THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER VIII.

Continued from page 4.

At the north side of 98th street commences the stone viaduct, which extends to a point midway between 115th and 116th streets, forming the third division of the work; it was constructed under the supervision of Mr. George S. Baxter, C.E. This viaduct is built across the marshes known as the Harlem flats, and is, in all respects, a remarkably substantial work. Itstotallength is 4,563 feet, its greatest hight above street grade, which occurs at 104th street, 31 feet 1 inch, and its width in the clear, at railroad grade, 48 feet. The grade of the road across the viaduct, as will be seen by a glance at the profile (page 308, Vol. XXXI.) is by no means level. Between the south and north ends there is one continual fall of 40 feet per mile, the south end being41 feet 3 inches higher than the north end. The work consists of an earth embankment contained between two retaining walls of first class rubble masonry, laid in cement mortar, with vertical and horizontal joints, and battered on the outer face one inch to the foot. The hight, breadth, and depth of foundation vary. Thus, at 100th street the dimensions are: Hight 9 feet, breadth of wall at foundation 6 feet, breadth of parapet 4 feet; at 102d street, 21 feetx11 feetx4 feet; at 103d street, 25 feetx11 feetx4 feet; at 104th street, 29x13x6 feet, and at 115th 2x4x3 feet.

In laying the foundation of such a massive structure in such soft ground, considerable difficulty was encountered. By far the greater part was laid either in concrete or on piles, the latter being used very generally under the piers and abutments of the bridges at the street crossings.

The piles (of which 198,900 linear feet were driven) were of white oak and spruce, from twelve to fifteen feet in length and twelve inches diameter at the butt, and were driven two feet six inches from center to center till they reached hard bottom, or till a ram of 1500 lbs., falling 30 feet, did not settle them more than half an inch. The tops were then sawn off level, at the proper hight, and capped with two courses of white oak timber laid crosswise and treenailed to the piles; and on these was laid the foundation. Whereverconcretewasemployed, it was quickly mixed and deposited in layers of from four to nine inches, and settled by slightly ramming, sufficient to flush the mortar to the surface. The viaduct is carried over the cross streets on arches, the first series of which is at 102d street.

Fig. 19 shows a portion of the viaduct in perspective, and also the passenger station, which is built in part within the viaduct. Fig. 20 shows an end elevation of the viaduct. Fig. 21 is a side elevation in part section, showing the character of the arches at the street crossings.

The foundations of these arches are first class gneiss rubble masonry, and project one foot beyond the line of the superstructure of the piers and abutments. On these foundations is placed a bridge of three arches, two of them semicircular arches, of 10 feet span and 5 feet rise, and 20 inches thick, which span the sidewalks, and one elliptical arch, 30 feet span and 17 feet rise, and 24 inches thick, placed between the two small arches and spanning the roadway. The piers are 8 feet by 5 feet by 56 feet, and the abutments 8 feet by 6 feet by 56 feet. The faces of the abutments, spandrels, wing walls, piers, and arches, are built of freestone well dressed, and (with the exception of the arch stones, which are cut to long ⅜ inch joints) are all cut to lay half inch joint. The backing of the walls, abutments, and hearting of the piers is first class gneiss rubble masonry, well tied to the face

