of unripe cotton or the leaves or limbs of the plant. It has been patented by Mr. Charles R. Stephenson, of Lyon, Miss. In the forward part of the car which carries the mechanism, at one side, is journaled a vertical shaft, upon which is loosely mounted a frame, the top and bottom faces of which are nearly triangular in general outline, these faces being connected by vertical strips. On the vertical shaft, within the frame, is a drum, and in the rearwardly extending portion of the frame is another shaft carrying a drum, an endless apron extending around the two drums. Upon this apron are vertical boxes in which are journaled outwardly projecting spindles that are tapered and have longitudinal grooves. Upon the inner ends of these spindles, within the boxes, are grooved pulleys, the upper pulley having a flange adapted to roll in contact with a track attached to the under surface of the upper part of the frame, and thus communicate a rotary or twisting motion to all the pulleys and their spindles, by means of a belt or cord running over the top and bottom pulleys and alternately behind and outside of the others in the series. A vertical shaft, journaled in the floor and a rear cross bar of the frame, receives its motion through bevel gears from the drive wheel, a clutch mechanism, connected with a lever in easy reach of the driver, allowing the gear to be thrown into and out of engagement, and a belt from this shaft operates the forward drum-carrying shaft. Upon the lower end of this main operating shaft is formed an eccentric adapted to be engaged by the short arm of a forked lever pivoted on the floor in front of it, the long arm of such lever entering a notch in the lower part of the drum-carrying frame, whereby the latter is vibrated, or moved in and out, with the rotation of the shaft. In the forward part of the frame, to the left of the drum shaft, is also journaled a vertical drum shaft, belts or cords running horizontally around all three of the shafts journaled in the frame, one such belt or cord passing between each series of outwardly projecting spindles. Behind the latter shaft, and adjoining the wall of the car, is arranged an inclined endless carrier, the lower end of which is placed near the floor while its upper end is near the top of the car at the rear, the drum operating the carrier receiving its motion through a belt from a short shaft connected with the main operating shaft. The upper part of the main drive wheel is incased, and the auxiliary side wheel turns on a stud projecting from an inverted U-shaped bar attached to the side of the car. As the machine is drawn through the cotton field, the drum shafts are revolved to move the spindles rearwardly, while the cotton is wound loosely upon the rotating spindles, as the vibrating frame is alternately projected among and withdrawn from the cotton plants. As the spindles pass into the car at the rear, the cotton is removed from them by the horizontal belts or cords passing around the drum at the foot of the inclined carrier, which takes the cotton up for delivery in bags or to a wagon attending the pickers.

Rich without Money.

Many a man is rich without money. Thousands of men with nothing in their pockets, and thousands without even a pocket, are rich. A man born with a good, sound constitution, a good stomach, a good heart, and good limbs and a pretty good headpiece, is rich. Good bones are better than gold; tough muscles than silver; and nerves that flash fire and carry energy to every function are better than houses and land. It is better than a landed estate to have the right kind of a father and mother. Good breeds and bad breeds exist among men as really as among herds and horses. Education may do much to check evil tendencies or to develop good ones; but it is a great thing to inherit the right proportion of faculties to start with. The man is rich who has a good disposition, who is naturally kind, patient, cheerful, hopeful, and who has a flavor of wit and fun in his composition.

The hardest thing to get on with in this life is a man's own self. A cross, selfish fellow, a desponding and complaining fellow, a timid and care-burdened man—these are all born deformed on the inside. They do not limp, but their thoughts sometimes do.—*Clay Manufacturers' Engineer.*

The Swedish Cure for Drunkenness.

The habitual drunkard in Norway or Sweden renders himself liable to imprisonment for his love of strong drink, and during his incarceration he is required to submit to a plan of treatment for the cure of his failing which is said to produce marvelous results. The plan consists in making the delinquent subsist entirely on bread and wine. The bread is steeped in a bowl of wine for an hour or more before the meal is served. The first day the habitual toper takes his food in this shape without repugnance; the second day he finds it less agreeable to his palate; finally he positively loathes the sight of it. Experience shows that a period of from eight to ten days of this regimen is generally more than sufficient to make a man evince the greatest aversion to anything in the shape of wine. Many men after their incarceration become total abstainers.

THE DEVELOPMENT OF THE CALIPER.

