A New Cage Cover as an Aid to Laboratory Rodent Disease Control* (33406)

ROBERT J. FLYNN (Introduced by R. N. Feinstein)
Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Illinois 60439

The common "shoebox" cage used to house laboratory rodents is customarily fitted with a cover that has either large areas of perforations or coarse wire mesh. Experience at this laboratory has shown that rodents scatter soiled bedding and feces through these openings, inviting the transmission of pathogens should they be present. If a disease agent enters a previously pathogen-free colony, it can spread rapidly throughout the colony (1).

Long term studies involving specific-pathogen-free animals require a degree of management that will give the greatest assurance of the successful completion of the studies. This includes a type of caging that will minimize the transmission of disease agents. Since no commercially available cage cover has this capability, one was developed in our laboratory. The present paper describes the results of this effort: a cage cover that effectively prevents feces and soiled bedding from getting out of the cage without interfering with ventilation. This cover has been used to house breeding mice and their unweaned progeny, and mice in many types of experiments. It is equally suitable for rats and other rodents. Its use neither complicates animal management procedures nor reduces valuable laboratory space.

Development procedures. Several types of ventilation characteristics were compared (Table I). These included round perforations, elongated perforations, louvers, and areas of medium or fine wire mesh. Some models were fitted with either a perforated or solid baffle: a second sheet of steel attached about 0.5 in. below the undersurface of the cover and about 0.5 in. from the sides of the cage when the cover is in position on a cage bottom.

The ability of each model to control the scatter of feces and soiled bedding was judged by placing it on a cage containing five mice, on a table top covered with black paper. The cage was left undisturbed for 1 week (except for one change of the water bottle) when the amount of debris on the paper was visually estimated and recorded.

At the same time, the degree of ventilation was determined by measuring the amount of ammonia that had accumulated within the cage. This was done on an aliquot of air drawn from each cage through a collecting solution; and then the ammonia content of the sample was determined with a coulometric cell (2).

Results. The fecal and bedding scatter patterns surrounding four typical models are shown in Fig. 1. The ability to retain feces and bedding and the ammonia concentration in each cage after 1 week are given in Table I. Although the permissible ammonia concentration for the mouse is not established, several models were considered to provide inadequate ventilation based on the maximum permissible level for man, 50 ppm (3) [or 100 ppm (4)], and the knowledge that 170 ppm is toxic for the guinea pig (5). Several other models failed to retain feces and bedding. Only three covers prevented the scattering of feces and bedding and provided adequate ventilation. Because the cover with the 40 × 40 wire mesh insert is easiest and cheapest to manufacture (it costs no more than the usual cover with large open areas), it is the most satisfactory; therefore, the cover shown in Fig. 2 was fabricated. It has a ventilation area of 26 in.^{2} of 40 × 40 wire mesh (double crimp, square mesh, stainless steel screen with 40 openings/linear inch) and is for a 7.5 × 11.5 × 5-in. cage that is designed to hold from one to five adult mice or a breeding pair and their unweaned progeny. Similar

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TABLE I. Characteristics and Attributes of Several Cage Covers.

Cover	Baffle*	Ability to retain feces and bedding	Ammonia concentration after 1 week (ppm)
Slots (5/16 × 3 in.)	None	Poor	7
	Perforations (5/16 in.)	Poor	15
	Perforations (1/8 in.)	Excellent	13
	Solid	Excellent	219
Perforations (5/16 in.)	None	Poor	9
	Solid	Excellent	734
Louvers (3/16 × 6 in.)	None	Poor	466
	Perforations (5/16 in.)	Fair	488
Perforations (1/8 in.)	None	Poor	1
	Perforations (1/8 in.)	Excellent	10
Wire mesh (4 × 4)	Wire mesh (8 × 8)	Poor	1
(40 × 40)	None	Excellent	3

* A second sheet of steel attached about 0.5 in. below the undersurface of the cover and about 0.5 in. from the sides of the cage when the cover is in position on a cage.

covers for larger cages are equally suitable for larger groups of mice or for rats and other rodents.

Discussion. Although the filter cap developed by Kraft *et al.* (6) and modified by others (7) will prevent contamination of a cage, it has disadvantages: feeding and watering, normally one-hand operations, become two-hand operations, there are continual replacement costs when the typical disposable cap is used and, most important, useful research space is reduced. To feed and water animals in such a cage, the cap must be raised. This requires an increase of about 25% in the space between supporting shelves and results in a decrease of about 20% in room capacity.

The cover shown in Fig. 2 effectively prevents the transfer of feces and soiled bedding from cage to cage. It has been used on cages housing breeding mice, and mice used for biochemical, toxicologic, and carcinogenic studies, without detrimental effects. Animals can be fed and watered without removing the cage cover, thus there is no loss of useful research space. The initial cost of this cover is no more than that of the usual cover with the large open areas and there is no unusual replacement or maintenance cost. The wire mesh, although delicate, is able to withstand normal cage handling procedures without damage. Research involving disease-free rodents can be performed in cages equipped with these covers with a minimum chance of contamination from other cages, and without any modification of the building. Since the cover requires no special management, no increase in time is required to service it and the animal care personnel need no special training.

