THE UTILIZATION OF NEW YORK CITY GARBAGE.

It was only a question of time before the city of New York should awaken to the necessity of finding a better way of disposing of its wastes or general refuse than by emptying it into the sea, a practice which was at once pernicious and wasteful. That it was pernicious is proved by the unsavory and unsightly fringe of rubbish which the sea has cast up on the shores of New York Harbor and the Jersey coast. Moreover, the heavier matter, settling to the bottom, became, under the influence of the tides, an active agent in silting up the entrance channels of the bay. That the practice of dumping at sea was wasteful is proved by the fact that it has lately been shown that there is sufficient commercial value in a considerable portion of the city refuse to more than pay for the cost of its collection.

In former days the household refuse, consisting of ashes, garbage (table and kitchen wastes), and paper, rags, etc., was collected indiscriminately and taken to the scows. The present system requires the householders and the management of hotels and industrial concerns to place their refuse for collection in separate lots, according as it is ashes, garbage, or light refuse. By this threefold division the city wastes acquire a positive value, each class being available for some specific use.

Under the head of ashes is included not merely the residue from boiler furnaces and household grates, but such material as broken crockery, oyster and clam shells and all material that is suitable for filling-in purposes. For a description of the methods of handling this matter the reader is referred to the issue of the SCIENTIFIC AMERICAN for June 5, in which are illustrations of the new steam dumping scows, which are to be employed in carrying away the ashes—at present to the outside dumping ground, but ultimately to Riker's Island, at the entrance to Long Island Sound, where it will be used for reclaiming swampy ground.

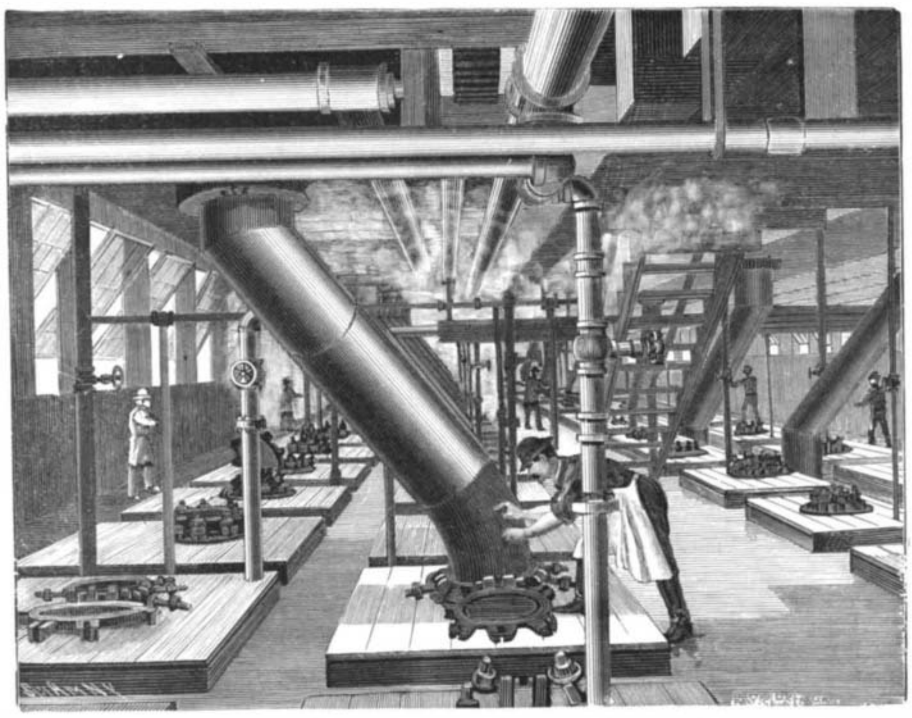
The present article is devoted to a description of the plant on Barren Island for the disposal of garbage—the second class of refuse—and in an early number we shall give an account of the experimental plant which the city has in operation at the foot of Eighteenth Street, on the East River, for the handling of the third class of refuse, such as paper, rags and kindred matter.

Under the present system the garbage is carried by the carts of the street cleaning department to seven different dumps conveniently situated along the river front. Here it is loaded into the scows of the New York Sanitary Utilization Company and is towed by their tugs to the large factory on Barren Island, views of which will be found on the front page of this issue. The garbage is taken away daily, and the amount removed averages about 800 tons per day throughout the year. At the factory it is unloaded onto the buckets of a large cantilever elevator which has a capacity of handling a thousand tons of this material per day.

This work was formerly done by single hoisting buckets, but the operation was slow, and the present large elevator has lately been installed in their place.