One of the first tools to suggest itself to the mind of the early worker in metals for the measurement of diameters or thicknesses probably was a gauge something like that shown in Fig. 1, which is simply a notched plate of iron, the width of the notch being the measurement of the diameter or thickness required, and by repeated applications of this gauge to the work, as it neared completion, accurate results were secured; but

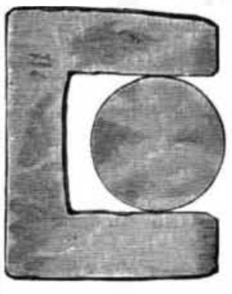


Fig. 1.

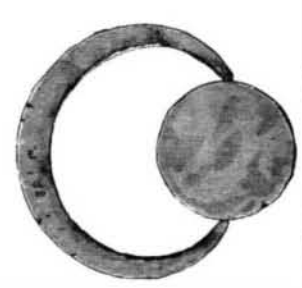


Fig. 2.

this tool was what would now be called a special tool or gauge designed for measuring fixed diameters. It lacked the adjustable feature which was necessary to adapt it to work of different sizes. Of course the tool could have been heated and altered, but this would have occasioned considerable labor, as well as the loss of the original gauge. It is, therefore, probable that, for an adjustable gauge or caliper, something like that shown in Fig. 2 was employed.

This tool consisted of a curved bar of metal, with the ends approaching each other, and the adjustments were effected by bending the bar. An obvious and early improvement upon this caliper is shown in Fig. 3. The difficulty of bending a bar whenever an adjustment was required suggested the use of a frictional joint at the center of the bar, which would permit of swinging the arm of the caliper to adapt it to the measurement of different diameters. From this crude mechanical device have been developed all the modern improved forms of caliper, one of

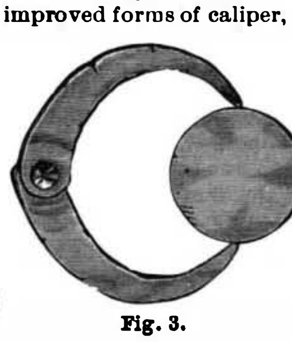


Fig. 3.

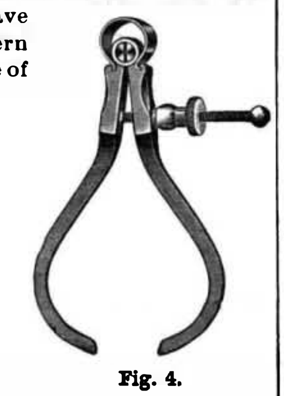
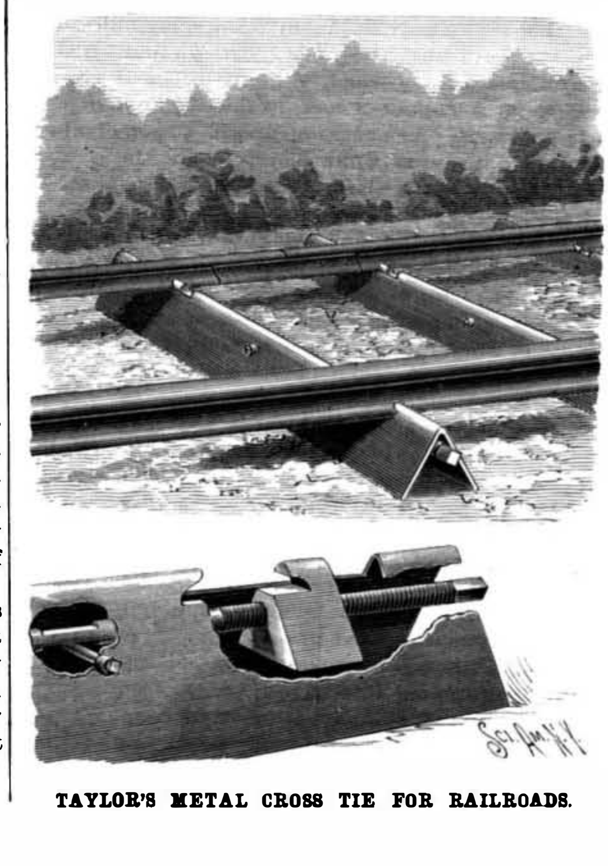


Fig. 4.

the latest improvements in this line being what is known as the Stevens caliper, represented in Fig. 4, manufactured by the J. Stevens Arms and Tool Co., Chicopee Falls, Mass. In this caliper the jaws are connected together by a fine joint, and a C-shaped spring is applied which tends to separate the free ends of the jaws. The adjustment is instantly effected by a simple and durable slip nut, which, together with the joint and spring, forms an ideal arrangement appreciated by every mechanic.

