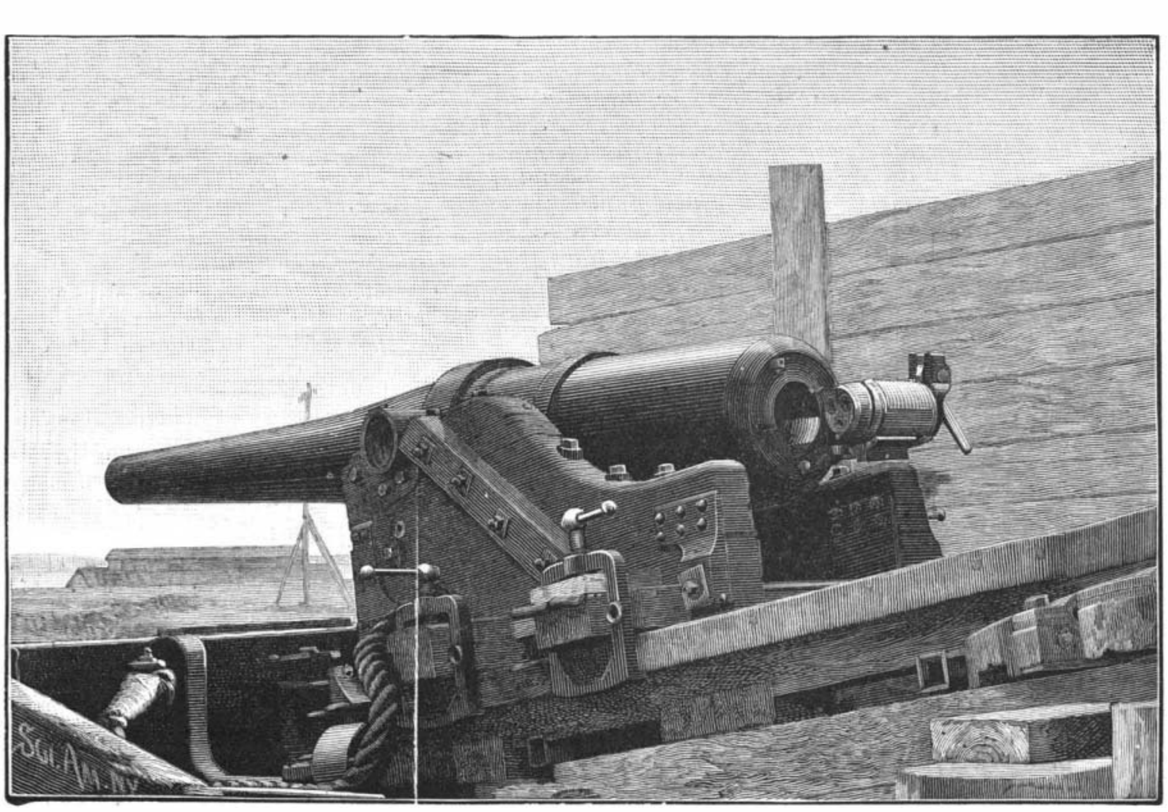
TEST OF THE CAST STEEL BREECH LOADING RIFLE OF OPEN HEARTH STEEL.

An act of Congress approved March 3, 1887, appropriated $20,400 for the purchase and completion of three rough-bored and turned steel cast 6 inch guns, one to be of Bessemer steel, one of open hearth, and one of crucible steel. One gun of Bessemer and one of open hearth steel have been finished, but no proposals for a crucible steel gun have as yet been received by the navy department. These castings were to be of domestic manufacture, of best quality of raw material, uniform in quality and free from all imperfections of casting. The guns were to be of one piece, except the trunnion band, if so desired, and they were not to be forged.

The test and bursting of the gun of Bessemer steel was described in our issue of December 29, 1888. The second gun, of open hearth steel, has recently been tried at the proving ground, at Annapolis. In external appearance it differs from the former gun in having a trunnion band of cast steel screwed on, instead of having its trunnions cast solid with the rest of the piece. It also has a slightly greater diameter across the cylinder or breech, and is nearly three thousand pounds heavier than the Bessemer steel rifle. The gun was cast, rough-bored and turned by the Standard Steel Casting Company, of Thurlow, Pa., and was finebored, chambered, and rifled at the gun shops at the Washington navy yard. As in the case of the Bessemer steel gun, the interior work shows most creditable machining by the government workmen at the navy yard. The interior profile was made exactly the same as that of the service 6 inch rifles of Bureau of Ordnance design, so that direct comparison could be made of ballistic results from the two classes of guns. The naval built-up gun is considerably lighter than the cast steel gun, its weight being about 10,800 pounds, as against 13,125 pounds for the Thurlow gun.