When the conveyor is at work the outer end of it rests upon the deck of the scow, and the upper end delivers the material onto a small cross conveyor, which in turn feeds two large inclined elevators which carry the garbage up to the top of the factory.

Here it is delivered into bins from which a series of large swivel pipes lead down to the mouths of what are known as the digesters. There are forty-eight of these digesters in all and they are arranged in rows of four through the center of the building. Each of the swivel pipes swings through a sufficient radius to reach the top of four digesters. The latter, which are large cylindrical tanks of plate steel, 5½ feet in diameter and 18 feet long, are arranged vertically as shown in the illustration. They are tapered at the ends, the mouths being closed by steamtight covers and the bottom terminating in a short lengths of pipe which are furnished with large stop valves. After the digesters are filled with the garbage, they are hermetically sealed and steam at 50 pounds pressure is admitted through the lower cone. The cooking is allowed to go on for a period of eight to ten hours, until the garbage is thoroughly disintegrated and reduced to a pulplike consistency, all germs in the meantime being thoroughly destroyed. The matter is then dropped into twelve storage tanks, there being four digesters to each tank. On the outside of each tank there is a curved telescopic delivery pipe, and through these the matter is unloaded onto the press platens carried upon small trolleys, which are run underneath the pipe for this purpose.



TOP OF DIGESTER ROOM SHOWING PIPE FILLERS.

Upon the platen is placed a mould or outer frame which is covered with burlap, and after a sufficient amount of the material has been run into the burlap to fill up the mould, the burlap is folded over above it and covered with a rack or wooden gridiron about ½ inch in thickness. Another mould with burlap is placed above this and more of the cooked garbage is run in, the process being repeated until there is a pile about 4 feet in height. This is then run into the presses, where it is subjected to a pressure of 250 tons. The presses work at a very slow speed, and it takes about three-quarters of an hour to compress the mass from 4 feet to 18 inches. The material, which is now in cake form, passes to the "strippers," men whose task it is to remove the burlap and take the cake from the moulds. It is then carried by conveyors to the drying room, where it is put into a dozen cylindrical steam-jacketed driers. A steel shaft carrying a set of arms rotates in the interior of the drier, and serves to pulverize the material. When this operation is complete, the material is unloaded through a bottom door into a conveyor, by which it is carried to the screen room, in which are a series of revolving cylindrical screens. Here all rubbish, such as fine metal, bits of tin, rags, and similar material, is separated from the "tankage," which falls through the sieves as a fine powder. Tankage is the name given to this powdered material. It is used for fertilizer filler, and for that purpose is sacked and shipped to the fertilizer works. At this stage of the process it contains 4½ per cent of ammonia, 14 per cent of bone phosphate, and ½ of 1 per cent of potash.

The grease and water from the presses is led by pipes to a set of settling tanks, ten in all, which cover a space 20 feet wide by 75 feet long, the depth of the tanks being 6 feet. Here the grease rises to the surface and is recovered in catch basins. In the illustration on our front page showing these tanks the workman is employed in skimming off any mechanical refuse which may be floating on the top of the tank. From the catch basins the grease is pumped into a large storage tank, from which it is barreled for shipment. It is used for the manufacture of soap, candles, etc., and is known commercially as "soap grease." The water from the presses, which contains about 14 per cent of soluble ammonia and 1½ per cent soluble potash, is pumped into a large evaporator in which these substances are recovered, and the product is then mixed with the tankage and serves to raise its quality and value. In addition to the plant already erected, the company is about to put up a plant to work the refuse screenings, which will be cremated in retorts and will yield a certain amount of sulphate of ammonia.

It will thus be seen that the unsightly mass which reaches the factory on the garbage scows is transformed ultimately into two most essential and valuable commercial products—fertilizer and soap. It is certainly a triumph of science and art that the material which we reject from our tables should render us service once more as the producer of food and agent of cleanliness.

Barren Island, the site of the above very interesting plant, is about five miles distant from Canarsie and lies one mile distant from the eastern end of Coney Island. It is in some respects the most unique spot to be found in the United States, for within its restricted area—it is about half a mile wide by one and a half miles long—are five different factories, all of which are devoted to the reduction of animal and vegetable wastes to commercial products. In addition to the works we have just described there are also a fish factory, a phosphate works, White's rendering factory and another smaller rendering factory. The employes and their families number 800 and in the course of the year over $250,000 are paid out in wages. We are informed by Mr. Thomas F. White, who is largely interested in the utilization works and the various other factories on the island, that the health of the community is remarkably good throughout the year. We are indebted for facilities in the preparation of our illustrations to Mr. White and Mr. McDonough Craven, C.E., of the New York Street Cleaning Department.

