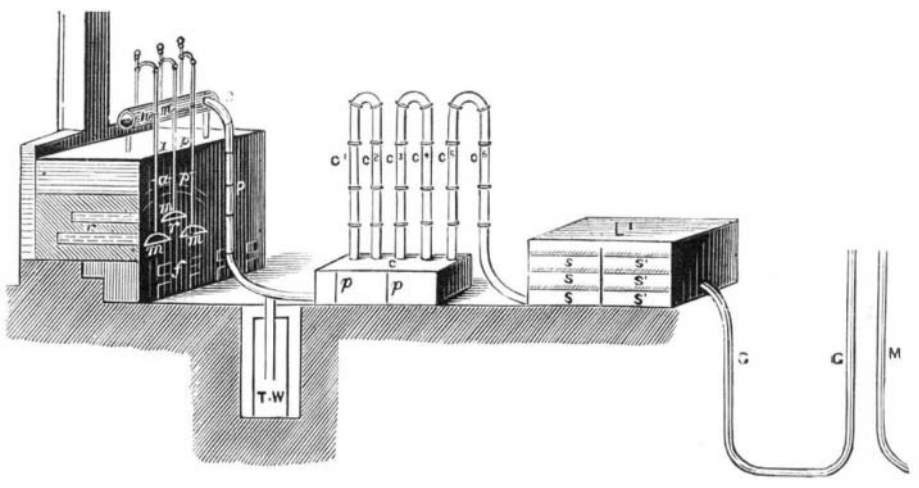
THE DISTILLATION OF COAL.