AN IMPROVED METAL CROSS TIE.

The cross tie shown in the cut is designed to securely hold the rails in position and be sufficiently elastic to prevent injurious shocks to the rolling stock. It has been patented by Mr. James P. Taylor, of No. 315



TAYLOR'S METAL CROSS TIE FOR RAILROADS.

Pecan Street, Fort Worth, Texas. The body of the tie is preferably of wrought iron plate, and bent to nearly triangular shape in cross section. At the proper distances apart to allow for the width of the track are longitudinal slots, in which are integral lips or flanges adapted to hook over the adjacent edge of the base flange of the rail when placed on the tie. Within the tie body is located a rod, oppositely threaded at each end, and on these threads are mounted blocks or nuts, as shown in the small figure, each block having a lug adapted to fit upon the inner base flange of the track rail. The outer ends of the rod are squared to receive a wrench, and near its center is a square portion, where the rod rests upon a transverse bolt. The squared portion of the rod is designed to retain it from rotation when in place sufficiently to prevent it from relaxing the lugs, the rod yielding when turned by a wrench to adjust the parts and draw these lugs against the flanges on the track rails.

Thinking and Doing.

The successful man, as a rule, is that one who knows the trick of doing the right thing at the right time, and the trick is not one which comes from inspiration, but from trained habits and thought. All the untrained genius in the world combined could not have composed in their present perfect literary form the thirty-nine articles, it was genius schooled and trained which accomplished them.

Attention enough is now given to physical training, but there is still a somewhat common lack of faith in some parts of the United States with regard to the advantages of mental training. A little "schooling," it is considered, is essential, but boys and girls, it is thought, especially in the country, should not be permitted to waste too much time over their books. The theory was, and, to a lesser degree, is, that good men are best made by beginning their working careers early—the earlier the better. But a change is occurring in this matter, as in others, and in these days of great enterprises, in which trained thought, science, and skill play so large a part, the man of educated mind is likely to be preferred to the man of uneducated mind. The man who has been taught to think according to system and principle is the man who, in the most attractive business pursuits, is sought by employers.

The value of such training as enables the man to rise promptly to the requirements of the emergency was very happily illustrated by Mr. Chauncey M. Depew the other day in an address he delivered to the boys of St. Paul's school, at Concord. Mr. Depew said:

"In a boat race between a Yale and an outside crew the other day, the oar of the stroke oarsman broke just at the critical moment. In such cases the great thing is to know just what to do, to be able to call on all your powers of knowledge and skill. The ordinary man knows how to drive, to go to church and sit in his pew, to come in when it rains, but only the well trained man knows what and how to do in an emergency. An ordinary man would have said: 'Abandon the race.' This fellow made up his mind in a moment, and judging just the right moment and just the right place, he leaped from that thin shell of a boat without disturbing the other rowers. Thus the boat was relieved of his weight, and Yale won."

The difference between the ordinary and the extraordinary man, when it does not arise from extraordinary natural gifts, to quote from the Philadelphia *Ledger*, lies generally in the superior mental training of the latter. The former may have intellect as quick and bright, but unless it has been trained to act, he is like a man with all the craftsman's tools, but without the craftsman's trained skill. The hand does the better work always, the better-schooled the thought behind it is, and this applies not less to the ordinary workman of the anvil, saw, or loom than to the man of affairs. The carpenter or mason whose mind has been trained as well as his hand is likely to put aside the plane and the trowel and to become the master builder or architect. It is the mental training that tells oftenest in this world's race, and the man who seizes the right moment in it when to stay in or when to leap from the boat is pretty certain to be found at the end upon the winning side.

The Tortoise Market of Philadelphia.

The taste for "stewed terrapin" and "snapper soup" has become so general in Philadelphia, that the United States are now ransacked for the means of supplying it. Within a few years the species sold were the "terrapin," *Malacoclemmys palustris*; the "red belly," *Chelopus insculptus*; the "slider," *Chrysemys rugosa*; and the "snapper," *Chelydra serpentina*. Now large invoices of turtles are sent from Mobile, New Orleans, and St. Louis, which include the following species: *Chrysemys bellii*, *C. elegans*, *C. concinna*, and *C. troostii*; *Malacoclemmys geographica*, and *M. leseurii*; total, exclusive of sea turtles, ten species. All are abundant in the market except the *C. bellii*.—*E. D. Cope.*

Natural History Notes.

