

Scientific American

A JOURNAL OF PRACTICAL INFORMATION IN ART, SCIENCE, MECHANICS, AGRICULTURE, CHEMISTRY, AND MANUFACTURES.

VOL. VI.—No. 3.

NEW YORK, JANUARY 18, 1862.

NEW SERIES.

NEW STEAM EXCAVATOR.

The millions of dollars that are annually expended in excavating earth have attracted the attention of inventors to devise modes of aiding the operation by machinery; and large and costly machines have been made for excavating in certain situations, especially in deep cuts of soft sand, which work well, and perform the labor of many men. In all of the excavators which we have seen, the earth was deposited in carts for removal.

The use of the ponderous machine here illustrated is to excavate earth, and transport it to the desired place of deposit, it being intended to work in ground free from large stones or nearly so, and where the hills are not too steep for the ascent and descent of a locomotive running on broad wheels on the ground.

The rectangular frame, A, is supported on four wheels, two of which, B B, are the driving wheels propelled by the engine, C C. The two forward wheels are joined to the frame by means of a king bolt, and are connected by rack and pinions with the steering wheel, D, so that the machine may be guided in its course. As the machine is driven along, the plow, E, turns up the dirt, and rolls it into the radial chambers of the elevating wheel F. As the wheel, F, revolves, the dirt is held in the chambers by the plate, G, till it is carried above the edge of the plate, when it slides down by its own gravity, and falls into the car, H. The car shown in the cuts is only one of a series intended to surround the machine on a railway having turning tables at the corners; as each car is filled it is pushed along by hand, and thus

all receive their loads, when the wheel, F, is raised so that it will not operate to lift the earth, and the machine is propelled under the guidance of the operator to the place of deposit, when the cars are emptied in the usual manner. The shaft of the wheel, F, runs in journal boxes, which are secured in the upright guides, i i, and are suspended by chains which are wrapped around the shaft, k, so that the wheel, F, may be raised by the power of the engine, by throwing the clutch, m, into operation, and thus turning the shaft, k. The wheel, F, is rotated by means of the chains; n and o, and the pulleys, p and r, as shown.

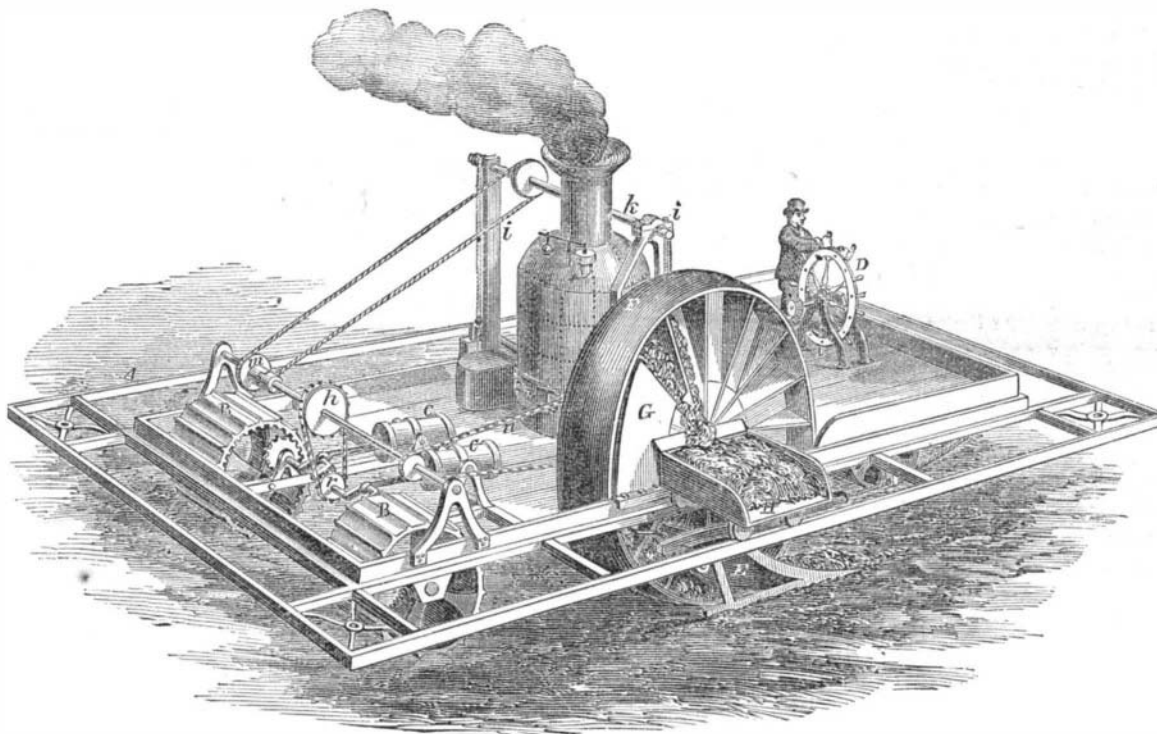
This machine is the invention of W. G. Goodale and R. L. T. Marsh, to whom a patent was issued through the Scientific American Patent Agency, Dec. 20, 1859, and persons desiring further information in relation to it will please address Messrs. Goodale & Marsh, at Centralia, Ill.