Bituminous coal, of which there are several varieties, is the best suited for the production of coal gas. The Newcastle coal is principally used in the manufacture of London gas. Scotch parrot coal produces a superior gas, but the coke produced is of inferior quality. Boghead coal is also used for gas making—in fact, every kind of coal, except anthracite, may be used for this purpose. The bituminous shale produces a very good gas, and it is used partly to supply the place of cannel or parrot coal. As carbon and hydrogen, principally with oxygen, are the elements from which gas is formed, most substances containing these elements can be partially converted into gas. And gas has been made from grease or kitchen waste, oil peat, rosin, and wood, besides coal. A ton of Newcastle or caking coal yields about 9,000 cubic feet of gas, Scotch coal about 11,000, English cannel about 10,000, and shale about 7,000, with illuminating powers in the ratio of about 13, 25, 22, and 36 respectively. The coal is put in retorts, *r*, commonly made of fire clay and often of cast iron. These retorts are from 6 feet to 9 feet long, and from 1 foot to 1 foot 8 inches in breadth. They are made like the letter D, elliptical, cylindrical, or bean shaped. They are built into an arched oven, and heated by furnaces, *f*, beneath. One, three, five, seven, or more are built in the same oven. The mouthpieces are of cast iron, and project outward from the oven, so as to allow ascension pipes, *a p*, to be fixed, to convey the gas generated from the coal to the hydraulic main, *h m*. After the coal has been introduced into the retorts, their mouths are closed with lids luted round the edges with clay, and kept tight by a screw. The retorts are kept at a bright red heat. If the temperature be too low, less gas and more tar are produced, less residue being left; while, should the temperature be too high, the product is more volatile, more residue remaining. And should the gas remain for any length of time in contact with the highly heated retort, it is partially decomposed, carbon being deposited, thereby lessening the illuminating power, and choking up the retort, and more carbon disulphide is produced at a high temperature. The object is to maintain a medium temperature, in order to obtain a better gas having the greatest illuminating power. In about four or five hours the coal in the retort will have given off all its gas. The mouth of the retort is opened, and the coke is raked out into large iron vessels, and extinguished by water. A fresh charge is immediately introduced by means of a long scoop in the cherry-red retort, and the door luted to. The ascension pipes, which convey the gas from the retorts, pass straight up for a few feet, then turn round, forming an arch, then pass downward into the hydraulic main, beneath the level of the liquid contained in it, and bubble up through the liquid into the upper portion of the main. On commencing the main is half filled with water, but after working some time, this water is displaced by the fluid products of distillation. In this way, the opening into each retort is closed, so that a charge can be withdrawn and replaced without interfering with the action of the other retorts and pipes. The liquid tar, ammoniacal water, and gas pass from the end, *e*, of the hydraulic main, down through the pipe, P, and the liquid falls down into the tar well, T W, while the crude gas goes on into the chest, C, partially filled with the liquid, so that the plates, *p p*, from the top dip into it to within a few inches of the bottom. These dip plates are placed in the chest, so as to separate the openings into each pair of condensing pipes, *c c*, so that the gas passing into the chest finds no exit except up c_1, and down c_2; and there being no dip plate between c_2 and c_3 it passes up c_3, and down c_4, and as there is no dip plate to prevent its progress, it passes up c_5, and down c_6, into the lime or iron purifiers, L I. The condensers are kept cool by exposure to the atmosphere, and are often cooled by a stream of water from a tank above. The gas cools quickly, and liquids passing along with the gas in a state of vapor are condensed and fall into the chest, and pass by an overflow pipe into the tar well. The purifier is a cast iron vessel, L I, containing a number of perforated shelves, s_1 s_1 s_1, on which slaked lime, to the depth of about 4 inches, or much greater thickness of iron oxide and sawdust, is placed. The gas passes up through the shelves, *s s s*, and down through the shelves, s_1 s_1 s_1, through the pipe, G, into the gas holder, and from thence through the pipe, M, to the main pipe. The lime abstracts carbonic anhydride, sulphuretedhydrogen, cyanogen, naphthalin, and a portion of the ammonia, but not carbon disulphide, which latter may be absorbed by passing the gas through a solution of sodic hydrate and plumbic oxide, mixed with sawdust. Gas containing CS_2, on burning, produces H_2SO_4, which injures books and furniture in rooms. However, the quantity of CS_2 in gas is generally so minute as to be practically uninjurious. By a proper regulation of the temperature during distillation, the quantity produced is infinitesimal. When the lime is saturated it is removed, and fresh supplied; but the iron, after use, can be reconverted into oxide by exposure to the atmosphere, and used repeatedly. When iron is used a separate lime purifier is necessary to remove carbonic anhydride. The last traces of ammonia are removed before passing to the gas holder, by passing the gas through dilute sulphuric acid, or up through the interior of a tower having perforated shelves covered with coke in small pieces, through which a constant supply of fresh water percolates. This washing removes some of the more condensable hydrocarbons, and lessens the illuminating power of the gas. Before the gas passes from the condensers into the purifiers, it passes through a kind of pump, termed an exhauster, driven by steam power. This action relieves the retorts from the pressure of the gas passing through the hydraulic main, etc. It diminishes the deposit of graphite in the retorts, and lessens leakage in them, should there be any flaws. It also has the beneficial effect of producing a gas of a higher illuminating power, since the relief of pressure in the retorts produces a more favorable condition of combustion.

The following are some of the bodies produced in the manufacture of gas, namely, acetylene, *g*, the carbonate, *s*, chloride, *s*, cyanide, *s*, sulphide, *s*, and sulphate, *s*, of ammonium; aniline, *l*, anthracene, *s*, benzine, *l*, carbonic oxide, *g*, carbonic anhydride, *g*, carbonic disulphide, *l*, chrysene, *s*, cumene, *l*, cymene, *l*, ethylene, *g*, hydrogen, *g*, leucoline, *l*, methyl-hydride, *g*, naphthaline, *s*, nitrogen, *g*, paraffine, *s*, phenylic alcohol, *l*, picoline, *l*, propene, *g*, quartene, *g*, sulphureted hydrogen, *g*, toluene, *l*, water, *l*, xylene, *l*, etc.

