THE KIDNEY worm of swine, Stephanocephalus dentatus, used to be considered of economic importance only in swine raised in the Southeastern States.

Surveys in 1947, however, disclosed that 20 to 40 percent of the livers of the general run of hogs sent from the Corn Belt to the meatpacking plants showed damage that was attributed to kidney worms. Kidney worms also have been found in pigs originating in Massachusetts, Kansas, Nebraska, and central Washington. They have caused estimated annual losses of more than 72 million dollars.

Kidney worms attack swine almost exclusively, but they occasionally occur in cattle.

The mature worms are 1 to 2 inches long and have a rather thick, black and white body. They usually live in cysts, or pockets, along the walls of the ureters (the tubes connecting the kidneys with the urinary bladder) and in the kidney. A female that happens to be in a cyst near a ureter pierces its wall and deposits its eggs in the opening. If she is in the kidney, she deposits the eggs in the ducts there.

In either instance, the eggs are swept into the bladder and are voided with the urine. If they fall on warm, moist soil, where they are protected from direct sunlight and from drying, they hatch in 18 to 24 hours into very small, free-living larvae, which are not infective. In another 3 to 5 days, under favorable conditions, the larvae undergo two molts and then can infect pigs.

As one infected pig may pass a million kidney worm eggs in a day, a pasture or hog lot can soon become heavily infested.

Pigs become infected with kidney worms in two ways—by swallowing the larvae while feeding on or rooting in infested soil and by lying on infested soil—the larvae, stimulated by the warmth of the pig's body, are able to penetrate its unbroken skin. After gaining entrance into the pig, whether by way of the mouth or by the skin, the larvae begin their migration through the body.

The larvae that are ingested penetrate the intestinal wall and presumably are carried to the liver by way of the blood stream; most of them leave the blood vessels and invade the liver. They damage the liver tissue and produce hemorrhages, which are visible on its surface just beneath the transparent capsule that encloses it. When these injuries heal, the liver becomes badly scarred, and the lesions appear as hard, grayish areas of varying sizes and shapes.

The unhealed or incompletely healed liver injuries are far more unsightly than the healed lesions. The latter usually no longer contain worms, but the unhealed lesions are soft and contain pus and live, dead, or degenerated worms. The entire liver may be covered also with a fibrinous deposit and may adhere rather firmly to the stomach and diaphragm.

Some of the larvae may leave the liver and invade other parts of the body. Immature kidney worms have been found in the body cavity, lungs, kidney fat, various blood vessels, the loin and other edible muscle tissue, and the spinal cord.

Larvae that enter through the skin invade adjacent tissues and blood vessels and become as widely distributed throughout the pig's body as those that entered the digestive tract.

Most of the larvae die in the pig's organs and tissues before they attain maturity. Usually they form abscesses wherever they happen to be. Some of
the parasites can migrate to the region of the kidney and ureters, where they mature and mate and the females deposit their eggs. The period necessary for the worms to attain egg-laying maturity is about 6 months to a year from the date of infection.

The economic losses due to kidney worms (estimated at more than 72 million dollars a year) are of two main kinds—those occurring on the farm and those sustained when the pigs are marketed.

The first group includes losses resulting from unthriftiness, from the additional cost of labor and feed necessary to bring a parasitized pig to market weight, and from the death of pigs because of gross parasitism.

The second group of losses results from lower market prices because of damage done to otherwise edible parts of the carcass.

An example of the losses due to unthriftiness and increased consumption of feed is a report that uninfected pigs gained 30 percent more weight than their infected litter mates and that infected pigs gained about one-half pound less a day than their uninfected litter mates during the growth period.

In meatpacking plants, all parts of the carcass in which kidney worms are found or which show evidence of damage due to the migration of the parasites are condemned entirely or are trimmed so as to remove the damaged parts. The condemnations may run as high as 66 percent of the kidneys and 94 percent of the livers of pigs from farms where infestation is heavy. Condemnations of the loins and hams are somewhat less, but the overall damage to the hog carcass caused by kidney worms has been estimated to be as much as 50 cents a hundredweight of live weight.

