age of marine vegetation, and the growth of plants so rapid and rank, caused by the supposed large amount of carbonic acid gas and hydrogen then composing the atmosphere, that these conditions on the face of the earth produced plants containing less carbon and more hydrogen than the plants which produced coal beds, hence the fermentation produced oil, now petroleum. Had these marine plants taken up more carbon and less hydrogen than by fermentation they would have produced seams of coal. The discovery by me of a thin seam of bituminous coal in the upper members of this Oil Bearing Formation aids to substantiate the theory advanced, for the ancient marine vegetation which produced the petroleum in the Devonian Formation, gradually passed into a more carboniferous one.

Petroleum found in bituminous coal basins no doubt originates from beds of coal. Rock Oil found in other districts of North America may be derived from the decomposition of animal tissue, but it is my opinion that the petroleum of Oil Creek Valley, Pennsylvania, is the result of the decomposition of marine plants. Oils derived from animal origin have an offensive odor, whereas the oils from vegetable matter has a more pleasant odor. If their chemical compositions should be similar, their physical characteristics are entirely different. Oil found in bituminous coal fields is of a brown color, whereas the oil found in Oil Creek Valley is of a greenish hue. The substance iodine at the present day is found to exist in sea plants, but it may not have existed in the marine plants that produced the oil of Oil Creek.

The oil of Oil Creek is the result of fermentation of vegetable matter of long standing, and the carburetted hydrogen gas evolved was "cabined, cribbed, confined" for a long period of time until the boring tools probed it to the great pool below, then this gas became the chief agent in bringing the oil to the surface, producing spouting wells whose yield has been from 200 to 2000 barrels of petroleum each per day.

Water-proof Walks.

From the London Mechanics' Magazine, December, 1862.

But a new method of path-making is fast coming into vogue, and will soon be universally adopted for its cheapness, general excellence,