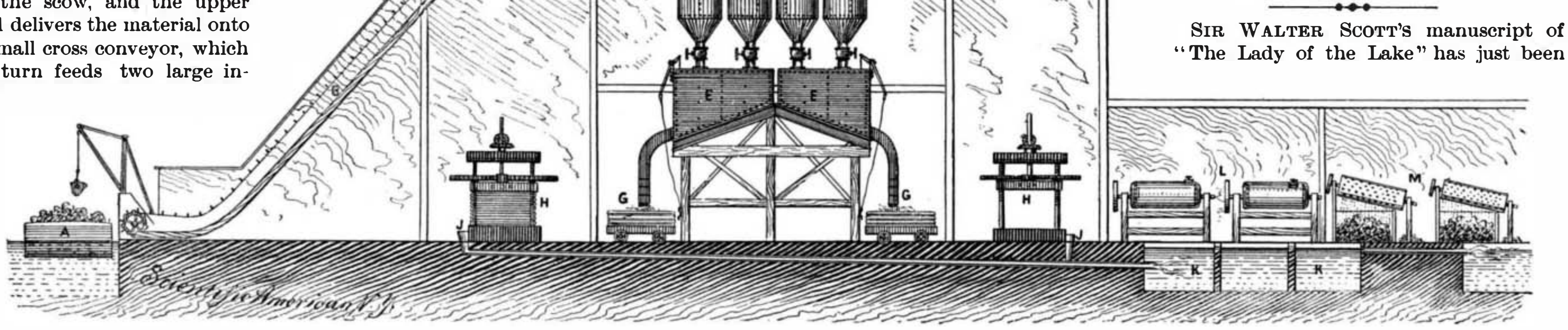


DIAGRAM (NOT TO SCALE) SHOWING PROCESS OF GARBAGE REDUCTION.

A. Scows with garbage. B. Garbage elevator. C. Pipe fillers. D. Digesters. E. Storage tanks. G. Press platens and trolleys. H. Presses. J. Pipes to settling tanks. K. Settling tanks. L. Steam driers. M. Screens.

SIR WALTER SCOTT'S manuscript of "The Lady of the Lake" has just been sold in London for $6,450; thirty years ago it brought $1,385. The manuscript of "Old Mortality" sold for $3,000. Lord Nelson's autograph memoir of his own life with some autograph letters was sold for $5,000; twenty-three other letters of his to Trowbridge fetched $1,400. Robert Burns' private journal, begun in 1787, "The Edinburgh Commonplace Book," brought $1,815. Eight manuscripts of A. C. Swinburne, poems published in his first volume, sold for $198.

Science Notes.

According to the Journal de Médecine de Bordeaux, a man placed under arrest for illegal practice of medicine, claiming to be a graduate of an American college, presented a diploma which excited the suspicion of the magistrate. Calling in the services of an expert, the document was submitted to the action of a Crookes tube, and the result showed distinctly the outlines, in the substance of the paper, of a name which had been erased from the surface to make room for that of the man who was convicted upon this evidence.

Dr. Judson Deland, of Philadelphia, has invented an instrument for counting blood corpuscles. It works on the centrifugal force principle, and accomplishes the measurement by means of comparative bulks. A quantity of blood is placed in a finely graduated tube and the latter revolved at a speed of about 1000 revolutions a minute. The corpuscles divide by force of gravity and form on the side of the tube in easily traceable divisions of red corpuscles, white corpuscles, and serum. The new method permits of larger, and consequently more representative, quantitatives being used in experimenting, besides doing away with actual microscopic counting.—Microscope.

The results of some recent researches on the direct union of carbon and iron at a high temperature have been communicated by the author, M. Moissan, to the French Academy of Sciences. He states that when pure iron and carbon are melted together in an electric furnace and allowed to cool slowly, the metal is found to contain only a very small quantity of combined carbon, a gray pig iron being obtained that solidifies at 1,150° C. By suddenly cooling in water iron saturated with carbon at 3,000°, the metal became crystalline in structure, and from it were separated brilliant crystals of the carbide of iron, identical with that occurring in steel. Though this was one of the first metallic carbides known, it has proved the last to be prepared in quantity by direct synthesis.