THE ART OF TANNING.

The following extracts are taken from the second lecture of the Hon. Gideon Lee, on the above subject as published in the *Shoe and Leather Reporter*. The substance of his first lecture we published on page 384, Vol. I. (new series):—

“Saving is the order of the day. Each pound of gluten wasted, incapacitated, expunged, consumed, or otherwise lost, involves the loss or prevents the gain of nearly an equal weight of tannin, which the gluten so lost would otherwise have combined. I am satisfied that excessive soaking and softening is the incipient waste. But we must be equally careful to avoid the opposite extreme; for if our theory be correct, short or deficient softening is no less a cause of loss or waste than overdoing. The purest glue and the purest tannin have no more chemical affinity in a perfectly *dry* state than the two most repellent substances in nature. It is only in a state of solution, or extreme softness approximating solution, that

ing the fatty particles, and distending and swelling the whole hide to double its natural thickness. It must be obvious to the most ordinary mind that a menstrum so cogent should be used with great discretion; we have good reason to apprehend it has done great waste to our trade in consuming the soft gelatine of which the raw hide is composed. Every tanner knows that all high limed leather is loose, porous, pervious to water, weighs light and wears out quickly; I ascribe the whole mischief in the process to the actual consumption of the soft and more delicate particles of the gluten. Let us suppose that ten pounds in the hundred are thus consumed. Why, we have not only lost the ten pounds of hide, but we have failed to gain the five, or seven, or ten pounds of tannin which should have combined with it! I shall say but little of another process adopted by a great number of our large tanners within a few years, commonly called *sweating*, which accomplishes, by the process of that fermentation natural to all dead animal substances,



GOODALE & MARSH'S NEW STEAM EXCAVATOR.

this affinity has active existence. Every ounce of the hide, therefore, which fails of that degree of softness requisite for the incorporation or union of tannin is no better than lost; it can never form the necessary union with the tannin in order to make leather; but it must remain in a state which, in technical phrase, we call 'horn' or 'starved hide.' Some tanners have fancied that the opening power of the lime, in the next stage of the process of preparation, may perform what the pure water and the softening mill had left undone. We know that lime is a powerful solvent, and in part it possibly may remedy the defective work of the water and the mill, but not fully. If then, ten pounds of hide in a hundred should fail of the requisite degree of softness, in the harder or thicker parts the leather will fail proportionably, both in weight and quality. The operation of a strong solution of lime, on the soft and raw hide, is powerful, opening the pores, loosening the hair, consum-

