all the Bessemer steel works of Great Britain, nearly one hundred being in use in the city of Glasgow alone. In all, about one thousand are in use in England at this time, and a large number on the continent. By the aid of one of these machines Mr. W. Ireland, the noted iron founder, made a 250 tun anvil block, probably the largest casting ever made, melting the iron at the rate of thirty tuns per hour, and completing the entire work in a little over eight hours.

This blower received the highest award conferred on machines of this class at the Paris Exposition of 1867. We notice that it is on exhibition in the American department at the exposition now being held in Vienna. It has also received the highest awards for three years successively at the Fair of the American Institute of this city, and also the highest premium at all the industrial expositions held in the city of Cincinnati, Ohio.

For further information address the inventors and proprietors at Connersville, Ind., or S. S. Townsend, general agent, 31 Liberty street, New York city.

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END OF ANOTHER HALF YEAR.

With this issue a number of six months' subscriptions, which commenced with the year, will end. We hope all such subscribers will renew, and it will gratify the publishers if each would send a new subscriber. It is just as easy to remit $3 for two names for six months as half the amount for one name, and it suits the publishers much better. Remittance by postal order is the safest and best. Address MUNN & Co., 37 Park Row, New York city.

NECESSITY FOR SANITARY REFORM.

In another column of this issue will be found a continuation of our series of "Sanitary Notes," a paper on the subject of "Sewerage and Sewage," devoted mainly to a brief description of the various projects for the utilization of refuse filth, so as to transform it from a source of expenditure to one of valuable profit. In large cities the question of obtaining the fertilizing matter from the material, though in itself one of no small importance, is, owing to the vast quantities of the latter produced, subordinate to the problem of disposing of the noxious substance in such a manner that it shall not breed disease or nurture pestilence in the narrow and confined limits of thickly populated districts. It need not be pointed out that without an effective system of sewers, which not only convey away the filth but also form complete drains for every portion of the city, the removal of this waste is impossible. Here, where the main conduits are on a level below the high water mark of the rivers into which they empty, or are distorted to convey their contents (hypothetically) up hill, or where the branch sewers connect with mains set on a superior level, nothing else is to be expected than a stagnation of contents in the tubes, and in the former instance their reflux through the action of the entering tides.

Bad as such a state of affairs is, and pressing as is the invitation which it holds out to epidemic and zymotic diseases, it nevertheless obtains in New York and probably many other cities of which the growth has been proportionally rapid. Some of the daily journals, notably the *World*, have recently taken up the subject, and the information published is well calculated to arouse the citizens of the metropolis to a sense of the insidious dangers to which they are constantly exposed. The death rate from zymotic diseases alone averages 9,000 a year within the corporate limits, and the cases of sickness aggregate from the same period at least 100,000. It requires but a casual stroll through certain portions of the city to determine the reasons for this fearful mortality.

Probably the action of the tides, as above described, forcing the filth back and often out of the street culverts, is a prolific source of the miasm of the lower lying districts. It is but a few days since that, in passing through a street contiguous to the Hudson river, we ourselves observed that, after a heavy rain and at high tide, the gutters and roadway in the neighborhood of the openings were flooded over a considerable area, and to several inches deep, with a black, horrible liquid, in which, despite its disgusting odor, the street urchins were holding especial revel. For such glaring faults as this there is clearly no excuse, even if any in deprecation be admitted for the negligence to which the more hidden defects of the uptown sewers must be ascribed. Cellars are flooded, and the soil, permeated with filth, giving rise to deadly mephitic gases, makes the locality a hot bed for disease, originating that scourge of children, *cholera infantum*, and also the rheumatism, scrofula, fevers, and innumerable pulmonary complaints of adults. In the new and manufactured portion of the city, in the neighborhood of Central Park and above, the condition of matters, though less apparent, is not much better. Some years since General E. L. Viele published a map of Manhattan Island, showing the lead of the natural water courses and ponds, the beds of which, like that upon which the Tombs or city prison now stands, were quagmires and soaking bogs. This map disappeared, but was resurrected by the Citizens' Association in 1865, and from its topography the origin of the maladies prevailing in certain quarters is readily traced. Old marshes, which, in the overwhelming desire to raise grades and make streets, were filled up with sand and stone, have asserted their existence and converted the land into a sponge, absorbing the filth which flows from the faulty sewers. In the upper portion of our city, even at the present time, there are streets, raised far above the normal grade, enclosing lots on the bottom of which stagnant pools still exist; and we can recall localities which, now thickly built up, were, hardly ten years since, sites of skating ponds of considerable extent. This land, as well as whole districts indicated by General Viele's map as the former beds of water courses, is now covered with many of the finest residences in the city, the owners of which, though experiencing sickness in their families, little suspect the hidden cause to which the prevalence of disease is due.