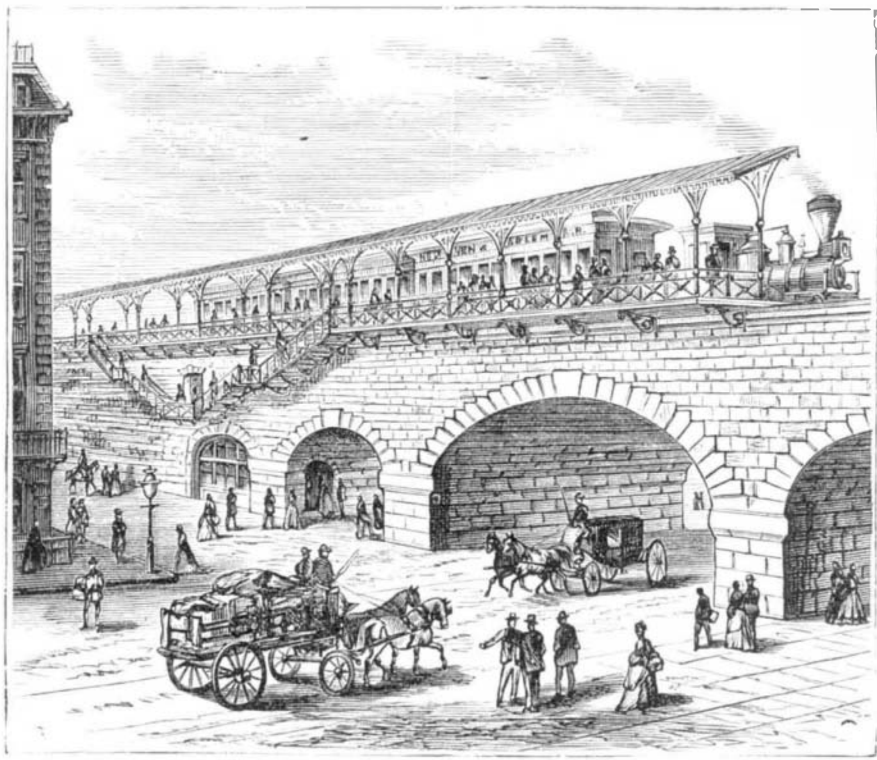

Fig. 19.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—THE VIADUCT AND PASSENGER STATION AT 110th STREET.

with face headers. The abutments are carried up five feet above the springing line of the arches on the outside; and from the top of this backing to the crown of the main arch, the spandrels are filled with concrete, plastered with half an inch of cement. The bridge at 103d street does not differ

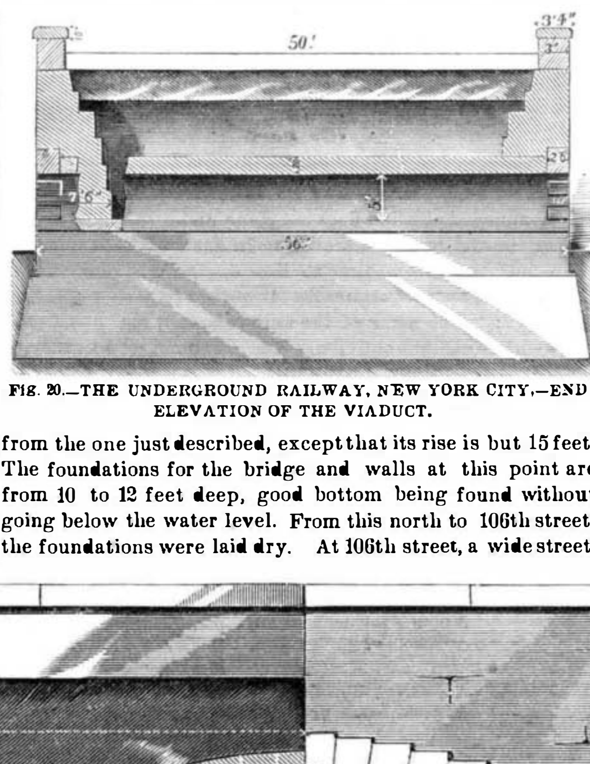

FIG. 20.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—END ELEVATION OF THE VIADUCT.

from the one just described, except that its rise is but 15 feet. The foundations for the bridge and walls at this point are from 10 to 12 feet deep, good bottom being found without going below the water level. From this north to 106th street, the foundations were laid dry. At 106th street, a wide street, there are four arches, one over each sidewalk, twenty inches thick, 15 feet span and 7½ feet rise, and two 24 inches thick, 26 feet span, and 13 feet rise. The two outside piers are 5 feet 6 inches by 9 feet by 56 feet, and the middle pier and two abutments 7 feet by 9 feet by 56 feet. Like all the bridges, it is built of freestone, the material in this case being obtained from the old bridge, which was carefully taken down, and the stones cleaned and, where necessary, re-dressed. The north pier and abutment foundations were put down about 9 feet below high water to a good sand and gravel bottom.

In the block between 106th and 107th street, the foundation of the retaining walls was put down to a depth of some 12 feet below high water, thus giving the foundation at this point a hight of 23 feet. The excavation was made through six to eight feet of black mud and about four feet of a black clay-like material, which was very probably the mud in a compressed state. The earth was taken for a distance of four feet outside of the foundation lines, and the excavation sheet piled and braced with heavy timbers. For the west wall, guide piles were driven on the water side to hold the sheet piling in place, and outside of these an earth dam was thrown up. On the east side the place of the dam was supplied by the embankment of an old road. The excavation, into which the water ran slowly, was easily kept dry by a steam pump, except on one or two occasions during the full moon tides.