all the beneficial purposes of the lime; and, I am inclined to believe, with less waste of the raw material. Several practical tanners, in whose judgment I have very great confidence, say, that the sweating process, in comparison with the liming, 'requires less labor saves a portion of the hides, which, in the process of incipient putrefaction, would be suddenly destroyed by lime, causes a greater gain in the weight of the leather; that it is more solid, finer texture, less pervious to water, and wears longer; but requires longer time in the tanning, and is very difficult for the shoemaker to

sew or stitch.' The process called *bating*, which immediately follows the liming, is intended to expunge the lime and restore the texture of the hide, as nearly as may be, to what it was before the liming process. It is, in its nature, that kind of fermentation which immediately precedes putrefaction, and the ultimate decomposition of all animal substances. This is perhaps the most delicate and critical operation in the whole range of the manufacture of leather, and requires in the operator the nicest perception, the most improved judgment, and constant watchfulness especially in variable weather. The next process is the *handling*. Here begins the actual tanning, in a solution of tannin, which, being a powerful anti-putrescent, instantly arrests the fermentation generated in the bate. I have good reason to believe that, in the *bating* process, a large portion of the substantive body of the hide may be 'run off,' without destroying its organic structure. I presume every reflecting tanner will support me in the

opinion that the waste of glutin, in over-bating, is very great, but I have reason to fear that a greater loss is incurred by means of the *tardy* application of the tannin from the first handler to the last layer, than by all other wasting causes together. I have noticed the results of numerous experiments of both *slow* and *quick* tanning; and in all cases (the preparation of the hide for the ooze being equally well done) have found the *quick* tanned specimens of a firmer and closer texture, more solid, less pervious, vastly greater weight, and far more durable in the wear, than the slow tanned specimens. By *quick* tanning, I mean three to four months for light sole leather; five to six months for middling; and seven to eight months for very heavy; dating from the first handler. By *slow* tanning I mean any considerable additional time to the terms named. I believe a much quicker process might be had, that would give as great or greater weight; but it would render the leather too hard and harsh in its texture to be conveniently worked up by the shoemaker. It will be observed, I am speaking of *sole* leather only, with which kind I am most intimate. The ordinary increase of weight among the large tanners of this State, on the *unsalted dry* hides, imported from Lagaira, Angostura, Buenos Ayres, Rio Grande, and other parts of South America (and such chiefly make up their stocks) is such that each one hundred pounds of *dry* hide make one hundred and forty to one hundred and fifty pounds of sole leather. I may also repeat here that, when all the glutin composing the hide is entirely combined (saturated) with the tannin—when the union is perfectly formed—not a single additional ounce can be gained from the strongest ooze, whatever time you continue the process. I had a most satisfactory experimental proof of the correctness of this conclusion. I consider active and long-continued handling vastly important, not only in the acquisition of weight, but in point of firmness and durability. I would handle sole leather from eighty to one hundred and twenty days, according to the weight of the sides, and the subsequent *laying away* should be short and frequently repeated; a few days only for each layer, and in no case more than two-thirds the quantity of sides which is usually laid in each vat. I have ascribed the greatest loss or waste in glutin to the *tardiness* of the *tanning* stage of the manufacture. I am not able to satisfy my own mind precisely how or when it goes; I am rather inclined to think it does not separate and escape from the body of the hide, as in the process of softening and bating; but for want of an immediate conjunction with the tannin, I believe it somehow perishes, and becomes extinct in its original position, or becomes incapacitated ever thereafter to form the necessary union with the tannin. If these conjectures be well founded, then much handling will prove the best remedy. I believe that the glutin of the interior parts of the hide chiefly suffers this disqualification; for the exterior being brought into immediate contact with the tannin, the two surfaces are always *first* tanned, as every body knows. And it is somewhat curious to see the progress of the combination extending from the two surfaces inward—the interior remaining colorless, soft, raw hide, for months after the two surfaces have become firm, well-tanned leather; the glutin of the two surfaces having arrested and combined all the tannin before it reaches the interior."