The physical characteristics of specimens from this casting are quite uniform. With the eight specimens experimented upon, the ultimate tensile strength varied from 79,246 pounds to 81,334 pounds, the elastic limit varied from 36,414 to 38,961 pounds, while the elongation ranged from 19·10 to 27·85 per cent.

As will be seen from the plan of the gun, the breech is a cylinder, while forward of the trunnions the profile of the chase and muzzle slope away in a curve of such a trend as to make the resistance of the gun at any point correspond with the ordinate of the pressure curve at that point. The breech is closed on the interrupted screw system used in most breech-loading guns. The De Bange pad seals the joint between breech plug and gun chamber, preventing any escape of gas to the rear, and the front face of the "mushroom" or nose plate is fitted with the housings of three gauges for recording the gas pressure in the chamber of the gun. The following are the principal dimensions of the gun:



RECENT TEST OF 6 IN. CAST STEEL BREECH LOADING RIFLE.

Length	193·5	inches.
Length of bore in calibers	30	cals.
Diameter across breech	22·2	inches.
" of bore across lands	6·0	"
" " powder chamber	7·5	"
Capacity " " "	1,400	cu. in.
Twist of rifling—increasing from 1 turn in 180 calibers to 1 turn in 30 calibers at muzzle.		
Weight of gun	13,125	lb.
" " projectile	100	"
" " powder charge	48¼	lb.

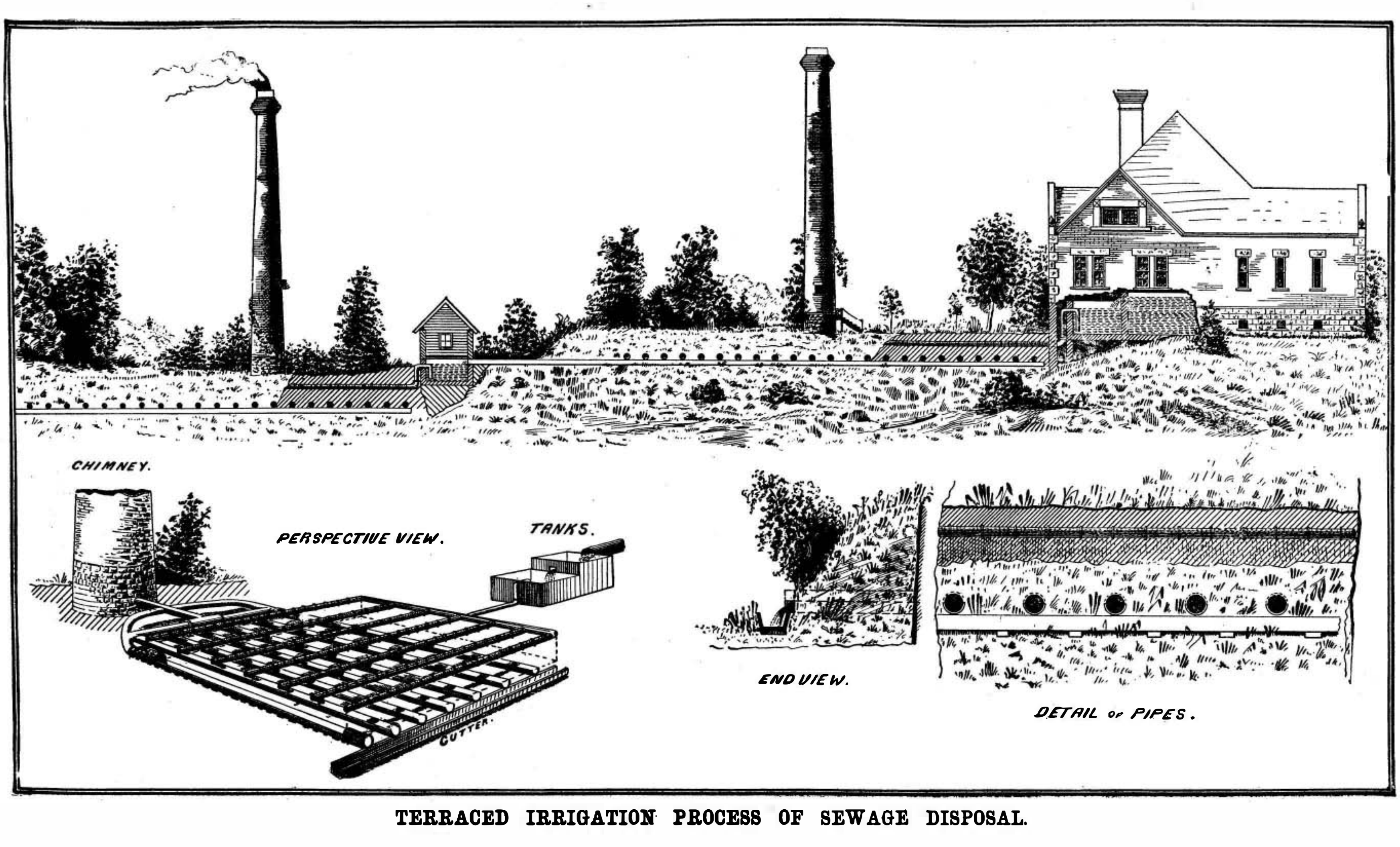
There are 24 lands and grooves, the rifling being of a modified ratchet system. The projectile is fitted with a soft copper band near its base, of a diameter greater than that of the bore across grooves. When the gun is fired, the band is forced into the rifling as the projectile moves down the bore, and thus the necessary spin is given the shell. The projectiles were the common cast iron shells, cored for a bursting charge of five pounds of powder; but in tests of this kind at the proving ground the shells are not filled with powder, being brought up to the standard weight (100 pounds) with sand.

