Not all antibiotics are free from toxcity however. The polymyxins, for example, have considerable renal toxicity, which definitely limits their use.

A disturbing and increasingly dangerous practice of giving antibiotics promiscuously for almost any and all kinds of sickness has become increasingly common in recent years when many antibiotics became generally available.

Some susceptible strains of disease-producing bacteria, especially staphylococci, may develop a total resistance because the antibiotics are improperly used. It has become apparent that when an antibiotic is used promiscuously in any given community or hospital, resistant strains of staphylococcic bacteria can be found in a significant portion of the animal or human population.

The appearance of a disease germ during antibiotic treatment may be a major tragedy for a patient, but it will have little significance for other animals if the patient is properly isolated. Resistant germs, if they are to assume great significance, must be spread from a sick animal to other susceptible animals. Therefore the population of antibiotic-resistant disease germs in a herd or flock is directly proportional to the number of carrier animals and susceptible animals and to the frequency and intimacy of contact between the two groups.

Many persons have relied too much on antibiotics to control diseases. Under such circumstances it is natural that there should be concurrent laxness of hygiene and management of animal patients. Before we can take full advantage of antibiotic therapy, there must be renewed emphasis on isolation of the sick animal, with feeding and management measures that decrease the transmission of antibiotic-resistant organisms from patient to patient and from carrier to patient.

Antibiotics must be used cautiously, or their value will be lost. On the other hand, no patient should be deprived of the benefit of antibiotic therapy solely because of fear of inducing resistance in the disease germ.

L. MEYER JONES *is professor of veterinary pharmacology in Iowa State College. He formerly was a fellow of the Research Council of the American Veterinary Medical Association and a Fulbright lecturer in pharmacology in Tierärztliche Hochschule in Vienna.*

The Sulfa Drugs

L. MEYER JONES

THE SULFONAMIDES were discovered in 1935. They have been as important in controlling bacterial diseases in animals as in man.

Despite the subsequent introduction of the more effective and less toxic antibiotics, the sulfonamides continue to be widely used in the treatment of certain animal diseases because many domestic animals individually are of low economic value and must be treated as members of a herd or flock. Mass treatment in most instances involves giving the drug in water or ground feed. The sulfonamides possess greater physical and chemical stability than do the antibiotics and are more adaptable to mass treatment in the control of diseases in animals.

The sulfonamides are produced by

chemical synthesis, and are stable white powders, which may be mixed in animal feeds or compressed readily into tablets for administration by mouth. They are sparingly soluble in water and in the fluids of the body. The low solubility sometimes leads to difficulty in eliminating the drug in the urine.

Sulfanilamide was the first of the sulfa drugs to be synthesized. It was followed by sulfapyridine, sulfathiazole, sulfadiazine, sulfamerazine, and sulfamethazine. Other sulfonamides—phthalylsulfathiazole and phthalylsulfacetamide—have been synthesized for slow release in the digestive tract to control infections. Sulfasoxizole is admirably adapted to treatment of urinary infections because of a broad antibacterial activity and a high solubility in the urinary system.

The sulfonamides inhibit bacterial multiplication during the growth phase. A therapeutic dose of sulfonamide does not kill the micro-organisms but prevents further bacterial multiplication until the body defenses can destroy the invading organisms. Early treatment of an infected animal is therefore necessary if the sulfas are to be effective.

The sulfonamides have little value in treating prolonged sickness, because the body defenses already have been exhausted by the chronic infection and cannot dispose of the invading disease germs. Prolonged use of sulfonamides in a chronic infection tends to make the disease germs more resistant to the drugs.

The sulfonamides must be administered at regular intervals throughout the 24 hours for greatest effectiveness. The objective in sulfonamide therapy is to maintain an antibacterial concentration of sulfonamide continuously in all tissues of the body where the disease germs might multiply.

The sulfonamides are excreted primarily by way of the urine. Large amounts of the poorly absorbed sulfonamides are excreted in the feces. They are excreted also in milk and in bile in concentrations approaching that of the blood stream.

