tracted from its compound. This method may be varied in different ways, and renders valuable service in medico-legal researches; it is much superior in sensibility to the process actually in use.

FISSURES IN SAND ROCK THE RESERVOIRS OF PETROLEUM.

BY R. P. STEVENS.

[For the Scientific American.]

The paleozoic, or sedementary strata, west of the Alleghany Mountains, have three important systems of fissures or shrinkage cracks. One generally running with the magnetic lines, or north and south; another at right angles, and the third perpendicular to the above. Besides these there are subordinate ones, crossing the others at various angles, from only a few degrees to forty-five. It is by means of these fissures that the limestones and slates of the West are so easily removed from their beds in the quarries. The longitudinal fissures will extend to great distances. In the lead-bearing limestones of the Black River country I measured one in a due east and west course, across the entire plateau, for three-fourths of a mile. On the Alleghany River, I have traced them across the valley to quite the same distance, and, in Virginia, one has been traced for many miles.

The perpendicular fissures will often reach through the whole thickness of a particular series of rocks, forming chasms many hundred feet deep.

In the great bed of coarse, pebbly, and fine-grained sandstone forming the base of the coal rocks of Pennsylvania, these latter fissures divide the rocks into immense square blocks, with spaces 10, 15, and even 40 feet between.

These fissures in ancient times were often water channels, and have since become filled with the result of such drainage, viz., cemented sands, pure silex, clays and ores. In this way we account for the iron ores of the trap rocks of Nova Scotia, the veins of jasper, spar and other minerals in the same rocks; the veins of lead in the Shawangunk Mountains, as the Erie and Ellenville lodes, and probably also the gold and silver mines of our Western States and territories. When the veins become filled with material, the course of water drainage is changed, and the waters seek some new channel. Lately we have seen in Nova Scotia the central fissure of the vein filled with mud. This is almost always seen in the lead and hematite caves of Missouri and the Galena region. One of these fissures, east and west, in the Alleghany Mountains is thus spoken of by J. P. Lesley, Esq., of Philadelphia:—"There stands this vertical, east and west running vein of solid petroleum, an evidence both of the abundance and of the antiquity of the Devonian petroleum."

A peculiar feature attending these perpendicular fissures may here be noticed. In their downward extent they will most usually be cut off by the intervention of a stratum of dissimilar nature, or composed of different material. Thus, fissures of limestone will be interrupted by a very thin layer of sandstone or sandy shale. Thus, in the great lead region of the upper Mississippi, sand rocks always cut off the veins of lead.

Another important feature of veins in mountain systems we will also notice.

It has long been well established by M. E. Beaumont, of France, and Prof. J. Dana, of our country, that mountain ranges are upheaved along great fissures in the rock strata of the earth, pursuing definite directions, according to the age of the upheaval, as, for instance, the Alleghanies have a general north-east and south-west direction. In these mountains all the main fissures will have the same direction, and the veins of iron ore, copper or graphite will obey the same law, while the subordinate fissures will be at right angles, or north-west and south-east.

In the Shawangunk Mountains the course of the mountains is north 20° east; the longitudinal fissures have the same course, while the cross fissures run south 60° east, and north 60° west. The Galena veins of these mountains are in the latter system.

Besides the fissures already mentioned there are innumerable other ones, running horizontally with the strata, and minor cross cracks, due in part to shrinkage, and in part to repeated upheavals and down throws. These, when viewed separately, seem of minor importance, but, when viewed in the aggregate, become very important in the amount of any fluid they may hold, whether of gas, oil or water.

When we stand by the side of any of the great spouting oil wells of Oil Creek, as, for example, the Empire, in its flowing stage, and see it flowing at the rate of 1,000 barrels of oil per day for many months in succession, we naturally look for the original reservoir hidden in the rocks below, which is capable of holding such an immense quantity of fluid.

To the fissures of the third sand rock must we look for this reservoir. Unfortunately, this rock is hidden 500 feet beneath the surface, at the point of penetration by the bore of the Empire well. It is, therefore, impossible to descend into it; we must reason by analogy, or search for subterranean tanks where this rock comes to the surface. Fortunately, owing to the dip of this, and all contiguous rock to the south, at the rate of about eleven feet to the mile, by traveling northward and ascending the dip we are enabled to find this sandstone coming to the surface. Accordingly, on French Creek we can see it, cut up by its numerable fissures—so much that it is quite difficult to find any very large-sized mass. In similar sand rocks I have measured fissures 10, 12 and 15 inches wide running many rods in linear extent.

The whole of the Devonian series of rocks, wherever seen in chasms, ravines and river bluffs, is always cut up by the system of fissures already described. Now, these Devonian rocks are our great receptacles of oil, whether in Canada or the United States. Alluding to the quautity of fluid these cavities can contain, the writer already quoted has so ably stated the subject, we shall continue to quote from him.

"Some of the main fissures are known to be four inches wide. Suppose them of all sizes, from four inches to a quarter of an inch in width, and at various distances, as under from 5 to 50 feet, and to be limited to the sand rock itself, say 30 feet in hight; suppose we take the contents of the fissures to be equal to $\frac{1}{300}$th of the mass of the rock. Now, supposing the oil to occupy but $\frac{1}{10}$th of the space in each fissure, the rest being occupied by gas and water, we have a yield of oil from each square mile of sand rock, amounting to nearly 50,000 barrels of oil."

