Gravity System.—This consists of the excavation of channels, outfalls, laterals, and sub-laterals leading to some arranged point or points of final discharge. The necessary tide and flood gates forming a component of the scheme are constructed either of timber or concrete. Generally the same system is world-wide, but many small features—in the aggregate large—were observed, and will be utilized as opportunities occur in our own practice.

Salt-marsh Drainage.—The amount of work done in this connection is quite trifling compared with gravity drainage proper. The systems closely resemble each other, but much greater precision has to be observed, and these undertakings are rather shied at. Their success depends on a good range of tides being available, secure, impervious levees, and really good tide-gates or sluices. Observations made on ground lead one to the conclusion that, given a good range of, say, 8 ft. between mean low- and mean high-water marks, marsh land at, say, mean level can be successfully dealt with. The drainage of areas with less range than above mentioned has not been an unqualified success by any means, and has in some cases been subsequently assisted by pumping.

Drainage by Pumping.—Very considerable areas throughout the United States have been reclaimed by pumping. The Mississippi Valley offers many examples of areas of from 1,000 acres up to 7,000 acres. Apparently the latter area is a good size to handle. In Louisiana several drained tracts were visited, and the inspection was very satisfying.

In North Carolina a very large tract, now known as New Holland, but locally as Lake Matamaskeet, was visited, and proved most instructive. The total watershed, comprising lake and foothills, is about 100,000 acres. The lake, originally 3 ft. to 5 ft. deep, is to be drained completely, and was at date of visit practically non-existent. The pumping plant is capable of handling 1,800 cusecs, and comprises the latest centrifugal pumps, which are steam-driven. The pumping plant cost £50,000; annual maintenance, £10,000.

Areas were also visited in Sacramento Valley, California, it being observed that the general lay-out of pumping plants and areas was similar to those seen in Louisiana. The majority of schemes have low pumping-heads. In addition, the huge pumps in use in New Orleans, known as the wood-screw pump, were seen. They are 12 ft. in diameter, and have a capacity of 800 cusecs each. These pumps are for low heads, and came into use during times of continued heavy rains, and control the drainage of many miles of country surrounding New Orleans.

Exceptional precautions have to be taken in designing pumping units and lay-outs. The practice universally adopted is for the engineer to prepare all hydraulic data, amount of power available, the special features of the job, &c., and then invite quotations from manufacturers of pumps for a suitable installation. This results in obtaining guaranteed efficiency plants. The practice of allowing the civil engineer to design the plant is entirely discouraged, and rightly so. Great development has taken place in connection with low-lift pumps, and is ever increasing.

Tile Draining.—In many parts of the United States tile draining is rapidly coming to the front, and its use has been most successful. Open ditches are a disability to any farm, and their maintenance is a continual worry and expense. Then again, a smooth tile will discharge water with much less friction than is possible with an open ditch. Open ditches formerly 6 ft. deep have been replaced with tiles of 48 in. diameter, and then the old ditch backfilled. There can be no doubt of the advantages of the system. Pipes of 36 in. diameter were observed running 75 per cent. bore.

Tiles are variously of clay, cement, vitrified sewer-pipe, or segmental block. Necessarily, this system is very expensive as to first cost, but, on the other hand, maintenance is eliminated, and the absence of open ditches can be appreciated.

Tile-laying machines are extensively used, and are generally very efficient. For backfilling of trenches various machines or horse scrapers are used.

Tile costs are shown in accompanying sheets of costs data.

Excavation of Channels and Ditches.

The excavation of all ditches is performed—for at least 90 per cent.—by machinery. The following machinery is standard practice:—

Floating dipper dredge	¾ to 8 cubic yards capacity.
Floating grab or clam-shell dredge ..	¾ to 6 „
Dry-land dipper excavator	½ to 2 „
Dry-land grab excavator	¾ to 2 „
Drag-line scraper excavator	¾ to 3 „
Hydraulic suction dredge	10 in. to 24 in. suction and delivery.

Dipper Dredges.—Floating dredges of dipper type are undoubtedly the best diggers of stiff clay seen, and are deservedly popular on account of their performances as to output and economy. Fully 80 per cent. of drainage-channel excavation in the eastern States is done by dippers of various makes. The bucket capacity varies from ¾ cubic yards to 8 cubic yards, but in general ditch-work the average would be about 2-cubic-yards capacity. Their performances were noted under conditions such as exist in New Zealand. The heaviest dredges were seen at work in the Everglades, Florida, but they were engaged in excavating coralline limestone from large canals.

Clam-shell Dredges.—In the west (California) the grab or clam-shell floating dredge is the favourite, and does remarkably good work. Machines fitted with booms 240 ft. long and carrying