It will be observed on the profile (page 308, Vol. XXXI.) that at 112th and 113th streets the grade of the railway approaches so near to that of the avenue that sufficient headway could not be obtained for stone arches. Their places are therefore supplied by double wrought iron Post truss bridges, capable of supporting 3,000 lbs. per linear foot of track, independent of their own weight, their factor of safety being 5. In the bridge at 112th street, the trusses are 8 feet high, 52 feet in the clear between the outside trusses, and 63 feet span. It is supported on stone abutments 7 feet thick at street grade, 4 feet at top, and 15 feet high by 58 feet long. These abutments are returned on each side to the retaining wall. The bridge at 113th street is the last in the viaduct.

The retaining walls from 98th street to 115th street are surmounted by a parapet wall (rock faced on the outside) 2 feet 6 inches in hight, 2 feet at bottom by 18 inches at top. Upon this is placed the coping of pene-hammered granite, 10 inches by 3 feet four inches. The coping and parapet are anchored to the retaining walls by wrought iron galvanized rods, 1¼ inches in diameter and 6 feet long, with a head and washer on the bottom and a nut and cast iron washer on top.

At 110th street is one of the way stations, built in part within the viaduct, as shown in exterior view in Fig. 19. It consists of a waiting room built in the north abutment of the 110th street bridge, and two iron stairways which rise, on the outside of the east and west retaining walls of the viaduct, from the waiting rooms to two covered landings on top of the viaduct. The waiting room is on a level with the street grade, and consists of a vaulted room 10 feet broad, 3 feet 6 inches long, and 12 feet 7 inches from floor to the crown of the roof, and running parallel to the axis of the north archway of the bridge, into which it opens through a groined archway of freestone, 12 feet broad by 5 feet

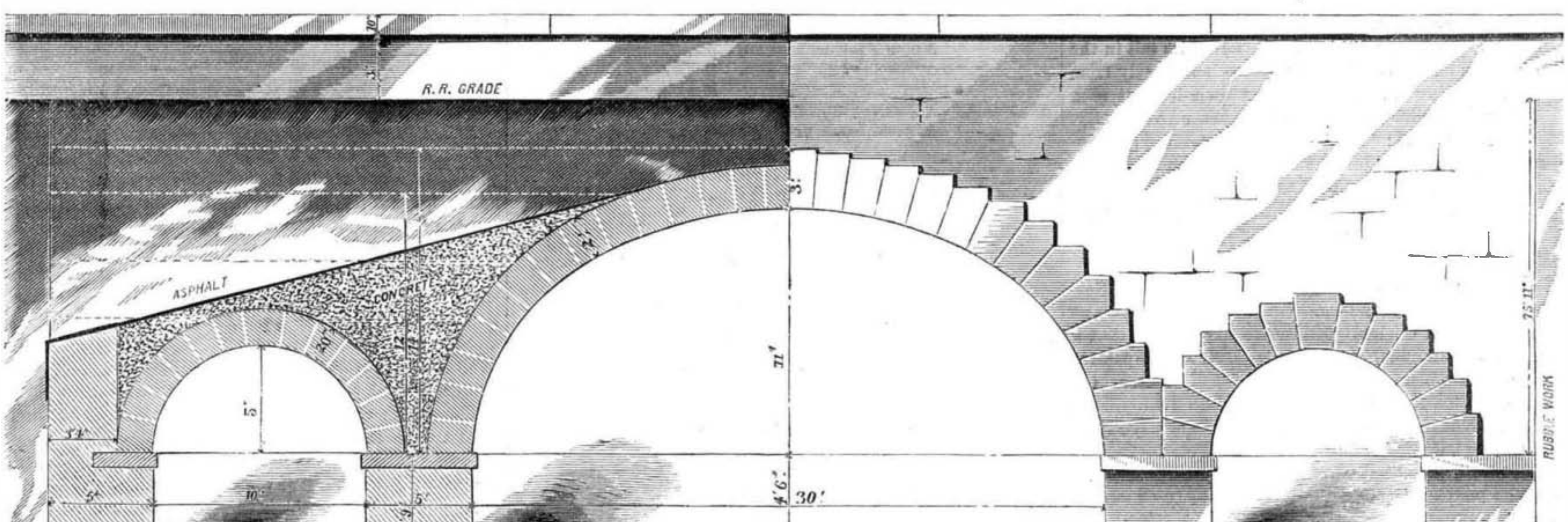

Fig. 21.—THE UNDERGROUND RAILWAY, NEW YORK CITY.—SIDE ELEVATION OF VIADUCT AT STREET CROSSINGS.

thick, and placed 22 feet from the outside of either retaining wall.