Another source of oil has been demonstrated by excavations in the oil-bearing sand rocks of Ohio, and this is, the pores of the sand rock itself. The rock is saturated with oil to that degree that from open cuts it oozes out in sufficient amount to become an economical investment to cut into this rock by deep and lateral excavations.

P. Sterry Hunt, of Montreal, has made some experiments testing the capacity of sand rocks to hold water or other fluids. The mean of his results will give seven gallons per minute for thirteen years from one mile square and one hundred feet thick. From a rock as porous as the oil-bearing rocks of Venango County, this quantity should be increased five-fold.

The able author from whom we have already so largely quoted, has also made some calculations upon this point of our subject. He thus says:—"Every foot of gravel-rock may be considered to consist of three-fourths quartz, etc., and one-fourth cavity, occupied by water and oil. If we suppose only the uppermost four inches of the whole formation charged with pure oil, that would give an absolute layer of oil one inch thick, underspreading the whole country as far as the sand rock extends, or about 4,000 millions of square inches under every square mile; or, in other words, $17\frac{1}{3}$ millions of gallons, equaling 551,706 barrels."

When we consider that there are many sand rocks thus charged—not less than fourteen, and possibly as many more—extending over many hundred square miles of territory, much of which has yet been unexplored, we may rest in the fullest confidence that petroleum, in its regular supply and permanent quantity, will not fail of becoming one of the most important mining enterprizes of our country, as well as one of the most remunerative, to capital judiciously invested and economically expended.

Lightning Arresters.

Lightning arresters have attracted considerable attention of telegraphers from time to time, and many have been introduced, used for a while and then thrown aside. None have been invented that have answered fully the purposes for which they are intended, and when we take a philosophical view of the subject, it seems quite difficult, if not impossible, to accomplish it perfectly. The desideratum to be arrived at is an arrester which will, at all times, carry off the great bulk of the atmospheric electricity, thereby preventing its passage into the helix or cable, and retain its arresting power unimpared, and also leave the conductor uninjured. In other words, to separate the atmospheric from the battery electricity, convey the former to the ground, and secure the passage of the latter over the conductor, to the terminus of the line for which it was intended.

The one mostly in use at the present time is that of two plates of brass, separated by thin strips of glass, isinglass, hard rubber, or gutta-percha tissue, the upper plate forming a portion of the conductor, and the lower one being attached to the ground for the purpose of providing a medium for the atmospheric electricity to pass off, which it will do, provided the conductor does not present a better medium for its transit than the space between the plates. The plates being larger than the conducting wire, the question arises, does not this plate become, so to speak, a reservoir for the electricity, and must it not become surcharged before it will leave the one plate and pass through the space, which is non-conducting, to the other? If so, it is plain that the principle of plates is erroneous. These plates, to be effective, must be placed as closely together as possible, and not touch, so that if the electricity does pass off in this way, it is almost sure to fuse the two plates, thus giving a ground circuit to the line.

If this theory is correct, there seems to be a field for the inventive genius of our telegraphic friends, and our telegraph companies should look carefully after any improvements that will supply the deficiency which now seems to exist.—*The Telegrapher.*

SUBSTITUTES FOR ALCOHOL AND METHYLENE AS SOLVENTS FOR ANILINE DYES.

BY M. GAULTIER DE CLAUBRY.

With the exception of fuchsine and the violet of Perkin, the tinctorial substances coming from aniline and in its congeners, naphthalin, petroleum, the phenic compounds, etc., are insoluble in water, and can be employed in dyeing only in solution in alcohol. Many fruitless attempts have been made to replace this vehicle by substances of a less elevated price. It is the solution of the following problem which occupies us, and the results obtained are to-day sanctioned by experience:—To find substances which will render these colors soluble in water, without modifying their characters, permitting the dyeing and printing of tissues in the conditions habitual in the manufactories, furnishing colors well united and of all tints, of an easy employment, exercising no action injurious to the health of the workmen, and reducing in a large proportion, the price of the manufactured products.

The violets, taken as an example, are composed of red and blue elements—the first more soluble in divers vehicles, the second very difficult sometimes to dissolve.

The alcoholic solution, mingled in suitable proportion with water, furnishes a bath which, abandoned to repose, allows spontaneously to precipitate a very large part of the color, and retains only the red; the light ebullition to which it must be raised for dyeing, disengages easily this alcohol, augments the precipitation, and determines the production of an unequal deposit of the color on the threads and tissues, which explains at the same time the difficulty of obtaining tints perfectly united, and the liability of this class of colors to be rubbed from off the tissues on which they are deposited, (*le caractere que present plus ou moins les objets teints avec ce genre de produits de tacher le linge par le frottement*). The colors obtained by aid of the solutions which are the subject of this memoir, are, on the contrary, easily obtained, they are of a uniforn tint, and the coloring liquid which impregnates them is expelled by washing and wringing on coming out from the bath.

A great number of substances give to water the property of dissolving colors, which, heretofore, have been dissolved only by alcohol; we shall signal among them gums and mucilages, soap, and, in particular, that of almonds, glucose, dextrin, jellies of starch,