It was announced recently, says the Electrical Review, that the National Meseum, at Washington, D. C., had secured the famous Cyrus W. Field collection of documents, autographs, telegrams and cablegrams relating to the first Atlantic cable. It has been donated by Mrs. Isabella Field Judson, of Dobbs Ferry, N. Y., and is being arranged for exhibition by Prof. Maynard. The journal kept by Mr. Field, and the notes of deep sea soundings made by him and the officers of the Great Eastern, are part of the collection. Mr. Field's private library forms another part of it. There are also copies of medals presented to him by Congress and the French government, engraved resolutions passed by members of bodies in this country and Europe, a cane made from the wood of the Great Eastern, cases containing sections of the first cable, and those evolved from it, and the globe used by Mr. Field while working out his plans.

The electric light has been used in night fishing, and now a French entomologist has devised a plan to secure specimens of insects. He took an incandescent lamp of three or four candle power, he then placed a small portable battery on the bank of the pond. The battery was connected with the lamp by wire; the lamp was fixed to a semicircle of iron, and below the semicircle and lamp was placed a large net having an opening thirty-two inches across and similar to those used for snaring birds. The whole contrivance was lowered very slowly into the pond, the current was turned on and the lamp lighted. The insects, fish, larvæ, frogs, tadpoles, etc., rushed in in great number. A string is now pulled which closes the net, and by a single movement several pounds of victims may be captured, with a considerable number of fish and tadpoles that happen to be in the pond. A small Geissler tube can be used in the same manner.

Schumburg (Deutsch Med. Woch., No. 10, 1897) describes a new method of sterilizing water by the nse of bromine, one grain being sufficient to destroy all the bacteria in one quart of water, the bromine afterward being neutralized by ammonia, so that a clear and tasteless water is obtained. For this purpose a twenty-per cent solution of bromobromiodide (bromiodide, one part; bromine, one part; water, five parts) is used. Thirty minims of this solution are sufficient to sterilize in five minutes one quart of river water. If the water is very hard or very foul, the lime salts and the ammonia contained in it neutralize a part of the bromine, and in such cases it is necessary to add the bromine solution until a faint yellow color is obtained and persists for at least half a minute. An equal quantity of a nine per cent solution of ammonia suffices to neutralize the free bromine. It is desirable that these amounts should exactly correspond, although a faint taste either of bromine or of ammonia is not objectionable. When the bromine is exactly neutralized, the water is clear and can scarcely be distinguished from the original water, while the amount of bromine salt which it contains is so small that it has no effect upon the system. This method bids likely to be of especial use in times of epidemic, in war, etc.

Equilibrium in Flight.

BY JAMES RICHARDSON.

In a critical review of recent progress in aeronautics, Mr. Octave Chanute, the well known engineer and promoter of aviation, pointed out a fatal defect in most if not all the attempts that have been made to fly by mechanical means.

"The machines," he said, "have almost always come to grief for lack of that stable equipoise which the bird maintains by instinct under the varying conditions of flight and wing."

Without assured equilibrium safety is uncertain; and without a reasonable degree of safety, flight, whether for pleasure or for business, is out of the question.

In Mr. Chanute's judgment—a judgment shared apparently by most workers in this field—the surest and least difficult way to discover and demonstrate the means required for meeting this primary and most imperative need in flying machinery is through imitation of soaring birds. Such birds rise high and fly fast, apparently with little effort, by taking advantage of the action of the wind on their outspread pinions. Men, it is asserted, should study their structure and copy their methods; a slow, costly, and essentially hazardous process, but the best.

"The experimenters will doubtless meet with many failures and mishaps. They may break their machines and possibly their limbs; but there seems to be no safer or surer way of ascertaining the exact conditions which will have to be met in practical flight."

This sounds reasonable; yet it involves several unproved assumptions. For example, that if men were to work out something equivalent to the bird's equipment for flying, they could use it as a bird does, or learn to do so. But that is simply impossible. A man on a machine and a bird in a body are very differently situated. Consider a young bird when about to leave the parent nest. Its physical organism is complete—that is, structurally complete. It has everything to fly with that an old bird has. But it cannot fly, though it may flap its wings with regularity and vigor. It gets into the air more or less, but its progress is erratic, and its early flights end in tumbles. Thanks to its light and elastic structure, the bird can tumble without serious risk of injury, and it keeps on trying and tumbling until it has acquired the difficult art of keeping its balance in air. Instinct does not teach the art any more than reason could. It has to be learned in action. The proper nerves have to acquire, in connection with the proper muscles, the habit of feeling and counteracting all balance disturbing influences instantly and harmoniously, not through conscious perception and volition, but automatically, without thought or hesitation. By virtue of inherited capacity the young nerves and muscles learn fast and do not forget; and in a little while the bird ceases to tumble, and flies steadily, if not gracefully.