The Lamp Bird.—An explorer, Dr. H. Labonne, mentions a curious peculiarity of the stormy petrel, which has caused it to be styled the lamp bird by the fishermen of the island of Saint Kilda. The flesh of this bird is very oily, and the inhabitants of the island, who kill it by thousands, utilize this property for domestic purposes. They insert a wick in the bird's bill, and obtain for an hour a light that is sufficiently bright to serve their purposes.

Conversion of Sugar into Starch by Plants.—According to the researches of Saposchnikoff, sugar can be turned into starch in the leaves of plants. Plants of various kinds were placed by him in the dark for a time, and then some of the leaves were cut off and divided in halves along the midrib. One half was tested for starch, and the other was allowed to remain for from four to ten days in a 10 to 20 per cent solution of cane sugar, and then tested for starch. The latter was found in abundance, especially along the veins. In variegated leaves, only the chlorophyl cells formed starch.

The Forms of Leaves.—Two papers relating to the forms of leaves were recently read by Sir John Lubbock before the Linnean Society. The first paper dealt with the form of the oak leaf, which is unequally developed on the two sides of the midrib, and sinuate at the margin. He compared this leaf with that of the beech, and showed that the leaf bud is smaller in the oak than in the beech, although the leaf is larger. For this reason the oak leaf becomes curved in the bud, and this curvature is probably the reason of the sinuate form of the leaf. The asymmetrical form is due to the leaf being conduplicate, so that one half of the leaf is subject to less pressure than the other during growth. In the beech, the leaf not being subject to the same pressure in the bud, it is not curved, and the development of the parenchyma takes place in the form of plaits. The second paper related to the two British species of *Viburnum*, in which, although the two species sometimes grow within a few yards of each other, the form and character of the leaf is quite different. In *Viburnum lantana* the leaves are densely hairy when young, and are not lobed. In *V. opulus* the leaves have stipuliform appendages and the leaves are lobed and glabrous. In all the species allied to *V. opulus* the leaves are lobed and these appendages are present. In *V. lantana* the hairy surface serves as a protection to the young leaves, but in *V. opulus* the young leaves are protected by thickened scales. The pressure thus exerted throws the leaf into the lobed form, and the stipules fill the hollow left at the base of each folded leaf, just as in the maples, which have leaves similar in shape. The interstices are filled up by the smaller succeeding pair of leaves.

Effect of Light upon Plants—From some experiments by Mr. W. G. Smith, it seems that the plant commonly called the strawberry geranium (*Saxifraga sarruentosa*) well serves, when grown with light on one side only, to show heliotropism and negative heliotropism. A small plant placed in a window turned all its leaves to the light, but sent out seven stolons away in a straight line from the light. As these elongated they became pendulous and formed rosettes of leaves at their tips. The new leaves requiring light, the stolons altered their direction and grew toward the light, until the young plants almost touched the glass. These young plants also sent out stolons, which again grew away from the light, and the same thing happened with a third generation of stolons.

Migrations of Plants as Affecting those of Insects.—A correspondent of *Insect Life* says that when he first went to Kansas, eighteen years ago, two plants were unknown in Geary County which are now very abundant. One of these is the *Solanum rostratum.* The region for two or three years suffered from the ravages of the Colorado potato beetle, but now, though the beetle is sufficiently abundant every year, the potatoes rarely are damaged. The cause seems to be that *Solanum rostratum*, sometimes called Buffalo nettle, or Buffalo thistle, is the native food plant of this beetle, and where it is scarce *Solanum tuberosum* is accepted as a substitute. The plant belongs to regions farther west, and by some means the beetle traveled in abundance eastward, reaching the other side of the Atlantic years ago, where the plant is still unknown. It is said that the prickly seed pods of this plant came on the tails of Texas and other cattle from the Southwest, and it is certain that counties remote from the cattle trails and the through lines of railway were the last to have the plant. The flower is bright yellow, and the whole plant not unhandsome, but its prickles make it a very undesirable weed. Two years ago the writer took particular pains to eradicate it in and around his garden patch, killing every young plant of *S. rostratum* as it came up. The result was a serious attack on the potatoes, which were only saved by twice going over all the plants and collecting and destroying the beetles. That the plant did not migrate easterly at a greater speed is to be wondered at, as in the region of the one hundred and second meridian on the wide prairies, it has the tumble weed habit. The whole plant is subglobose, and when ripe snaps off close to the ground and goes bowling along before the wind at a great rate. The winds there, however, are more north and south than from the west, so that probably has delayed the progress of the plant in longitude. The plant is abundant in waste places in towns, and by roadsides in all eastern Kansas now, and we rarely hear of the Colorado beetle damaging potatoes.