The most of the above solid and liquid substances, with the letters *s* and *l* written after, are removed by cooling the gas in the condensers, and the gaseous substances marked *g*, that are injurious in the consumption of the gas, are removed by purification. The impurities in the gas may consist of ammonic carbonate and sulphide, carbonic anhydride and disulphide, nitrogen, oxygen, sulphureted hydrogen, and water in the form of vapor; and acetylene, ethylene, and the vapors of the acetylene, ethylene, and phenylene series of hydrocarbons are the illuminating ingredients diluted with carbonic oxide, hydrogen, and methyl-hydride. The approximate percentage composition of coal gas is: H, 45·6; Me, 34·8; CO, 6·5; C_2H_4, 4; CO_2, 3·6; N, 2·4; C_4H_8, 2·3; SH_2, 0·3, etc.—*Hugh Clements in English Mechanic.*



THE DISTILLATION OF COAL.

A Short History of Petroleum.

The *Lumberman's Gazette* gives the following short history of petroleum: The production of petroleum as an article of trade dates from the 28th of August, 1859, when Colonel Drake, in a well 69½ feet deep, "struck oil," and coined a phrase that will last as long as the English language. From that beginning it has increased to an annual production of 14,500,000 barrels of crude oil. The first export was in 1861, of 27,000 barrels, valued at $1,000,000, and the export of petroleum in the year 1877 was, in round numbers, $62,000,000. The annual product of petroleum to day—crude and refined—is greater in value than the entire production of iron, and is more than double that of the anthracite coal of the State of Pennsylvania, and exceeds the gold and silver product of the whole country. As an article of export it is fourth, and contests closely for the third rank. Our leading exports are relatively as follows: Cotton annually from $175,000,000 to $227,000,000; flour from $69,000,000 to $130,000,000; pork and its products (bacon, ham and lard) from $57,000,000 to $82,000,000; and petroleum from $48,000,000 to $62,000,000. The total export of petroleum from 1861 to and including 1877 (16 years) has been $442,698,968, custom house valuation. From the best sources of information there are at this time 10,000 oil wells, producing and drilling, which, at a cost of $5,000 per well, would make an investment of $50,000,000 in this branch of the business. Tankage now existing of a capacity of 6,000,000 barrels cost $2,000,000, and $7,000,000 has been invested in about 2,000 miles of pipe lines connected with the wells. The entire investment for the existing oil production, including purchase money of territory, is something over $100,000,000, which amount cannot be lessened much, if any, for as wells cease to produce new ones have been constantly drilled to take their place.

Minute Forms of Life.

The Rev. W. H. Dallinger lately delivered a lecture at the Royal Institution, descriptive of the recent researches of Dr. Drysdale and himself. The object of the lecture was mainly to explain the method of research which had been employed. The first essays of the opticians to produce "high powers" were, as might be expected, feeble. These powers amplified, but did not analyze; hence it began to be questioned whether "one could see more really with a high power than with a moderate one." And this was true at the time. But it is not so now. The optician has risen to the emergency, and provided us with powers of great magnifying capacity which carry an equivalent capacity for analysis. They open up structure in a wonderful way when rightly used. The lecturer began by projecting upon the screen the magnified image of a wasp's sting—an object about the 1-20th of an inch in natural size—and beside it was placed a piece of the point of a cambric sewing needle of the same length, magnified to the same extent. The details of the sting were very delicate and refined, but the minute needle point became riven and torn and blunt under the powerful analysis of the lens, showing what the lecturer meant by "magnifying power;" not mere enlargement, but the bringing out of details infinitely beyond us save through the well made lens. This was further illustrated by means of the delicate structure of the *Radiolaria*, and still further by means of a rarely delicate valve of the diatom known as *N. rhomboides*. With a magnification of 600 diameters no structure of any kind was visible; but by gradually using 1,200, 1,800, and 2,400 diameters, it was made manifest how the ultimate structure of this organic atom displayed itself.

But this power of analysis was carried still further by means of the minutest known organic form. *Bacterium termo*. The lecturer had, in connection with Dr. Drysdale, discovered that the movements of this marvelously minute living thing were effected by means of a pair of fine fibers or "flagella." These were so delicate as to be invisible to everything but the most powerful and specially constructed lenses and the most delicate retinas. But since this discovery, Dr. Koch, of Germany, had actually photographed the flagella of much larger bacteria, such as *Bacillus subtilis*, and expressed his conviction that the whole group was flagellate. Mr. Dallinger determined then to try to measure the diameter of this minute *flagellum* of *B. termo* that the real power of magnification in our present lenses might be tested. This was a most difficult task, but 200 measurements were made with four different lenses, and the results were for the mean of the first 50 measurements 0·00000489208; for the second 0·00000488673; for the third, 0·00000488024; for the fourth, 0·00000488200, giving a mean value for the whole, expressed in vulgar fractions, of the $\frac{1}{204760}$ of an inch as the diameter of the flagellum of *B. termo*.