The opinions of Mr. Lee, regarding the experiment of quick-tanned hides, are the very opposite of those generally entertained by almost every person *outside* of the tanning business.

DRAINAGE OF CITIES FOR MANURES.

A very valuable letter has lately been written by Professor Liebig, the eminent chemist at Munich, in Bavaria, to Mr. J. J. Mechi, the well-known enterprising English agriculturist, in answer to a letter of the latter, which had been published in the *London Times*. We will give the substance of this letter, and request for it a careful attention, as the opinions expressed, and the information contained in it, are just as important to the citizens of all our large cities as to the inhabitants of London.

In reference to the use of sewerage matters for manures, he says:—I regard it as a fortunate event that a man of so eminently practical a character as yourself has now for the first time, in the interest of agriculture and the national welfare, taken up the question of the "sewerage of towns" with warmth, and in language adapted to

produce conviction. I have labored many years to impress such views upon the public, but my efforts have not been attended with any perceptible results. The men to remove the difficulties which stand in the way of procuring manure from the "sewerage of towns" will certainly be found; and a future generation will look upon those men who have devoted their energies to the attainment of this end, as the greatest benefactors of their country.

The ground of my small success lies clearly in the fact, that the majority of farmers do not know the extent to which their own interests are concerned in this matter, and because the views and conceptions of most men in regard to the circuit of life and the laws of the preservation of our race, do not generally rise above those of C. Fourier, the inventor of the phalanstery. He proposed, as you know, to supply the wants of the occupants of his phalanstery by means of eggs. He supposed it was only necessary to procure a couple of hundred thousand hens, each of which would lay thirty-six eggs a year, making as many millions of eggs, which, sold in England, would produce an immense income. Fourier knew very well that hens lay eggs, but he seemed not to know that in order to lay an egg they must eat an amount of corn its equal in weight. And so most men do not know that the fields, in order permanently to yield their harvests, must either contain, or else receive from the hands of man, certain conditions which stand in the same relation to the product of the fields as the hen's food does to the egg she lays. They think that diligent tillage and good weather are sufficient to produce a harvest; they therefore regard this question as one in which they are wholly unconcerned, and look forward carelessly and with indifference to the future.

It is true that the diligent tillage of the fields, sunshine, and timely rain, are the outward conditions, perceptible to all men, of good harvests, but these are perfectly without effect upon the productiveness of the field, unless certain things not so easy of perception by the senses are present in the soil, and these are the elements which serve for nourishment—for the production of roots, leaves and seeds—and which are present in the soil always in very small quantity in proportion to the mass of the soil itself.

These elements are taken from the soil in the products of the field, in the corn, or in the flesh of the animals nourished by these products, and daily experience shows that even the most fruitful field ceases after a certain series of harvests to produce these crops.

A child can comprehend that, under these circumstances, a very productive field, in order to remain very productive, or even simply productive, must have the elements which have been withdrawn in the harvests perfectly restored; that the aggregate of the conditions must remain, in order to produce the aggregate results, and that a well, however deep it may be, which receives no supply of water, must in the end become empty, if its water is constantly pumped out. Our fields are like this well of water. For centuries those elements which are indispensable to the reproduction of the field crops have been taken from the soil in those crops, and that, too, without being restored. It has only recently been ascertained how small a supply of these elements the soil really has. A beginning has been made to restore to the fields the loss which they sustain through the annual harvests, by introducing from external sources manures containing the same elements. Only a very few of the better-informed farmers perceive the necessity of this restoration, and those of them who have the means have zealously endeavored to increase the amount of these elements in their fields.