Effect of Poison on Sponges.—The *Biologisches Centralblatt* for April 1 contains a paper by Mr. Ledenfeld on the action of various nerve poisons on sponges. He finds that curare, strychnine, and cocaine act on living sponges in much the same way as on higher animals, curare relaxing the sphincter muscles surrounding the pores in the external surface, strychnine causing a sharp contraction, and cocaine rendering them less sensible to irritants. He believes, therefore, that the cells which act as muscles are in relation with others that act as sensory nerves, which are in the first place affected and communicate their irritability to the muscle cells.

Animal Coloring Matter.—In the *Journal of Marine Biology*, Mr. C. A. McMunn briefly discusses the coloring matter of several invertebrates. Among the interesting facts are these : Spectroscopic examination fails to show the presence of symbiotic algæ in *Antedon*, it being found that contrary results were due to the presence of plants in the food, and that when the stomach was removed, neither chlorophyl nor chlorofucin occurred in the extract. The digestive glands of echinoderms and crustacea not only form digestive ferments, but exercise a chromatogenic function. Chlorophyl was found in several annelids, while other green worms possessed no chlorophyl. The lipochromes in some cases may act as an absorber of light rays, but its other function is very uncertain. The author shows that a knowledge of invertebrate coloring matter is absolutely essential to a clear understanding of the physiological action of the pigments of the vertebrata.

Absorption of Nitrogen by Plants.—Since the apparently conclusive experiments of Boussingault, which were completed as long ago as 1854, it has been accepted as an axiom in physiological botany that the free nitrogen of the atmosphere is useless to plants for the purpose of assimilation, and that the exclusive source of their nitrogenous compounds is the soluble nitrates in the soil. But like so many generally accepted beliefs, very grave doubt is now thrown on the correctness of this view by several papers in the "Landwirthschaftliche Jahrbucher," by Dr. B. Frank. In these papers the results are given of a series of experiments which he considers to prove the point that the amount of nitrogen in the tissues of the plant is in excess of that which could possibly be due to the soluble nitrates absorbed from the soil. The nitrogen, which must thus have been absorbed through the leaves directly from the atmosphere, is perhaps in the tissues in the form of organic nitrogenous compounds, not of nitrates. The nitrates present in the tissues of plants, the amount of which varies greatly with different plants, are entirely absorbed as such through the roots. Dr. Frank believes that the low forms of vegetable life, as *Oscillaria, Ulothrix, Pleurococcus, Chlorococcum*, and the protonemes of mosses, have especially this power of removing free nitrogen from the atmosphere, and forming therefrom nitrogenous compounds, but that the property is probably common to all vegetable organisms which contain chlorophyl, and that, like the assimilation of carbon, it is a function of their chlorophyl. Drs. Hellriegel and Willfarth have put forward another view—that there is an essential difference between the way in which Leguminosæ obtain their nitrogen, and that of other plants. They claim to have determined by experiment that the growth of barley and oats is in direct proportion to the amount of nitrates absorbed from the soil, and that they are totally unable to live in a soil entirely deprived of nitrates. This is not the case, on the other hand, with vetches, which may grow luxuriantly in a soil containing no nitrogen, and which must, therefore, obtain their nutriment from some other source, viz., the free nitrogen of the atmosphere. The authors advance the theory that they do not do this directly, but through the instrumentality of the microbes contained in the tubers which occur on the roots of the vetch, bean, and many other plants belonging to the Leguminosæ. These microbes, therefore, carry on a symbiotic existence with the host plant, the microbes contained in the soil not being available for this purpose.