With such power of analysis it was manifest that immense results might be expected from a good use of the "highest powers." The proper method of using them was next dwelt on, and then the apparatus was described, by means of which a drop of fluid containing any organism that was being studied might be prevented from evaporating while under the scrutiny of the most powerful lenses, and for an indefinite length of time. The importance of studying such organisms in this way—by continuous observation—was then plainly shown, some of the peculiar inferences of Dr. Bastian, as to the transmutation of bacteria into monads, and monads into amœbæ, etc., being explained by discontinuity of observation.

Wages in England.

Consul General Badeau reports that during the past five years wages have increased gradually about 10 per cent, while the cost of living has increased about 25 per cent. Clothing is about 30 per cent higher, while fuel has not risen in price. Agricultural laborers get from $2 to $3 per week, including beer; building laborers and gardeners from $4.40 to $5.10 per week; bricklayers, carpenters, masons, and engineers from $6.80 to $11 per week; cabinetmakers, printers, and jewelers from $8 to $12.30 per week, although the best marble masons and jewelers receive $14.75. Bootmakers and tailors get from $4.86 to $7.65 per week, and bakers from $4.65 to $7.25, with partial board. Women servants are paid from $70 to $240 per annum. Railway porters and laborers on public works get from $4.45 to $12 per week. Rents have risen some 30 per cent, and are, for artisans in London, from $1.20 to $2.40 per week for one or two rooms.

The Treatment of Cancer by Pressure.

M. Bouchut has recently introduced to the notice of the members of the Académie des Sciences a cuirasse of vulcanized caoutchouc, which he has used with success for the treatment of cancerous and other tumors of the breast. In this country there has been much division of opinion upon the utility of pressure in the treatment of cancer, some surgeons regarding it as harmful, or but rarely useful, others attributing to it great retardation of the rapidity of growth of the tumor, or even cure. The surgeons of Middlesex Hospital studied it systematically some years ago, and gave an unfavorable report. The theory of the plan is certainly good: a neoplasia, like a healthy tissue, is dependent upon its blood supply for vitality and growth, and complete anæmia causes the death of a tumor, as it does of a patch of brain substance. It will be remembered that Mr. Haward last year related at the Clinical Society a case in point. He

ligatured the left lingual artery for a recurrent epithelioma of the tongue; the tumor sloughed away, and a fortnight before the patient's death from blood poisoning the tongue was quite healed. In just the same way ischæmia will impair the vitality and so lessen the growth of a tumor. The difficulty is rather in the practical application of this theory. The knowledge that we now possess of the mode of growth of cancers gives us at least one important indication. If we have to deal with a neoplasia that grows at the periphery by gradual infiltration of the surrounding tissues, it is plain that, for pressure to be useful, it must be applied around the tumor rather than over it, where, by compressing and obstructing the capillaries, it would cause overfullness of those at the circumference. It is the periphery of a cancer that is its active part, and we must, therefore, produce ischæmia around and not in the tumor. In the application of the treatment this must be obtained by the careful adjustment of elastic pads or cotton wool, and as the whole success of the plan depends upon the skill with which this is done, too much attention cannot be given to it. We cannot regard pressure as a substitute for removal of a cancer; but in the frequent cases where this is impracticable it appears to be the best substitute at present open to the surgeon. M. Bouchut's cuirasse would seem to be an improvement upon the spring pads and other appliances in use in this country. —*Lancet.*

NEW CUTTING AND BORING ATTACHMENT FOR LATHES.

Our engraving represents a useful little machine which is intended for attachment to lathes. Although it is exceedingly simple it is capable of performing a great variety of work.