Chronic toxicity from sulfonamides is more important than acute toxicity. The most significant form is kidney toxicity, which occurs after several days of therapy because the kidneys fail to excrete the sulfonamides properly.

The sulfonamides have a low solubility in the body fluids. After filtering out of the blood into the urinary fluid of the kidney, the sulfonamides normally are concentrated five times or more through the reabsorption of water from the filtrate by the kidneys. The sulfonamides may exceed their solubility and precipitate in the urinary system. The tendency for crystallization to occur is increased by the normal reabsorption of the alkali ions by the kidneys, which lowers the acidity of the urine and the solubility of the sulfas.

The needlelike crystals of a precipitated sulfonamide puncture and tear the lining of the kidneys. The crystals may become numerous enough to conglomerate and to form stones, which obstruct the urinary tract. After the obstruction, waste products that normally are eliminated in the urine accumulate in the body. The accumulation of wastes is progressive until it leads to the death of the animal.

Other toxic reactions are noted. In poultry, for example, sulfanilamide causes a hen to lay eggs with soft shells or without shells. Other sulfonamides may not interfere with the formation of shells but will lower egg laying. Large amounts of sulfonamides cause a marked interference with the structure and the function of the nerves to the legs so that walking becomes difficult or impossible. The continuous use of sulfonamides at therapeutic levels suppresses the bacteria in the digestive tract that the animal needs to synthesize certain nutrients.

Sulfonamides may be prescribed for any generalizing disease that is caused by a susceptible organism, if there is no impairment of kidney function that handicaps excretion.

Virus infections are not susceptible to sulfonamides, although secondary bacterial invaders may be.

366304°—56——8

Water must be available at all times to the patient receiving sulfonamide. If necessary, forced intake of water is indicated to insure a nearly normal consumption. Water is the vehicle for excreting sulfonamides, which will precipitate and block the kidney if there is too little fluid.

Signs of sulfonamide toxicity, especially bloody and frequent urination, must be recognized promptly and the treatment stopped immediately.

Sulfonamides should be administered no longer than absolutely necessary. The maximum period is 4 days. The dose should be decreased soon after the patient shows improvement. Therapy should be stopped 24 to 36 hours after the patient appears vigorous or after the 4-day maximum.

L. MEYER JONES, *professor of veterinary pharmacology in Iowa State College, holds degrees of doctor of veterinary medicine from Iowa State College and doctor of philosophy from the University of Minnesota. He is author of a textbook,* Veterinary Pharmacology and Therapeutics.

Disinfection

W. L. MALLMANN

A FARMER can do much for the health of his animals by keeping his barns and sheds absolutely clean.

The initial step in sanitation is to know (and to have workers who know) what proper cleaning is, why it is important, and how to do it.

Disinfection—destroying the disease germs—is possible only after thorough cleaning. Disinfectants spread over unclean surfaces kill only the microorganisms on the surface; the embedded organisms are untouched; the disinfectant is wasted.

Effective cleaning begins with the removal of all gross waste, such as manure and bedding. Then the surfaces are scrubbed with brushes and a good detergent solution until they are visibly clean. The surfaces then can be flushed with clean water and a disinfectant applied.

Any good alkaline detergent in warm water is satisfactory, but lye (caustic soda) alone may be used. Because lye is very caustic, rubber boots should be worn and the solution should be handled carefully lest it come in contact with the skin. The surfaces should be treated with the alkaline solution and allowed to react for a few minutes before brushing. The surfaces should be thoroughly flushed with clean water to remove all traces of the detergent.

Lye tends to destroy most microorganisms; it kills as it cleans. It corrodes metals and so cannot be used as a general cleaner.

The value of good cleaning before disinfection was shown in a test made in a meatpacking plant. On a badly contaminated concrete wall, 28 million bacteria were counted per 2-inch square. A section of the wall was sprayed with a good germicidal solution. The bacterial population was reduced to 11 million, which demonstrated the disinfectant had failed. Another section was washed with an alkaline detergent solution. Before rinsing, the bacterial count was 380,000. After rinsing with clean water, the count was 53,000. The wash operation removed the visible soil and 99.8 percent of the bacteria. The same disinfecting solution applied to the clean-