The powder used in the trial was the regular naval 6 inch gunpowder, manufactured by Messrs. Du Pont, at Wilmington. It is known as brown prismatic or cocoa powder, from its color, and is pressed in hexagonal prisms one inch high, each prism pierced with a quarter inch hole in its axis for ignition. Ten grains weigh one pound, the specific gravity being about 1·825. One of these grains, if ignited in the open air, will burn for eight or ten seconds before being consumed; but when under pressure, as in a gun, its rate of combustion is very rapid, although slow compared to that of ordinary black powder, which is not used for high powered guns, being far too violent and irregular in its action.

The charge of 48¼ pounds is known as the full service charge for naval 6 inch guns, and from a long record of firing at the proving ground can be depended upon to give a 100 pound shell a velocity of 2,000 feet per second, with a pressure in the gun chamber of about 15 tons to the square inch. The test ordered by act of Congress was to include ten of these full charges, delivered from the gun as rapidly as possible. Preparatory to the firing trial, the gun was mounted on an old-fashioned wooden carriage, with the slide inclined upward to the rear, so that the piece would run to battery again after its recoil. Recoil was controlled by friction compressors on the sides of the carriage, set up with screws, and a stout hemp breeching, with rubber buffers in rear. Bomb proofs were provided for officers and gun servants, and heavy bulkheads or traverses of timber and sand bags protected the other guns and carriages on the platform from injury from flying fragments.

The trial took place on February 7, 1889, and was under the direction of Lieutenant-Commander J. H. Dayton, Inspector of Ordnance in charge of the Proving Ground, assisted by Lieutenants F. A. Wilner and V. S. Nelson and Ensign R. B. Dashiell. Many naval officers from the Academy and representatives of the steel casting company and of the press were present.

Before the rapid fire test with ten rounds, two rounds with reduced charges of 36 pounds were fired



TERRACED IRRIGATION PROCESS OF SEWAGE DISPOSAL.

to set the gas check and warm the gun. These charges gave pressures from previous records of about 11 tons to the square inch. When all was ready, ten rounds, with full charges and projectiles, were fired rapidly, the ten shots being delivered in 19 minutes and 8 seconds.

The gun stood the ordeal without rupture, being the first American high-powered cast steel gun that has endured a full charge firing test of ten rounds. Whether the piece has been injuriously enlarged or strained in the trial, extended experiment alone can show.

TERRACED IRRIGATION PROCESS OF SEWAGE DISPOSAL.

T. O'CONOR SLOANE, PH.D.

The problem of sewage disposal cannot as yet be said to be adequately solved. In England, sanitarians propose new methods of treatment continually. Disinfection by chemical treatment, precipitation of the solid matter by mechanical deposition, or its removal by filtration have all been tried in every conceivable modification. Even electricity has been called in, and the electrolytic treatment is now exciting considerable attention. It is possible that a wrong conception underlies these attempts. A perfect method seems hardly realizable. Different circumstances make each case individual, and exact individual treatment.