The machine is used in two ways, either by attachment to a rigid support, as shown in Fig. 1, or by suspending it by a belt, so that it is capable of universal motion, as shown in Fig. 2.

The supporting frame, A, has three boxes for the spindle, B, and on the shaft at one side of the middle box there are planing knives, C, on the opposite side there is a balance wheel, and a pulley for receiving the driving belt. The spindle, B, extends beyond the ends of the frame, A, and has at each end a socket for receiving interchangeable cutting and boring tools. One end of the spindle is externally threaded to receive a face plate, to which may be attached a disk of wood for receiving sandpaper for smoothing and polishing wood or metal.

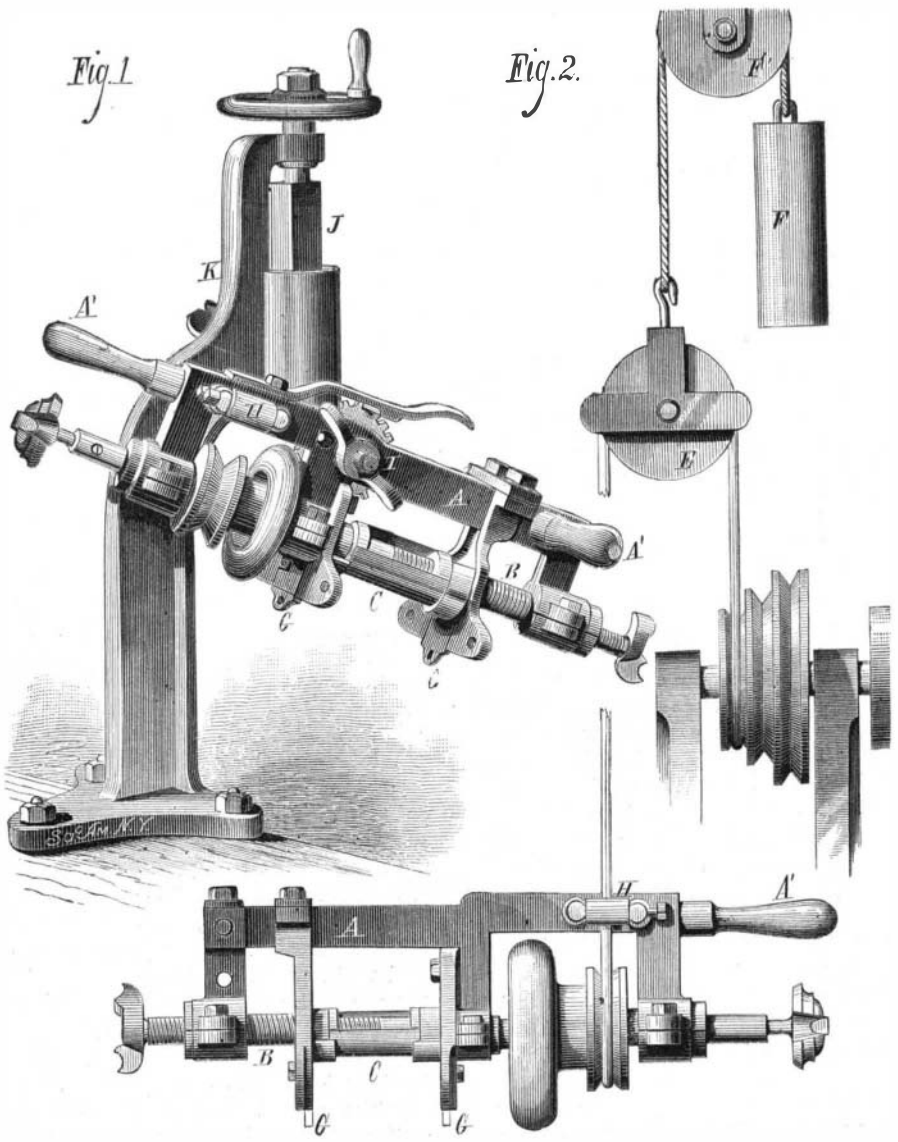
The frame, A, is held to its work by means of handles, A', and the spindle is driven by a round belt that passes over a suspended pulley, E, and also over the pulley on the lathe mandrel.