The arch is semi-circular, and of brick, 20 inches thick. This room is lined with brick and plastered, and closed at the east end by a large semicircular arched window (see Fig. 19.) Two flights of steps rise from this room through two brick-lined segmental arched ways, 6 feet broad by 8 feet high, to points on the outsides of the retaining walls 17 feet above street grade, from which iron stairways lead to the covered platform on top of the viaduct. Of these passage ways, the one leading to the west side of the viaduct passes out from the west end of the waiting room and forms almost a continuation of it. That leading to the east side of the viaduct is placed to the north of the waiting room, and parallel to it, but separated from it by a masonry wall 4 feet 6 inches in thickness.

At the outside of the retaining walls, at each of the openings of the arched stairways, just mentioned, is placed a wooden platform, 3 feet by 6 feet, from which are two flights of iron steps, one to the north and one to the south. These steps are 3 feet wide, with yellow pine steps, cast iron risers and string, supported by 9 inch heavy H beams built into the solid masonry of the retaining wall. They lead the covered landing beside the track. These landings consist of wooden platforms resting upon six rows of longitudinal wooden beams, supported, in turn, by iron beams, 8 feet long, placed transversely on the parapet walls, 7 feet 3 inches apart, and anchored by iron rods extending 6 feet downward through the masonry. The platforms are 130 feet 6 inches long and 8 feet 3 inches broad, thus projecting 2 feet 3 inches beyond the parapet wall on the inside and 3 feet on the outside. The covering railing is of design shown in Fig. 19.

The amount of masonry used in the construction of the retaining walls, foundations, bridges, abutments, wing walls, spandrels, parapets, etc., of the viaduct was 60,047 cubic yards; 2,458 cubic yards of concrete was laid; 198,900 linear feet of piling was driven; and of timber and plank used in platform, grillage, etc., 352,000 feet, B. M., was used, and of iron anchors, 51,000 lbs.

Correspondence.

Crystalization of Carbon.

To the Editor of the Scientific American:

While contemplating the great economy in all departments of Nature, in the utilization of many substances which casual thinkers might think noxious or waste materials, the thought occurred to me that, if Nature were to enter largely upon the manufacture of diamonds, a bed of charcoal would not be melted down for the purpose so long as carbonic acid gas is everywhere escaping and going to waste, from the decomposition of the rock formations. Further, if experiments were to be instituted in this direction, they could best be conducted in connection with the manufacture of stone lime. For example: Let the gas (which always escapes in large quantities from a burning lime kiln) be collected and turned into a retort; or, if found necessary, a series of three or four retorts might be employed, and the gas carried through a refining process, so that nothing but pure carbon should reach the last retort in the series. Should heat or pressure be found necessary, still another retort could be prepared for that purpose; but it is a question as to whether carbon will not readily crystalize as soon as set perfectly free from all other substances.

St. Albans, Vt. CHARLES THOMPSON.

Animal Suicides.

To the Editor of the Scientific American:

In your issue of January 9, you mention a suicidal scorpion. Allow an old reader to say that the scorpion becomes greatly enraged on very slight occasions; and bending its tail in the form of part of a circle, over its back, lashes it furiously from side to side, the sting barely missing its own body at each pass. When it strikes itself, which is not unfrequently, the verdict should read: "Deceased, while carelessly brandishing his weapon, accidentally inflicted upon himself a wound, from the effects of which he died."

New York city. T. B. TOMPKINS.

To the Editor of the Scientific American:

Your article on page 21, current volume, headed "A Suicidal Scorpion," calls to mind a story, related many years ago by my mother, of a suicidal rattlesnake She said that a party of men were removing an old barn in New Hampshire; and among the rubbish, they captured a rattlesnake, which they secured with a forked stick, and commenced tantalizing it. It soon became enraged and would frequently lay its head over on its body and remove it again. Finding its tormentors persistent, it at last threw its head back, thrust its fangs into its body, and soon after died. W. D. CLARK.

Springfield, Ill.

[For the Scientific American.]

THE CRESCENT STEEL WORKS AT PITTSBURGH, PA.

These works, belonging to Messrs. Miller, Barr, and Parkin, are located at Pittsburgh, on the Allegheny river, between 49th and 50th streets. They were established in 1865 by the present firm, with the avowed intention of rivaling, in the quality of their product, the very best Sheffield steel makers.