We notice with gratification a revulsion of opinion against filling in, as a means of reclaiming ground from bogs and swamps. The health authorities of Brooklyn have already taken steps in another direction, and have appropriated funds to pump off the water from submerged land before raising the grade. This, we think, is the wisest course the Health Board can pursue. Burying a nuisance out of sight is not abating it, and merely covering up so formidable an enemy to public health renders it doubly dangerous by concealing its existence until it becomes recognized through its deadly effects. The pumping operations can be accomplished very expeditiously, while the filling up process takes a great deal of time; and the expensive nature of the latter, for material, labor, and cartage, would cost the city or the owners a much greater sum than that for which the property when filled in could be sold.

We need rapid transit, and our present system of docks is a disgrace to any civilized people; but great as are both our wants in this direction, they are exceeded by the urgent necessity which exists for a thorough overhauling and, if need be, entire alteration of our sewerage.

RENEWAL OF THE REWARD OF ONE HUNDRED THOUSAND DOLLARS.

The Legislature of the State of New York has recently renewed, for the period of one year, the offer of one hundred thousand dollars reward for improvements in canal navigation. This will be good news to scores of inventors.

The law making the offer of this large reward was originally passed in 1871, and the text thereof was given in the SCIENTIFIC AMERICAN of May 6 in that year. It provides for the payment of one hundred thousand dollars to the introducer of a plan, for navigating the Erie canal in this State, which shall prove on actual trial to be better and more economical than the existing method of towage by horses. The following are the chief requirements of the law:

A Board of Commissioners is appointed, consisting of George B. McClellan, Horatio Seymour, Erastus S. Prosser, David Dows, George Geddes, Van R. Richmond, Willis S. Nelson, George W. Chapman, William W. Wright, and John D. Fay, whose duty it is to practically test and examine all inventions that may be submitted to them, by which steam, caloric, electricity or any motor other than animal power can be practically and profitably applied to the propulsion of boats upon the canals. Such tests and examinations are to be confined to the season of canal navigation in the year 1873, and the Commissioners are required to demand that the competing inventions shall be tried practically upon the canals at the expense of the applicants; that the boat shall, in addition to its weight of machinery and fuel, be able to transport at least 200 tuns of cargo, be able to run at a speed of not less than three miles per hour, be easily stopped and backed by its own machinery, which should be simple, economical, and durable, and readily adapted to the present canal boats. Lastly, the law requires before an award is made that "the Commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation, and increase the capacity of the canal."

Quite a number of boats were tried last year on the canal; and in our paper of February 15, 1873, will be found a brief description of their construction and performances.

Individuals who propose to compete for the prize should bear in mind that it is not simply the propulsion of the boat ahead that is required. It is not only the propulsion, but the steerage, rapid and economical handling of the vessel when in the canal. It is easy enough to drive a canal boat in open water by steam power, faster and cheaper than by horse towage. But to do so in a narrow canal, where the stoppages are frequent, the water shallow, the delays considerable, the boats constantly passing or repassing or dashing into each other, crowding together, jamming fast, etc., is a difficult problem. Evidently the boat should be provided with a variety of appliances to meet and promptly overcome the various exigencies to which it is to be subjected. It should have power to move laterally as well as longitudinally, at the will of the commander, and should have facilities for quickly anchoring and getting under way. Inventors will do well, therefore, to turn their attention to other things besides the mere form of the propellers. These have been invented already by the hundred, and little or no advantage has been secured from any of them. A velocity of only three miles per hour is needed, and this the ordinary propelling devices will easily supply.