The loss of these elements is brought about by the "sewerage system of towns." Of all the elements of the fields, which in their products in the shape of corn and meat, are carried into the cities, and there consumed, nothing, or as good as nothing, returns to the fields. It is clear that if these elements were collected without loss, and every year restored to the fields, they would then retain the power to furnish every year to the cities the same quantity of corn and meat; and it is equally clear that if the fields do not receive back these elements, agriculture must gradually cease. In regard to the utility of the avails of the "sewerage of towns" as manures, no agriculturist, and scarcely an intelligent man, has any doubt; but as to their necessity, opinions are very various. Many are of the opinion that corn, meat, and manures

are wares which, like other wares, can be purchased in the market; that with the demand the price may perhaps rise; but perhaps in half a century not one of those countries upon whose excess England has hitherto drawn, will be able to supply her with corn, and that too, from the natural law, that what is true of the smallest piece of ground is true also of a great country—it ceases to produce corn if the conditions of the reproduction of the corn which has been carried off are not restored to it.

In the United States the population increases at a still greater ratio than in other countries, while the corn production upon the land under cultivation has constantly fallen off. History teaches that not one of all those countries which have produced corn for other lands have remained corn markets, and England has contributed her full share towards rendering unproductive the best lands of the United States, which have supplied her with corn, precisely as old Rome robbed Sardinia, Sicily, and the rich lands of the African coast of their fertility.

Finally, it is impossible in civilized countries to raise the corn production beyond a certain limit, and this limit has become so narrow that our fields are no longer capable of a higher yield without an increase of their effective elements by the introduction of manures from abroad. By means of the application of guano and bones, the farmer of most limited capacity learns the real meaning of such increase; he learns that the pure system of stall or home-made manures is a true and genuine robbing system. In consequence of his restoring in the guano and bones but a small portion of the very same elements of seeds and of fodder which had been withdrawn from his fields by centuries of cultivation, their products are wonderfully increased. Experiments instituted with special reference to this end, in six different parts of the kingdom of Saxony, showed that each hundred weight of guano put upon a field produced 150 lbs. of wheat, 400 lbs. of potatoes, and 280 lbs. of clover, more than was produced by the same-sized piece of ground without guano; and from this it may be calculated how enormously the corn and flesh production of Europe has been increased by the yearly importation of 100,000 tons, or 2,000,000 cwt. of guano.

The effect of guano and bones should have taught the farmer the real and only cause of the exhaustion of his fields; it should have brought him to perceive in what a condition of fertility he might have preserved his fields, if the elements of the guano which he has transported in the shape of meat and products of his fields into the cities, were recovered and brought into a form which would admit of their being restored every year to his fields. But it is much simpler, he thinks, to buy guano and bones, than to collect their elements from the sewers of cities, and if a lack of the former should ever arise, it will then be time enough to think of a resort to the latter. But of all the farmers' erroneous opinions, this is the most dangerous and fatal. If it is considered that a pound of bones contains in its phosphoric acid the necessary condition for the production of 60 lbs. of wheat; that if the English fields have become capable, by the importation of 1,000 tons of bones, of producing 200,000 bushels more of wheat in a series of years that they would have produced without this supply, then we can judge of the immense loss of fertility which the German fields have sustained by the exportation of the many hundred thousand tons of bones which have gone from Germany to England. It will be conceived that, if this exportation had continued, Germany would have been brought to that point that she could no longer have been able to supply the demand of her own population for corn. In many parts of Germany, from which formerly large quantities of bones were exported, it has already come to be the case that these bones must, at a much higher price, be bought back again in the form of guano, in order to attain to the paying crops of former time. The price of bones is now so high in Germany as to forbid their exportation.

In relation to guano, I have been assured that in 20 or 25 years, if its use should increase in even the same proportion as hitherto, there will not remain in South America enough to freight a ship. We will, however, suppose its supply and that of bones to continue for fifty years, or even longer—then what will be the condition of England when the supply of guano and bones is exhausted? This is one of the easiest of all questions to answer. If the common "sewerage system" is retained, then the imported manures, guano and bones, make their way