The methods of manufacture used in the famous Sheffield houses are exactly followed here, merit being claimed for careful and exact working rather than for any quick or patent processes. In order to insure uniformity in stock, the firm have their arrangements for their fine Swedish irons so made that they import direct from the makers, and have secured to themselves an entire brand of Dannemora iron, equal to any ever made, so that in certainty of supply and quality of stock they are not second to the best houses in England. With abundant experience, skilled workmen, the best of material, and machinery in every respect up to the highest standard of the latest practice, the growth and reputation of the concern have been continuous. Established nine years ago, with twelve melting holes, three hammers, and a capacity of three tuns a day, they now have twenty-four melting holes, four Siemens furnaces (equal to ninety-six melting holes) capable of producing thirty tuns a day, six steam hammers, and three trains of rolls. They are thus prepared to make twenty to thirty tuns a day of all sizes and varieties of bar steel, and are making constant improvements in their appliances for a beautiful and exact finish to their work. Not the least of these is the rapid adoption of gas furnaces for heating, making it very difficult for a careless workman to overheat their steel. Having steadily pursued the policy of buying the best stock to be had, and having made its careful working a constant study, their success has corresponded with their efforts. For several years, they have supplied regularly some of the very best ax and edge tool makers in the country, and many of the largest machine works, nail factories, screw cutters, and others where steel has to do the hardest and finest work. They have driven the German rolls and the English die steel out of the United States mint, so that American specie is now rolled and coined on American steel. We are informed that, on account of the especial demand for their steel in Pennsylvania and the West, they had not solicited New England trade to any considerable extent prior to the panic. During the past 18 months, however, through their eastern agents, Messrs. Ely & Williams, No. 1,232 Market street, Philadelphia, and No. 20 Platt street, New York, they have secured the patronage of many prominent steel consumers in the East, and their steel is now sold by the leading dealers in principal cities throughout New England and New York, who pronounce it to be fully equal to the imported brands heretofore controlling the market. In conclusion, we must not forget to say that this firm use largely of the best American charcoal hammered irons, and are engaged in careful tests of new brands, some of which promise so well that they express a confident hope of soon putting into the market an exclusively American tool steel, which shall not be excelled by the combined product of Sweden and Sheffield; in the meantime their abundant supply of the best Swedish irons insures to their customers uniform and good results. Being all young men, none of them yet forty years of age, they propose to continue their studies and practice until such a thing as preference for English steel shall be no longer known. They make tool, machine, roller, spindle, hammer, file, frog, fork, hoe, rake, shovel, cutlery, and cast spring steel. * *

Grammar in Rhyme.

The annexed effusion does not come under the head of new inventions and recent discoveries, in fact we believe it has been published from time to time during the past twenty years. But, as the *Commercial Advertiser* (where it appeared last) says: "The name of the author should not have been allowed to sink into oblivion. On the contrary, he deserves immortality, and the gratitude of generations yet unborn, for we have never met with so complete a grammar of the English language in so small a space. Old, as well as young, should commit these lines to memory, for by their aid it will be difficult, if not impossible, for them to fall into errors concerning parts of speech:"

I.
Three little words you often see
Are articles, a, an, and the.

II.
A noun's the name of anything,
As school or garden, hoop or swing.

III.
Adjectives show the kind of noun,
As great, small, pretty, white, or brown.

IV.
Instead of nouns the pronouns stand,
Her head, his face, your arm, my hand.

V.
Verbs tell us something to be done,
To read, count, laugh, sing, jump, or run.

VI.
How things are done, the adverbs tell,
As slowly, quickly, ill, or well.

VII.
Conjunctions join the words together,
As men and women, wind or weather.

VIII.
The preposition stands before
A noun, as in, or through, the door.

IX.
The interjection shows surprise,
As oh! how pretty—ah! how wise.

The whole are called nine parts of speech.
Which reading, writing, speaking, teach.

The Fog Gun.

For some time past endeavors have been made to secure for coast signal purposes something more suited to the duty than the 18-pounder cast iron gun now used. Major Maitland, R. A., of the Royal Gun Factory, has designed a species of revolving gun which will no doubt answer the purpose admirably. But in order to determine the best material and form of muzzle for the new fog gun, four models, each 2 feet long and capable of containing a cartridge consisting of from four to five ounces of powder, were, says the *Engineer*, constructed upon the following different plans, to be tested from the summit of the proof butts in the Plumstead marshes, at various respective distances: A cast iron gun with a plain muzzle; a cast iron gun with a conical mouth; a cast iron gun with a parabolic mouth; and a bronze gun with a parabolic mouth.

