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.

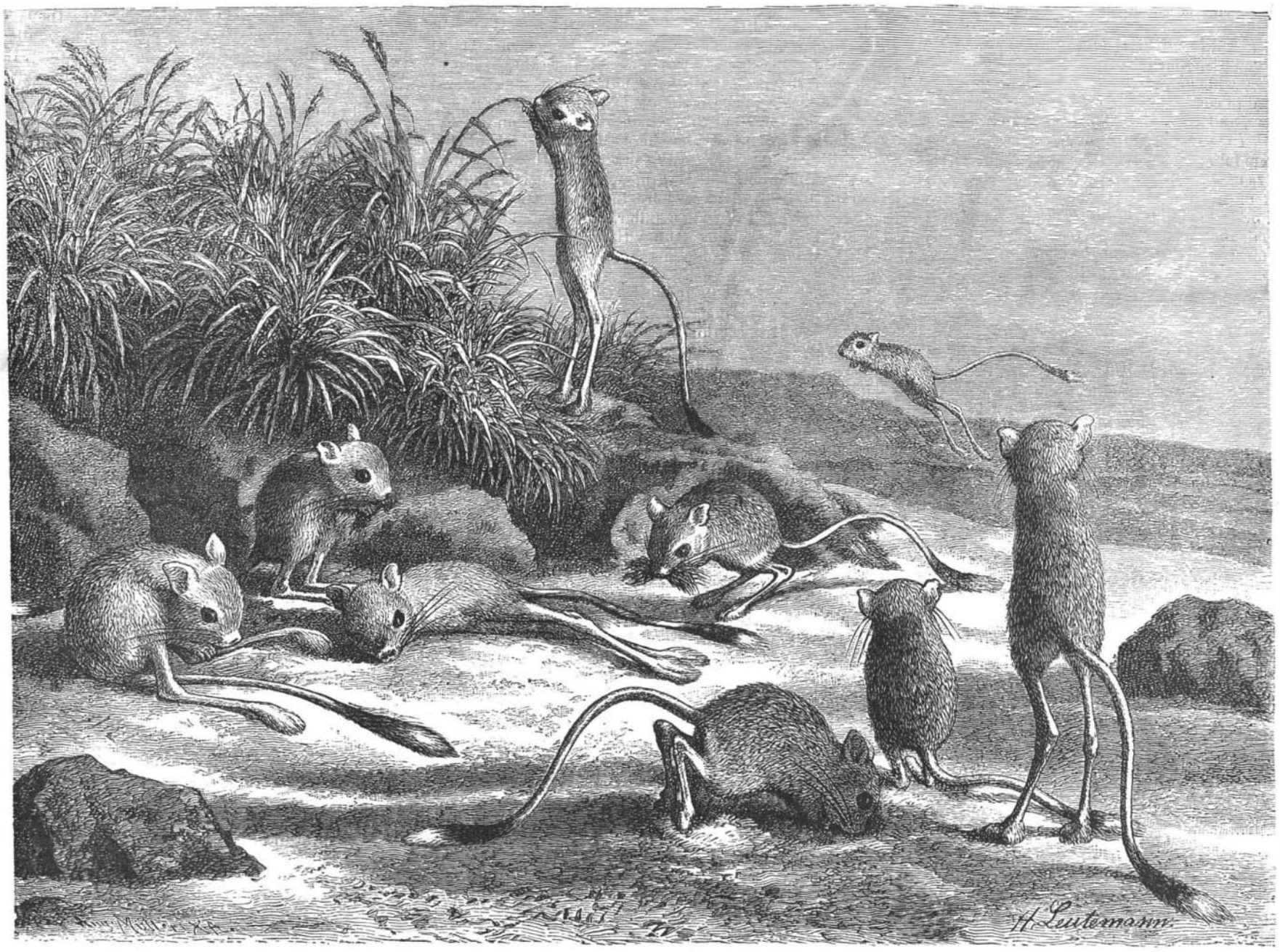
The sewage is received in a settling tank. In this receptacle it may be treated with chemicals, or it may receive them before entering. If in an isolated locality, the natural precipitation may suffice, the chamber containing the tank being properly ventilated. The principal object of chemicals would 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