

date of preparation. Perishable food that remains unsold, even though it has been properly refrigerated, should be disposed of at frequent intervals.

No vending machines should be located in areas where there is exposure to toxic materials.

IV. Control and Elimination of Insects and Rodents

A. INSECT CONTROL

Except for the food and other industries dealing with products that may serve as food for insects, the problem of controlling these pests is dependent largely upon good housekeeping. The more general problem of control of arthropods and arthropod-borne disease cannot be accomplished on a restricted scale as in a single industrial establishment, but must be a community-wide or regional undertaking of considerable magnitude. It should be understood, of course, that whenever an industry is located in an infested area it should cooperate with the agency effectuating control.

Although such insects as flies and roaches are of lesser health importance, their number and prevalence are a good general index of the "sanitation" practiced in the establishment. Of direct interest is the proof obtained of the relationship between fly prevalence and the infections, diseases, and deaths caused by the bacillary dysentery organism.²⁷ Field studies showed that bacillary dysentery was materially reduced in a community when effective fly control measures were undertaken.

The most direct method of dealing with an insect infestation problem is to eliminate breeding places. Wherever garbage, rubbish, or other organic matter is allowed to accumulate and become exposed to insects, it produces ideal conditions for their development. In the food-handling areas nourishment is available and harborage provided in cracks, crevices, voids, and other unused spaces.

The more common insect invaders are the roaches (German cockroach *Blattella germanica*, American cockroach *Periplaneta americana*, Australian cockroach *Periplaneta australasiae*, Oriental cockroach *Blatta orientalis*, brown banded cockroach *Supella supellectilium*) and flies, of which 90 to 95 per cent are houseflies *Musca domestica* and blowflies *Phaenicia*.²⁸

The use of insecticides is recommended when infestation is heavy and after the environmental conditions favoring breeding have been eliminated. A wide variety of insecticides (which are also of danger to the user) is available. These may be classified as: (1) contact poisons, (2) residual insecticides, (3) stomach poisons, and (4) respiratory poisons (fumigants).²⁹

²⁷ D. E. Lindsay, W. H. Stewart, and J. Watt, Effect of fly control on diarrheal disease in an area of moderate morbidity, *U. S. Pub. Health Repts.*, 68, 361 (1953).

²⁸ M. E. Parker, "Safe and Effective Insect Control," *Food-Plant Sanitation*. McGraw-Hill, New York, 1948, Ch. 9.

²⁹ A. E. Michelbacher and D. P. Furman, Control of household insects and related pests, *Calif. Agr. Extension Service Circ. 172*. College of Agriculture, University of California, Berkeley, 1951.

B. RODENT CONTROL

Infestation of the industrial plant by rodents, apart from the health hazards they produce as vectors of disease (bubonic plague, endemic or murine typhoid fever, salmonellosis, and Weil's disease), can be a tremendous economic drain. As a general principle, in the community the destruction of food, crops, merchandise, and property by rats is of a large enough magnitude to justify suppressive measures even if rats were not responsible for human disease. Rats, by their destructiveness and pollution of food, have gained the unenvied fame of being the worst mammalian pest in civilization. Davis (1950)³⁰ estimated about one rat per 35 people in New York City and about one rat per 20 people in Baltimore. As pointed out by Davis, the regulatory factors in any problem of species management can be classed in three main groups: (1) environment—which includes availability of food and protective shelter; (2) predation—which includes animals that feed upon the species, trapping, poisoning, and disease; and (3) competition—the fight for a limited supply of environmental necessities.

Control of the rodent population should be based primarily on a change of the environmental conditions so that the rodents are deprived of food and shelter. When this is accomplished, the rodent population will be reduced by competition among themselves. Since the reproductive rate of Norway rats (they reproduce during all seasons of the year, with a maximum in both spring and fall occurring in many areas) is on the average of 20 rats per year, it is evident that should the environmental conditions be favorable, killing procedures will be of little effect in reducing the population and maintaining it at a low level.³¹

C. RATPROOFING (BUILDING OUT THE RAT)

Ratproofing is a term applied to procedures for controlling the portals of entry of rats into a structure. Rats, being extremely cautious, nocturnal mammals, prefer small openings through which to enter a building. Only when they are subjected to peril will they venture away from normal pathways. The points of ingress and egress of rats that must be guarded against, in particular, are any openings around pipes, unused stacks and flues, ventilators, and hatches.

All new buildings should be designed and constructed to be ratproof. Foundations must be continuous and extend not less than 18 inches below the ground level and should always be flush with the under surface of the floor above. Floor joists should be imbedded in the wall and the space between the joists filled in and completely closed to the floor level, and all construction materials should be as ratproof as possible.³² In industry, the most frequent shelters for rats are areas surrounding the cafeteria, the lunch rooms, and other eating areas, although no

³⁰ D. E. Davis, Perspective on rat control, *U. S. Pub. Health Repts.*, 67, 888 (Sept., 1952).

³¹ D. E. Davis, "Control of Rats and Other Rodents," in K. F. Maxcy, *Preventive Medicine and Hygiene*, 8th ed., Appleton-Century-Crofts, New York, 1956, Ch. 8.

³² *Food-Borne Disease; Prevention and Control*. Communicable Disease Center, U. S. Public Health Service, Atlanta, Ga., 1949.