The dimensions and other particulars of the Erie canal are as follows: Depth, 7 feet; width at top, 70 feet; width at bottom, 56 feet; length, 345 miles; number of locks, 72. The locks are 110 feet in length over all, admitting boats 90 feet long. The width of the locks at the surface of the water is 18 feet, and at bottom 17 feet 4½ inches. The largest boats used on the canal are 96 feet long by 17 feet 8 inches beam, with a depth of 9 feet. Such boats draw 6 feet of water, and each of them carries 240 tuns.

COMETS.—THEIR CHARACTER AND SOURCE.

The spectroscope shows us that comets consist of a mass of carbon dust, so diffused as to make them bulky with little weight, and this explains at once the cause of the total absence of refraction of the light freely passing between those minute dust particles.

In regard to the question "whence these masses of dust particles came," Zöllner, whose observations and calculations we mentioned in a former article on the sun, holds that the solar eruptions throw up masses, consisting chiefly of hydrogen, ejected from the sun with a velocity of 133 miles per second. He comes to the conclusion that as thrice this velocity would carry material entirely beyond the limits of solar attraction, a somewhat less velocity would throw it to distances corresponding to those of the comets. He thinks, therefore, that comets originate from the sun, and are thrown out from that body finally to return thereto, just as volcanic material is thrown out from the earth and carried through our atmosphere, eventually coming down at remote spots.

Any doubt in regard to the possibility of the existence of such enormous projectile forces is removed by the actual observations of Janssen, Lockyer, and Respigbi. The latter says: "The solar surface is the seat of movements of which no terrestrial phenomenon can afford any idea; masses of matter, the volume of which is many hundred times greater than that of our earth, completely change their position and form in the space of a few minutes, showing motion of which the velocity is measured by hundreds of miles in a single second." Professor Young has observed a solar explosion of which the mean velocity, between the altitude of 100,000 and 200,000 miles above the solar surface, was 166 miles per second; as this indicates an initial velocity of 200 miles per second, it is sufficient to carry the projected matter beyond the orbit of the earth.

Schiaparelli, in the *Astronomische Nachrichten*, calls the comets "cosmical clouds." He says: "Cosmical clouds will always appear to us as comets when they pass near enough to the earth to become visible." The comparison is indeed striking; as watery clouds ascend in our atmosphere and float around the earth, so the fiery clouds from the solar surface ascend into planetary space and float around as comets. Both are raised by solar heat and are afterwards cooled.

It is possible that the hydrogen in the solar protuberances is at first so abundant that its spectrum overcomes the spectra of the other materials which it may hold, as it were, in solution; and that while being projected, it expands by its gaseous nature in the planetary space, leaving the carbon and other materials, as a mass of dust which slowly disintegrates by the disturbing influence of the solar heat, planetary attractions, and adhesion of the different particles, forming finally great numbers of small and dense masses, which will fly around the sun in the form of a belt; and when some of them at last come down upon the earth, we call them meteors. Schiaparelli further says: "Gradually the products of disintegration are distributed along the comet's orbit; and if the earth's orbit cuts this, the phenomena of shooting stars are produced."

Two interesting facts are connected with these views; one is that the position of some well determined meteor streams coincides with the orbit of a comet; the other fact is that recently chemists have extracted hydro-carbon from meteoric masses: indicating the hydrogen which the spectroscope shows to exist in excess in the solar protuberances, and the carbon which the same instrument shows to exist in excess in the comets.

A PERFECT VACUUM.

The ancient philosophers who defended the theory that "Nature abhors a vacuum" were greatly derided by their opponents; but modern research would seem to confirm their views. There is an anecdote that Galileo, who, as our readers know, lived in the seventeenth century, on being con-