The entire attachment is balanced by a weight, F, attached to a cord that passes over a fixed pulley, F', to the pulley, E, to which it is secured by a swivel hook that permits of turning the belt in any direction. The belt is guided by small pulleys, H, so that the device may be turned without running the belt from the pulley on the spindle.

Guides, G, are attached to the frame, A, for guiding the material being operated upon by the planing knives. The frame, A, may be supported by attachment to an arm, I, at the lower end of the screw-acted follower, J, which slides in a rigid support, K. The arm, I, has a notched disk which is engaged by a spring detent which holds the frame at any desired inclination.

Among the kinds of work that may be done on this machine may be mentioned shaping and edging, fluting and beading table legs, balusters, etc.; dovetailing, boring, carving, paneling, shaping or friezing mouldings, scroll or fret work, inlaying and engraving, blind stile mortising and blind slat planing. By changing the inclination of the spindle different varieties of mouldings may be produced by the same cutter.

The machine may be used as an emery grinder, and it may also be used for drilling and shaping metals. For further information address Mathew Rice, Augusta, Ga.



CUTTING AND BORING ATTACHMENT FOR LATHES.

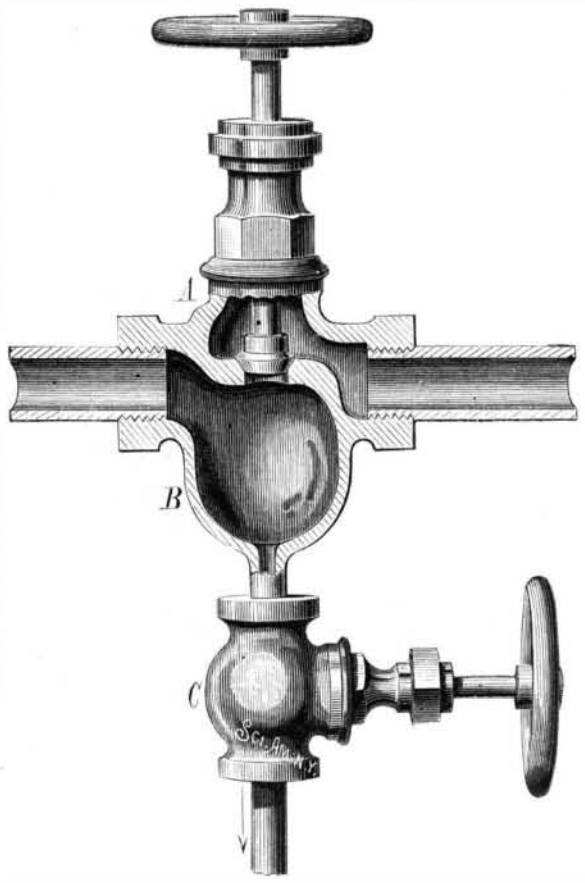
Decrease of the New York Rainfall.

In his report for 1876, Director Draper, of the New York Meteorological Observatory in Central Park, showed that a careful examination of the records in his office proved that there had been, in late years, a change in the rainfall of New York and its vicinity, affecting seriously its water supply. The decrease had been steady since 1869, previous to which there had been an increase. In his report for 1877, Mr. Draper discusses the question whether the change continues, or is likely to continue, in the same direction, and comes to the conclusion that the rainfall of New York will, most probably, continue to decrease by fluctuations for several years to come; also, that the variations are very nearly the same in the two portions of the year, the division date being July 1.

NEW STEAM VALVE.

The improved valve shown partly in section in the engraving is designed for removing the water of condensation from steam pipes, so that dry steam may be furnished.

In the engraving, the globe valve, A, is of the usual form,



SAUNDERS' STEAM VALVE.

except that the casing below the valve seat is enlarged, forming a pocket, B, which communicates through an aperture at the bottom with a small valve, C.

The steam, in passing through the valve, fills the pocket and there deposits any water that may have condensed from the steam in its passage through the steam pipe. The increased depth of the lower portion of the valve prevents siphoning, which takes place in valves of the ordinary form. The valve, C, is kept slightly open to discharge the water at the moment it collects in the pocket; the water is thus prevented from passing onward to the engine or other point of use.