For small systems, the subsoil irrigation method has, up to the present, met with perhaps the greatest success. Under proper conditions, it is quite inoffensive, and can dispose of large quantities of fluid. Its general principle involves the sudden and periodical delivery of the more liquid portions of sewage over a large area of ground about eighteen inches beneath the surface. The liquid matter is disposed of in three ways. A part is absorbed by the roots of the vegetation covering the soil. This portion naturally varies in amount, and in summer is far greater than in winter. A second part evaporates, after penetrating the overlying soil. A third part sinks into the subsoil.

To make the system work well, a piece of ground not too depressed must be chosen, in order that this drainage of the third portion, as specified above, may be effectual. If the soil is saturated with natural moisture, it will not answer as a filter bed. In such a case, subsoil drainage pipes must be put in below the irrigation system. The water collected by the subsoil lines will be more or less purified by the downward filtration. It will be diluted by natural water so as to be less offensive, and in many cases it can be delivered to the natural overground water courses without perceptibly polluting them. If the stream or river ultimately receiving the outflow should be in some degree polluted, it will, sooner or later, become pure again from the effects of aeration. Simple contact of running water with the air tends to purify it from offensive matter. The more broken the course of the water, and the thinner the sheet in which it is exposed to the air, the more effectual will be its purification for a given distance or time.

All these principles and methods are utilized in the arrangement here illustrated. The Waring or subsoil irrigation disposal is the basis of the work. The system is represented as applied to providing a sewage works for a small village or community.

For the sewage farm and disposal works, a piece of ground should be chosen that is lower than any of the area included in the sewer or drainage system. The field or farm must vary in level; one portion must be at least five feet lower than the other, a greater difference being desirable. This is easily secured by having a reasonably large piece of ground devoted to the work. Some kind of surface drainage—a stream or river is best—should be obtainable near at hand.

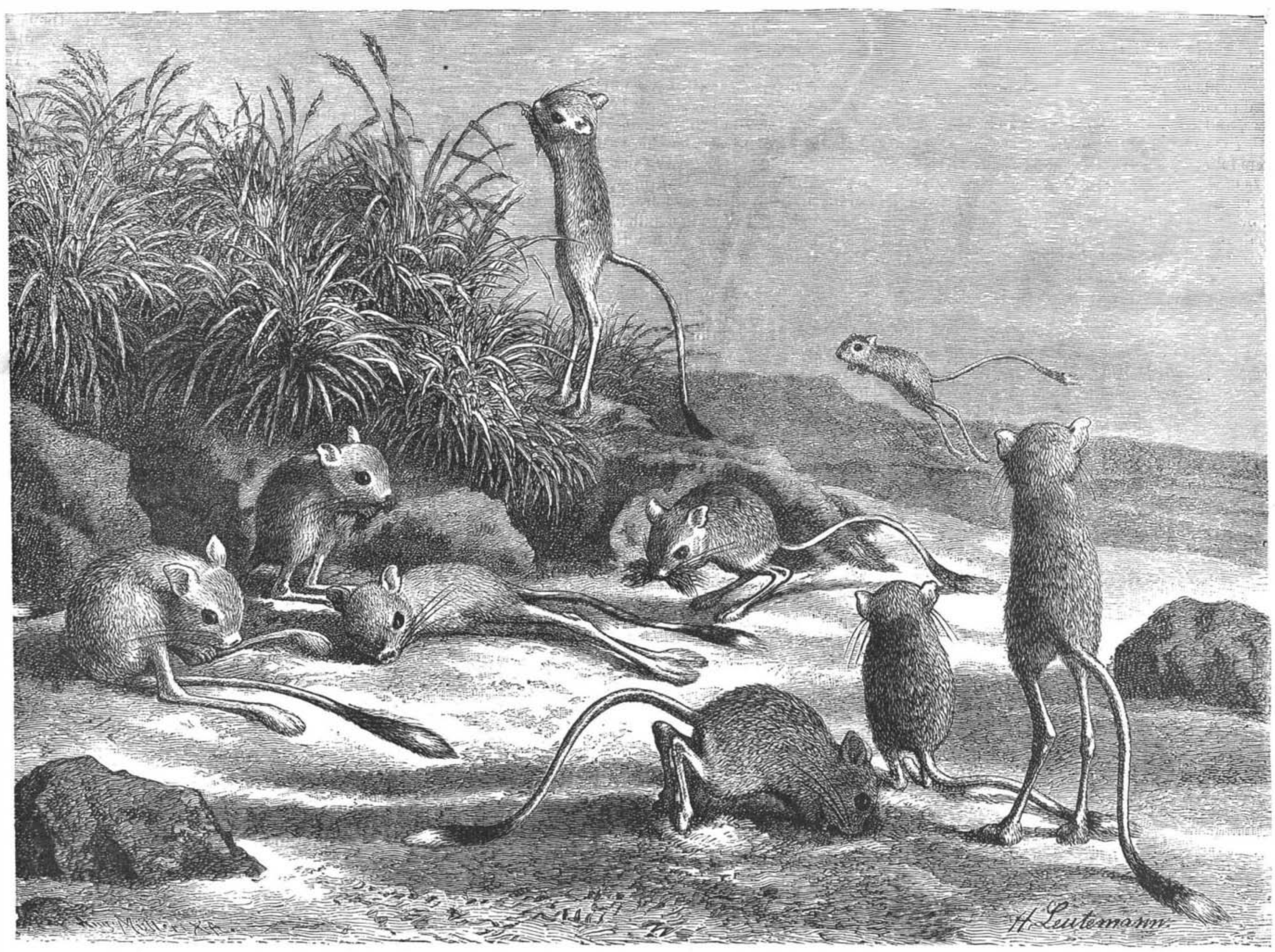
The sewage is received in a settling tank. In this receptacle it may be treated with chemicals, or it may receive them before entering. If in an isolated locality, the natural precipitation may suffice, the chamber containing the tank being properly ventilated. The principal object of chemicals would be to deodorize it. From the settling tank it overflows into the siphoning tank. From this it is periodically discharged by a siphon of any of the well known types. The liquid matter runs into the sub-surface perforated irrigation pipes, and is distributed through the soil.