Very different is the case of man with a machine of his own making, however wisely planned or skillfully constructed. The members of a lifeless machine have no sensibility, no capacity for learning, no power of independent action. They cannot acquire habits by use. Besides, the engineer in charge of a machine is something apart from the machine, and can never be so closely in touch with its working elements as a bird is with its bodily members. As a consequence, he can never do with the machine what a bird can with its body, and the bird's best, volitionally, is not enough to insure its equilibrium in air. The engineer may be quick to see, prompt in action, and infallible in judgment. And the machinery at his command may respond perfectly to its controlling valves or levers. But action by the roundabout way of perception and volition will not be quick enough to meet the exigencies of flight in his case any more than in the case of a bird. Educated nerves and muscles will automatically do the right thing ten times while the mind is perceiving the need of the action and ordering it once. Having an inherited capacity for acquiring the habit of performing such instant, unordered, infinitely varions yet harmonious muscular movements, the bird can learn to balance itself in air. Lacking such capacity, the machine never can, neither directly nor by proxy.

Just here the designer of a flying machine encounters a new and peculiar problem, one that never arises in connection with earth-supported machinery. If he wants to fly securely, he must make a machine that will balance itself. He must give it a mechanical substitute for the bird's sense of poise and capacity to maintain it. And the machine must not only balance itself, but do it forcefully, since the influences tending to upset a flying machine are apt to be violent as well as sudden in action. Only a positive, unresting, powerful working device will meet the demand. More than that, the device must do its work in practical independence of the engineer. The stability of the machine in air cannot safely depend on any man's perception or judgment or volition.

These difficult requirements are as imperative as fundamental. They cannot be minimized or avoided without constant peril. At all times while the machine is off the ground the balancer must be not merely in readiness, but in action, with a steadying force competent to overcome any influence likely to disturb the equilibrium of the machine, whether acting constantly like gravity or intermittently like varying air pressures due to change of wind or speed.

This necessity is apt to be overlooked. The maintenance of equilibrium is usually made an incident of flight; to be secured by shifting ballast or by means of inert structural devices for the air to act or react upon. As a consequence, most attempts at flight end in disaster. In steady winds or with considerable speed in still air such things may serve. But the air is seldom still, winds vary in speed and in direction, and the machine cannot always be moving with the requisite speed to insure stability. Wings may be folded, sails furled, and fan-like aeroplanes closed or opened to vary their action, but not with the promptness and exactness needed for safety. And it must not be forgotten that any structural devices capable of supporting or steadying a machine in air under favorable conditions of wind and weather must offer the same areas for adverse forces to act on in sudden emergencies. The balancing mechanism of a flying machine must not only be active and efficient, but constant in action and incapable of being taken by surprise.

For insuring equipoise the working elements of the lifting, propelling and steering machinery are as little to be trusted as inert structural devices. Of necessity their motion is inconstant, and must be arrested at times without reference to balance disturbing possibilities, making them least efficient as balancers perhaps just when equilibrium is hardest to maintain. The faster the machine flies and the higher it goes under such conditions, the worse for the rider—when he falls; and he is sure to fall sooner or later.

It would be a good thing to fly, no doubt; but men can live without flying; and most men will prefer to worry along on the earth rather than rise above it at the risk of their necks. Safety is the first consideration; speed, economy, and the rest are secondary problems.

True, some men are willing to risk their lives in air, the forty-seven showmen, for example, who were killed last year fooling with balloons; but they are as little to be considered typical men in this connection as rational promoters of aerial navigation. They were chiefly sensation mongers. The unfortunate Dr. Wolfert and the more venturesome and possibly more unfortunate Dr. Andrée belong to a different class. So too, Herr Lilienthal, and others like him, who risked life or lost it experimenting with soaring devices. Their aims were in all respects commendable in purpose and their efforts have been useful; chiefly however in showing that bulky and fragile constructions for wind sailing are as ill adapted as balloons for practical aerial navigation. Free flight, self-sustained, self-balancing and reasonably independent of wind and weather, from definite startings to predetermined landings, with comparative safety by the way, seems incompatible with such appliances.

To get into the air is not as hard. Many have done that to their sorrow. To stay in the air master of the situation is another matter. To be able to rest in air without risk of overturning, competent to move in any direction at will, and able to return to the point of starting surely and without shock—that is the critical test.

When man has made a machine that will lift itself a foot from the ground and remain poised there in any ordinary weather, he can safely venture further. When all its movements have been thoroughly proved, close to earth, higher and faster flights will be in order, and will not be foolhardy or useless, as premature flights are sure to be.