No satisfactory treatment has been devised for removing kidney worms after they have established themselves in the pig’s body. They cannot be reached by drugs or chemicals administered by mouth, and no chemical has been found that can kill the parasites without harming the pig.

Kidney worms can be controlled, however, in a number of ways.

Eggs of the worms and the larvae are quickly destroyed by exposure to direct sunlight, drying, low temperatures, and moderate degrees of heat.

If pastures grazed by pigs that pass eggs of kidney worms in their urine are planted so that the amount of soil surface exposed to sunlight is increased, the number of larvae surviving to the infective stage can be reduced greatly. That can be done by planting the forage crop in rows instead of sowing broadcast. Another way is to plow a bare strip about 3 feet wide inside the fence around the lots used by grazing pigs and place the shelter and feeding and watering equipment in places bare of vegetation.

The infective larvae can crawl from the soil to blades of grass or other herbage when the vegetation is wet with dew or rain. Their chances of being picked up by grazing pigs thus are increased. The use of forage plants with leaves that can be grazed several inches above the soil surface has the effect of reducing the number of larvae ingested by the pigs.

Several months may elapse before infected pigs pass eggs of kidney worms in their urine. Gilts farrowing their first litters may pass few eggs at farrowing time, but older sows from the same herd often pass large numbers of the eggs. By restricting his breeding herd to young sows farrowing their first litter, therefore, a farmer should be able greatly to reduce reinfection of the pastures.

The infective larvae that are not exposed to sunlight, drying, and extremes of temperature may survive 6 months or more on pastures. They also can survive and remain infective for a month or more when ingested by common earthworms.

Attempts have been made to use chemicals to kill the eggs and larvae in the soil. All of the methods tried have
been expensive, and the chemicals have been difficult to apply effectively or have harmed the vegetation.

Methyl bromide, a gas used to destroy nematodes in soil, destroys larvae of kidney worms to a depth of 12 inches in loose, sandy, loam soil. It is applied in the airspace between the soil surface and a layer of vaporproof paper placed immediately above it and is allowed to remain for 24 hours.

Commercial benzene hexachloride and the delta isomer destroy preinfec-
tive larvae in laboratory cultures, but its effectiveness on larvae in soil is un-
known.

Polyborate, a mixture of sodium pentaborate tetrahydrate and sodium tetraborate pentahydrate, applied dry or in solution to soil at the rate of 5 pounds of the chemical per 100 square feet, has been used experimentally to destroy larvae on small plots, but it was found to be injurious to vegetation and could not be used on pastures.

It appears, then, that any plan of control must be based on the suscepti-
bility of the eggs and larvae to sunlight and drying and on the relatively small numbers of eggs in the urine of gilts farrowing their first litters.

Good feeding and management also help to minimize the direct effects of kidney worms on infected pigs, as they build up the general health of the herd.

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The Large Intestinal Roundworm

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LARGE intestinal roundworms are pinkish worms about as thick as an ordinary lead pencil. The mature females may be about a foot long. The males are smaller and have curved tails. The adults normally live in the small intestine but may wander into the liver and elsewhere.

About 7 of every 10 pigs and 1 of every 3 hogs of breeding age on farms may have these parasites in the gut.

Commonly known as ascarids, large intestinal roundworms cost hog raisers of the United States an estimated 50 million dollars a year. Those losses result chiefly from unthriftiness and death of young pigs. They can be avoided to a large extent by good live-
stock management and treatment with approved remedies at the proper time.

Farmers combat ascarids and other parasites when they follow good hus-
bandry practices—sanitation, proper feeding, pasture rotation—which tend to protect pigs against infection and help them to withstand the injurious effects of the parasites they do acquire.

Pigs become infected with ascarids by swallowing the eggs. Each female ascarid may lay 250,000 eggs a day. These microscopic eggs pass from the pig's intestine with the droppings. When they reach the outside, they are in an early stage of development and are not infective. Within a few weeks, especially when the weather is warm and the eggs remain moist, a tiny worm develops inside the egg shell.

The eggs are then infectious to pigs. The eggs have thick, tough shells.