Where a systematic sewage disposal is the whole function of the area, plants can be selected for cultivation upon the sewage bed that have the greatest power of assimilating water. Red clover is a good instance, as its roots penetrate very deeply. Perennial or hardy crops might exercise a good effect, even in winter. No attempt should be made to obtain a paying result. The disposal works should be treated as a subject of expense, not of profit.

Three to five or more feet under the sub-surface pipes, a set of regular subsoil drainage pipes are placed. These are represented in the illustration as crossing the others at right angles, though the relative disposition is really immaterial. At one or more places the higher ends of these pipes are connected to a high chimney. This maintains a continual aeration of the pipes and water flowing through them. If necessary, a fire may be maintained in the base of the chimney to increase the draught. The lower ends of the drain pipes deliver their flow to a conduit. These ends must be unobstructed and open, and in laying the lines care should be taken to preserve an even pitch of considerable degree, so as to prevent the possibility of the formation of traps. The air which the chimney will draw through the pipes will play an important part in purifying the drainage water.

The diluted and filtered and partly aerated sewage water collected in the conduit is conducted to a low level siphoning tank, which delivers it to a second irrigation bed. There it is subjected to a repetition of the treatment just described, including the three purifying elements of filtration, aeration, and dilution. The water finally delivered to the low level conduit will be comparatively innocuous. It will have been twice filtered, aerated, diluted, and acted on by vegetation and humus. Its purification will have progressed in something like a geometrical proportion.

It will be observed that the above description refers to the disposal of the liquid matter. The removal of solid matter is the simplest part of the problem, and can be effected in any of the well known ways. When the aqueous portions of sewage are disposed of, nine tenths of the problem is solved.



THE JERBOA—[DIPUS ÆGYPTIUS LICHTST.]

THE JERBOA.

In the diluvial strata of clay at Thiede, near Wolfenbuttel and Westeregeln in the peat district of Magdeburg, Nehring found many fossil remains of the jerboa among other rodents of the plain, and also, as comparison with modern skeletons proves, of a kind of jumping rabbit which is identical with the *Alactaga jaculus Brdt.*, still found in the steppes of southwest Siberia and Central Asia. This proves that in the so-called post-glacial period the North German plain, as far back as the mountains of Central Germany, presented the same general character as the steppes, and had a Continental climate; that is, a hotter summer and a colder winter than at the present time. But it is not probable that the coast of the European continent then had its present form, to which the North German plain owes its moist and mild climate. Europe, especially the western part, must then have been connected with the northern part of Africa, forming a compact continent. Later changes in the divisions of land and water were caused by upheavals and sinkings of the surface of the earth, the sea making a deep impression in the European-African continent. The result of this