Above all, the maintenance of equilibrium should be and practically must be the first problem settled. It is a prerequisite: not something to be worked out in air or after all the other elements of the flying machinery have been perfected. Suicide, however scientifically or picturesquely attempted, is not commendable: and smashed machines, however cleverly constructed, are not worth any more than dead inventors for the promotion of aerial navigation.

Our New Supplement Catalogue.

There are still a large number of readers who have not sent for our new 1897 catalogue of valuable papers in the SCIENTIFIC AMERICAN SUPPLEMENT. This catalogue is sent free to any address in the world. A special edition, on heavy paper, has been printed, and this edition, which is cloth bound, is supplied at the nominal price of 25 cents each copy. This catalogue is really a valuable reference work, an index to some of the most valuable technical papers ever published. We feel certain that many of our readers are unfamiliar with the sale of the back numbers of our SUPPLEMENT. These papers usually furnish information of the utmost value, at small cost.

A POSTAGE stamp exhibition, which is said to be the most scientific and elaborate ever gotten up, is now open in London. The exhibits are valued at $1,250,000.

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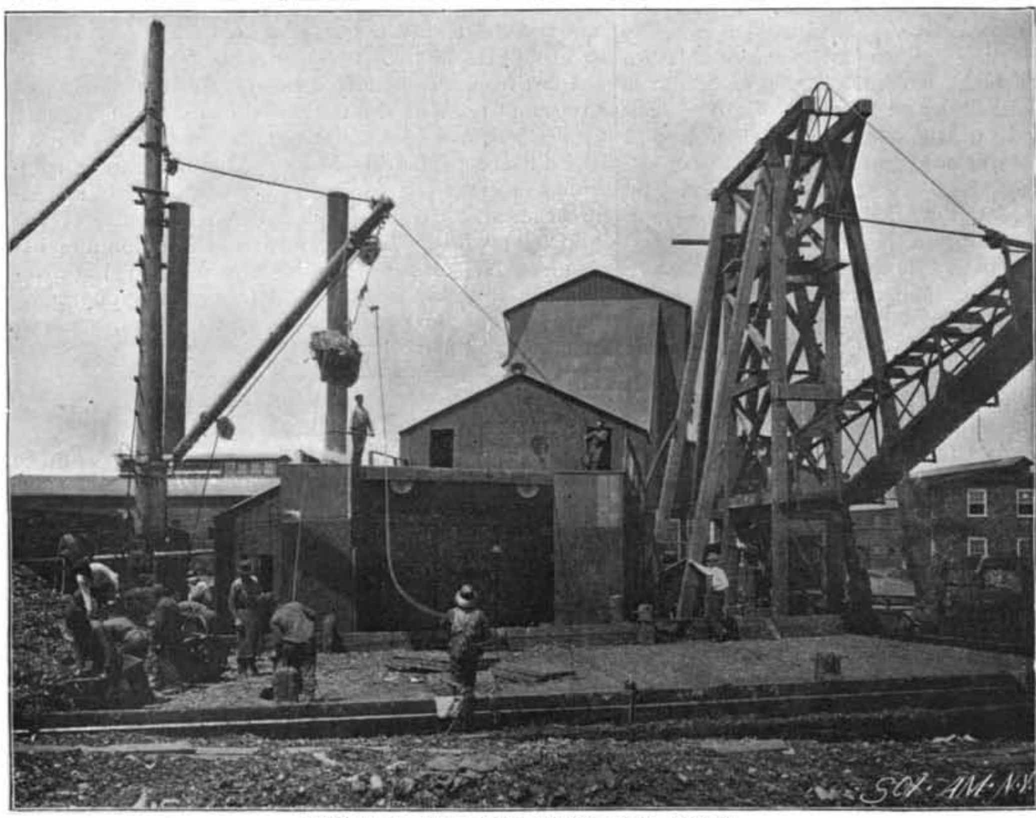
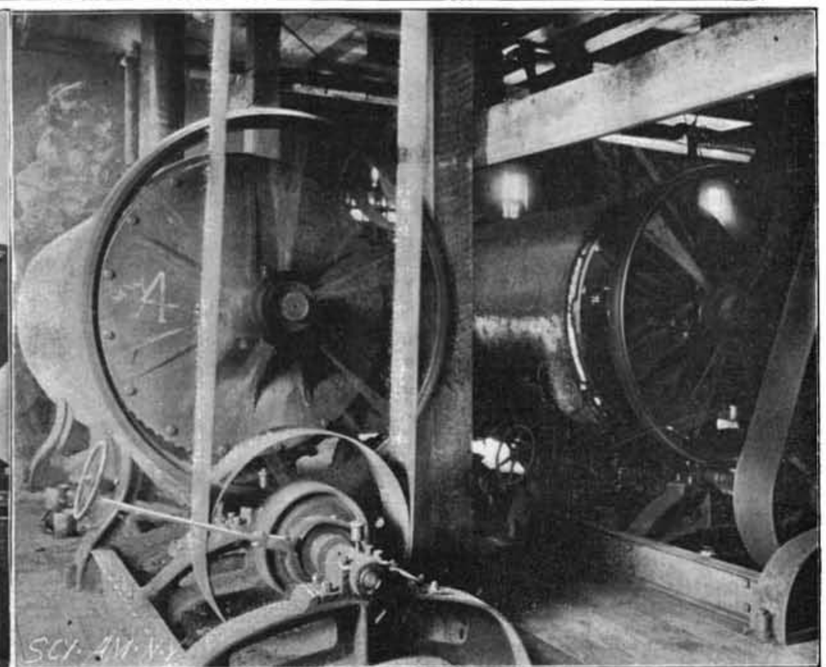
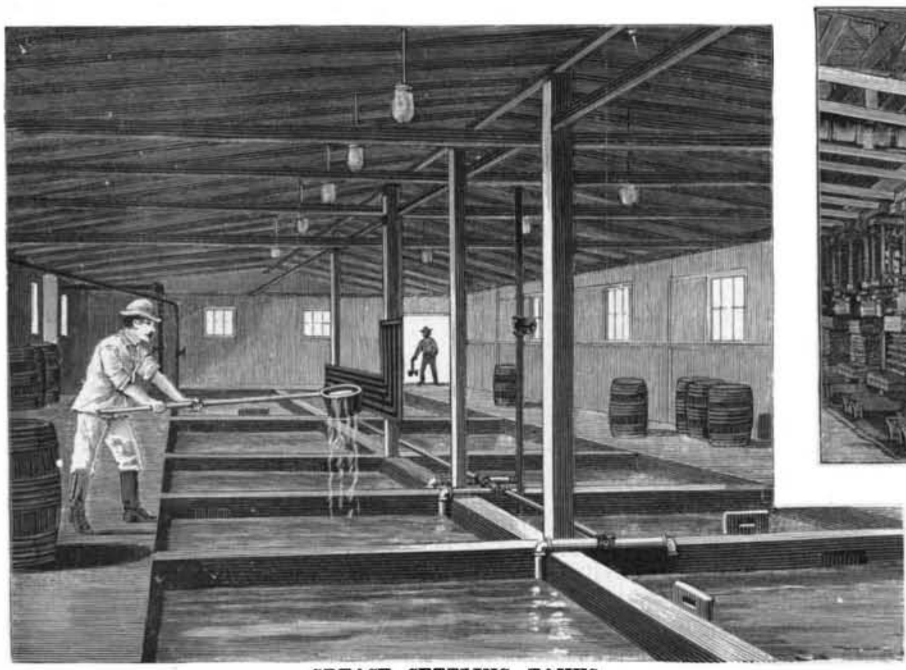