To this Dr. Frank replies, dissenting from the distinction drawn by Hellriegel and Willfarth between Leguminosæ on the one hand and grasses and other orders of plants on the other hand, all of which, he maintains, are, in certain conditions, capable of assimilating directly the free nitrogen of the air. He further points out that there is no single direct observation to connect the "bacteroids" in the root tubers of Leguminosæ with this supposed function, that the fact of their being living organisms is subject to considerable doubt, and that their structure and mode of life are altogether different from those of "mycorhiza," in which a true symbiosis between the fungus and the root which it envelops has been satisfactorily demonstrated.

Size of House Sewers.

As controversies occasionally arise between architects or owners and the health authorities as to the size necessary to the main house drain and sewer, it has been thought worth while to give somewhat in detail the data upon which the regulations of the New York Board of Health are based.

About a year ago the health department found that, in several cases, house sewers of the size which they considered essential for large buildings were not permitted by the co-ordinate department which has in charge the public sewer system. Correspondence followed as to the desirability of reaching a mutual and satisfactory understanding. This resulted in the preparation of a report on the subject by Messrs. Rudolph Hering and Horace Loomis, respectively engineer in charge of sewers and consulting engineer of the department of public works. This was accepted by the board, and its conclusions made the basis of their future requirements. The main points of the report on the deductions are as follows :

The first consideration is evidently as to the amount of water, per unit of surface, for which provision must be made. Formerly the records kept of rain storms gave merely the total fall per hour, leaving it uncertain whether this was uniform or, as more generally the case, the greater part had fallen in a comparatively short time. However, the meteorological observatory has obtained for a number of years an automatic record of the rainfall, showing for each storm the maximum rate and its duration, which evidently gives the data required for determining the size of the drains. These records show that, during the eight years from 1880 to 1887 inclusive, there were in all thirty storms with rates greater than one inch per hour :

Number of Storms.	Rate. Inches per hour.	Duration in minutes.
12	1 to 2	20 to 60
7	2 to 3	10 to 30
4	3 to 4	8 to 15
1	4 to 5	15
3	5 to 6	5
2	6 to 7	3 to 10
1	7·5	2

Thus in the eight years covered by the records there have been three storms with a rainfall of the rate of more than six inches per hour, lasting from two to ten minutes. As a very few moments of such a storm would wet and cool a roof or paved surface sufficiently to check evaporation, nearly the whole amount of water must have reached the house drain. It was therefore considered wise to provide for a maximum fall of six inches per hour, as the damage inflicted by a single storm, when the drains were insufficient, would more than outweigh the additional cost of the larger pipe. At the same time the other and equally important fact was kept in view that the drain should be made, as far as practicable, self-scouring under the ordinary conditions, and to accomplish this the diameter should be kept as small as may be consistent with safety.

The second consideration in determining the requisite size of the drain is the velocity of the water in the pipe. This should evidently be, not that derived from a theoretic equation, but such as can be attained in practice after making all due allowances for traps, short bends, etc. It was thought doubtful whether a velocity of six, or even five, feet per second could be obtained through a six inch quarter bend, unless the pipe was discharging full and under pressure. A maximum velocity of four feet was therefore assumed as safe.

Again, to prevent the drain running quite full, an available sectional area of 0·18 square foot was assumed for the six inch pipe. This, with a four foot velocity, would give a capacity of 0·72 cubic foot per second. With a six inch rainfall per hour, one square foot of roof surface would receive about 0 000140 cubic foot of water per second. The six inch drain should therefore carry the water from about 5,000 square feet of surface, if it have an effective grade of one-quarter inch per foot.

With a grade of one-half inch per foot, which is often practicable, and a fairly straight run of pipe, the velocity may be raised to six feet per second, and therefore the capacity and amount of surface drained increased to one-half. In this case the six inch sewer would safely carry the storm water from 7,500 square feet of roof. The following table gives the size of pipes, with the corresponding area of roof drained when the effective fall is respectively one quarter and one-half inch per foot.

Diameter of Drain.	Roof Area Drained. ¼ Inch Fall.	½ Inch Fall.
6 inches.	5,000 square feet.	7,500 square feet.
7 "	6,900 "	10,300 "
8 "	9,100 "	13,600 "
9 "	11,600 "	17,400 "

For large areas it is always better to use two or more small sewers rather than a single large one, as under the ordinary conditions of sewage flow the small pipes will be more thoroughly flushed. The effective grade of the house drain should also, for safety, be measured from above the hydraulic grade line of the public sewer, which, in this city, during the heaviest storms, will be at least as high as the arch of the sewer.—*A. H. Napier, in Architecture and Building.*