This valve affords a ready means of supplying dry steam to sulphuric acid chambers. We are informed that by its use a chamber in ordinary working order will produce acid 3° to 5° Baumé stronger than can be obtained with ordinary globe valves. Thirty steam pipes, arranged at different points, are found to deliver into a chamber in the space of five minutes from 4 to 16 ounces of condense water (according to the circumstances of distance, temperature of the air, size of pipe, etc.). These valves, being placed close to the chamber separating all the condense water, deliver with certainty uniformly dry steam, without the inconvenience of ordinary steam traps or other expensive appliances.

This valve was patented through the Scientific American Patent Agency, May 21, 1878. For further particulars address Mr. Joseph Saunders, 975 Third avenue, Brooklyn, N. Y.

A Hint from the Mormons.

Ex-Governor Hendricks, in a recent industrial address, alluded to the highly prosperous condition of the Mormons as existing previous to the influx of the Gentiles into Utah, saying that "to the fact that they produced all they consumed I attribute their wonderful prosperity." This remark, associated with the prosperity of other communities in different parts of the country, would suggest the query of "Why the principle cannot be more largely applied to the whole nation?" Certainly the resources of the whole country would indicate a much greater diversity of production, and if there was the same regard for a uniform building up of our industrial system there would seem to be need of but little importation, certainly of goods which can be readily made, and which our people need the labor to produce.

New Agricultural Inventions.

Joseph George, of Springfield, Greene Co., Mo., has patented an improved form of Cultivator or Shovel Plow, designed to be convertible into either a single, double, or triple shovel plow as occasion may require. It consists in two detachable clamping plates, which hold the plow beams, and their arrangement with respect to the said beams and the handles of the plow, whereby a single bolt is made to secure the forward ends of the handles and clamp the plates to hold the plow beams in place.

Russel O. Bean, of Macedonia, Miss., is the inventor of an improved Seed Planter for planting cotton and other seeds, and for distributing fertilizers. The details of the construction of this planter cannot be explained without engravings.

Rutus Sarlls and Alexander Kelman, of Navasota, Texas, have invented an improved combined Planter, Cultivator, and Cotton Chopper, which may be readily adjusted for use in planting seed, cultivating plants, and chopping cotton to a stand, and is effective and reliable in operation in either capacity.

William H. Akens, of Penn Line, Pa., is the inventor of an improved Dropper, for attachment to the finger bar of a reaper, to receive the grain and deliver it in gavels at the side of the machine, so as to be out of the way when making the next round. It is so constructed that when attached to the finger bar of a mower it will convert it into a harvester.

James Goodheart, of Matawan, N. J., has devised an improved machine for Distributing Poison upon potato plants to destroy the potato bug. It may also be used for sowing seeds.

William V. McConnell and Charles M. Dickerson, of Crockett, Texas, have invented an improved Fruit Picker, having cup-shaped self-opening spring jaws attached to its handle, and operated by a cord to close upon and clamp the fruit. It also has a hollow extensible adjustable handle and a fruit receiver.

Quick Work.

Two years ago a farmer-miller and his wife, at Carrolton, Mo., furnished some invited guests with bread baked in eight and a quarter minutes from the time the wheat was standing in the field. This year it was determined to make still better time. Accordingly elaborate preparations were made to reap, thrash, grind, and bake the grain with the least possible loss of time.

In 1 minute 15 seconds the wheat, about a peck, was cut and thrashed, and put on the back of a swift horse to be carried to the mill, 16 rods away. In 2 minutes 17 seconds the flour was delivered to Mrs. Lawton, and in 3m. 55s. from the starting of the reaper the first griddle cake was done. In 4 minutes 37 seconds from the starting of the reaper, a pan of biscuits was delivered to the assembled guests.

After that, according to the Carrolton *Democrat*, other pans of delicious "one minute" biscuits were baked more at leisure, and eagerly devoured, with the usual accompaniment of boiled ham and speech making.