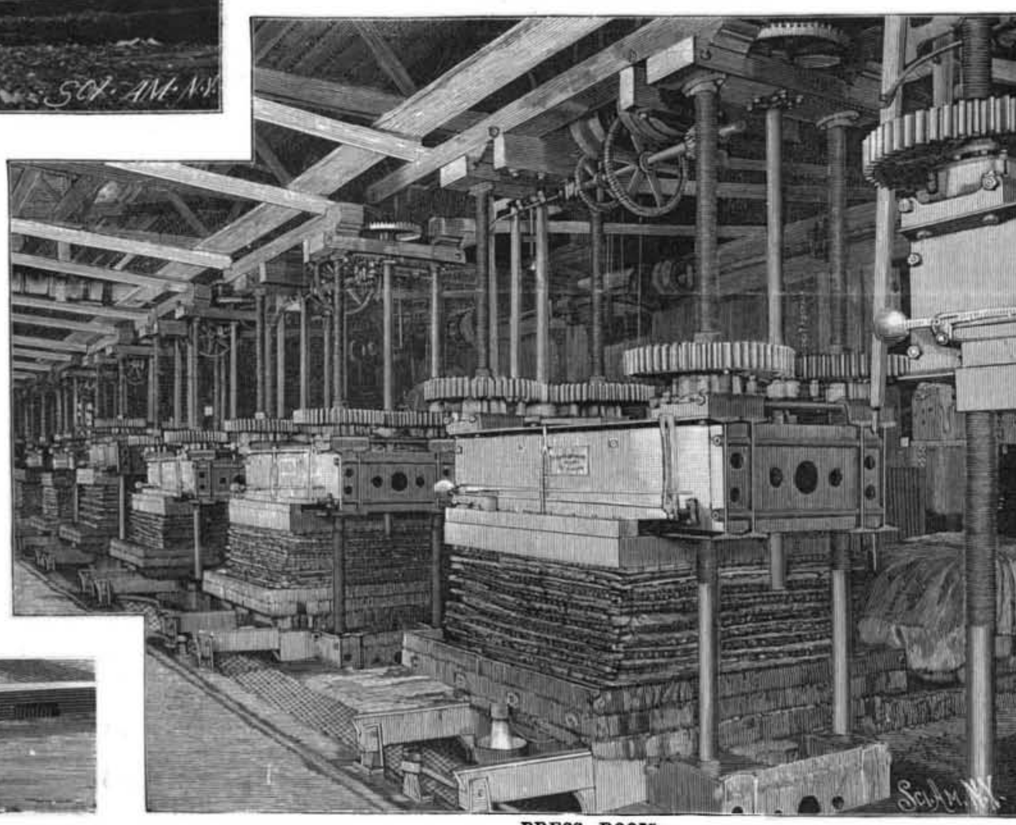
HOISTING GARBAGE FROM THE SCOWS.