The object of trying both conical and parabolic mouths was to arrive at a decision in regard to the question, which has always been pending among manufacturers of speaking trumpets, as to which is the best shape for transmitting sound. Some assert, that the form of the instrument should be a truncated cone; others, that it should be a truncated parabolic conoid, the mouthpiece occupying the focus. Either form would, in a greater or less degree, confine the undulations of sound (which would otherwise disperse themselves in all directions and cause them to take a direction parallel to the axis. Hence the application of one or the other of them. On the occasion of the recent experiments, the four models were placed in a row upon the summit of the butts, with their muzzles point ing towards Shooter's hill. The weather was cold and clear The observers stationed themselves at various distances in front of the row of guns, from 100 yards to 3,000 yards, moving forwards to a greater distance each time that the whole series of four guns was fired. They were ignorant of the order in which the guns were fired, that being purposely left in the hands of the proof master, so it was impossible for their opinions to be prejudiced. It was decided that the volume of sound emitted by each discharge should be represented as nearly as possible in figures, No. 1 being the highest figure of merit, and No. 5 the lowest. The following results were obtained: Adding together the respective figures of merit of each gun at eight several distances, from 100 to 3,000 yards, it was found that the cast iron gun with the conical mouth gave a total of 10, or, in other words, took the first place as regards the volume of sound produced at all ranges; the cast iron gun with the parabolic mouth a total of 21, thus taking the second place; the bronze gun with the parabolic mouth a total of 22½, or taking the third place; while the cast iron gun with the plain or straight mouth gave 26½, the lowest value of all four. At a distance of 1,000 yards only, the bronze gun with the parabolic mouth took the second place. This was probably due to the superior ringing qualities of the metal, which would be observed at such a short range. Further experiments were then made by observers stationed about two miles off upon Shooter's hill. The figures of merit under these circumstances for the several guns were as follows: Out of six observations, 6 for the cast iron cone, 12½ for the cast iron parabola, 19 for the bronze parabola, and 22½ for the cast iron plain mouth. Thus we see that the great increase of distance is very unfavorable to the bronze model, and that the plain muzzled one is out of the field altogether.

During the above mentioned experiments, trials were made with gun cotton, in order to see whether the sound of its report on explosion would reach teany great distance. Masses consisting of about ten ounces were detonated in the open air upon the butts. The noise made considerably exceeded that of the guns. It must be remembered, at the same time, that the proportion of powder in the gun cartridges bore no analogy to the quantity of gun cotton detonated. The result of the trials was, however, considered so satisfactory that a parabolic reflector is being constructed, in which it is intended to explode pieces of gun cotton.

Evergreens in Orchards.

A correspondent says that the theory of planting evergreens among fruit trees, for protection, mentioned in our Special Edition, recently issued, is wrong.

They impoverish the ground, occupy space, and shade the fruit trees. Fruit from shaded trees is always inferior in quality. To produce a fruit bud, the sun must thicken the sap to a glutinous liquid. Without the rays of the sun, buds will form only to produce leaves. The most perfect fruit is found on the outside of a tree; and therefore, to give light, the pomologist trims and thins out the branches. This explains why wall trees produce such uniformly large and excellent fruit.

A belt of evergreens around an orchard may be beneficial, not because of the heat that is supposed to emanate from them, but because they break the winds and still the air as sweeping winds often dry up the vital sap of both evergreen and deciduous trees.

Alternate heating and freezing are destructive to vegetable as well as to animal life; because the heat starts the sap, and the frost freezes it. The freezing swells the sap, and lifts the bark from the wood, the channels of circulation are strained and destroyed, and the part so affected dies. Well matured wood is not apt to suffer from cold. To save tender trees, let them finish their season's growth before cold weather; and to hasten maturity, give a dry bottom and light and air in abundance.

Some evergreens supposed to be tender (the rhododendron, for instance) will survive the winter better on the north side of a building, unprotected, than on the south of the same protected and sheltered from the rays of the sun.

A Cure For Diphtheria.

A correspondent says: "Take a flat iron and heat it a little on the stove; on this apply a very little pitch (not gas) tar; have the iron hot enough to make a good smoke. Then let the patient take into his mouth the small end of a funnel, and have the smoke blown through the funnel into his mouth. Let the smoke be inhaled well into the throat for few minutes five or six times a day. In very bad cases, it might be well to use it oftener. After this, let the patient lie on his back then break up small pieces of ice and put them into his mouth, and let them go as far down to the roots of the tongue as possible. When they have dissolved, put in some more; this will keep down the inflammation."