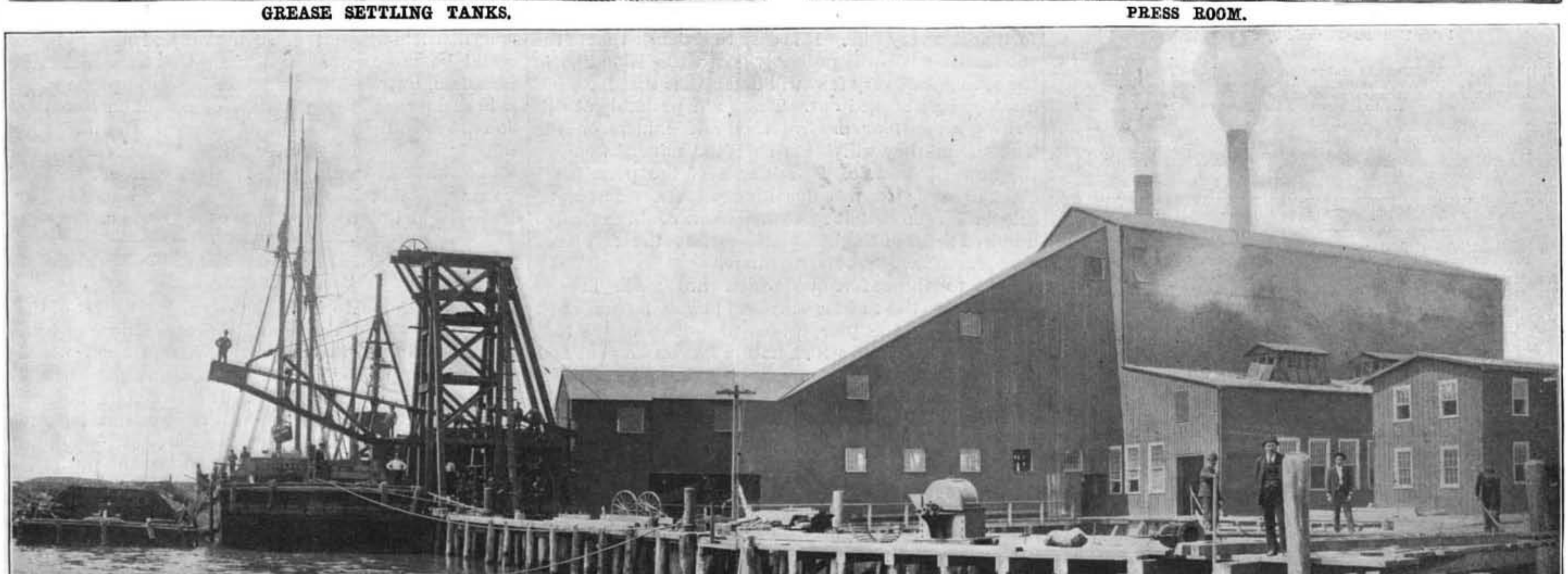
STEAM JACKETED DRIERS.



GREASE SETTLING TANKS.



PRESS ROOM.



EXTERIOR OF GARBAGE WORKS.

THE UTILIZATION OF NEW YORK CITY GARBAGE.—[See page 103.]