Summary. The development of a rodent cage cover that inhibits the spread of disease agents within a restricted area by preventing feces and soiled bedding from getting out of the cage is described. The cover differs from the usual cage top in that the typical large open areas of perforations or coarse wire mesh are replaced by a double crimp, square mesh, stainless steel screen with 40 openings per linear inch. The cover costs no more than the usual cover with large open areas. It gives adequate ventilation and has been used to house breeding mice and mice in experiments. It is equally suitable for rats and other rodents. Its use neither complicates animal management procedures nor reduces useful research space.

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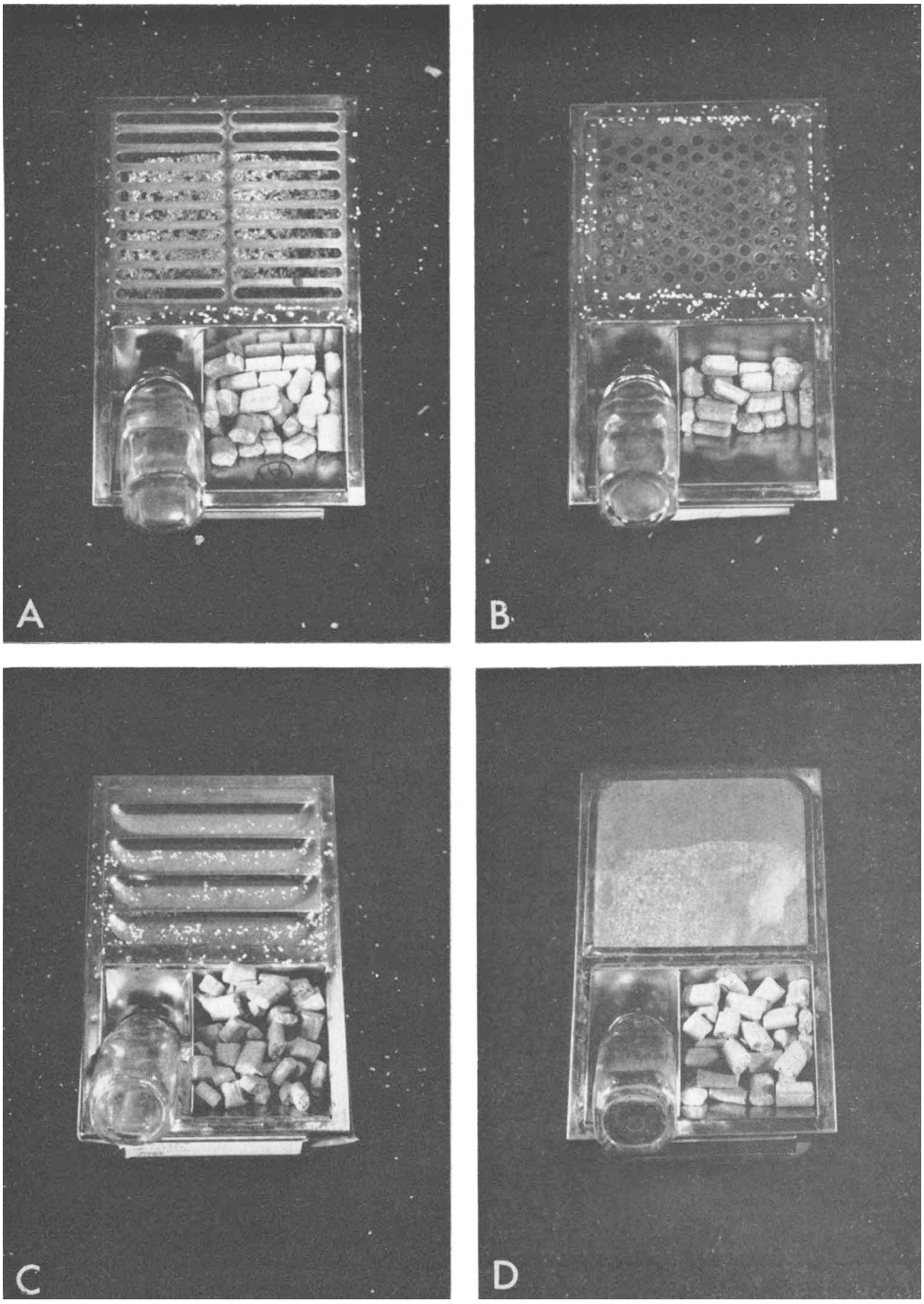

FIG. 1. Comparative amount of feces and bedding thrown by five mice over a period of 1 week from four different types of model covers: (A) 5/16 × 3-in. slots; (B) 5/16-in. perforations; (C) 3/16 × 6-in. louvers; and (D) 40 × 40 wire mesh.

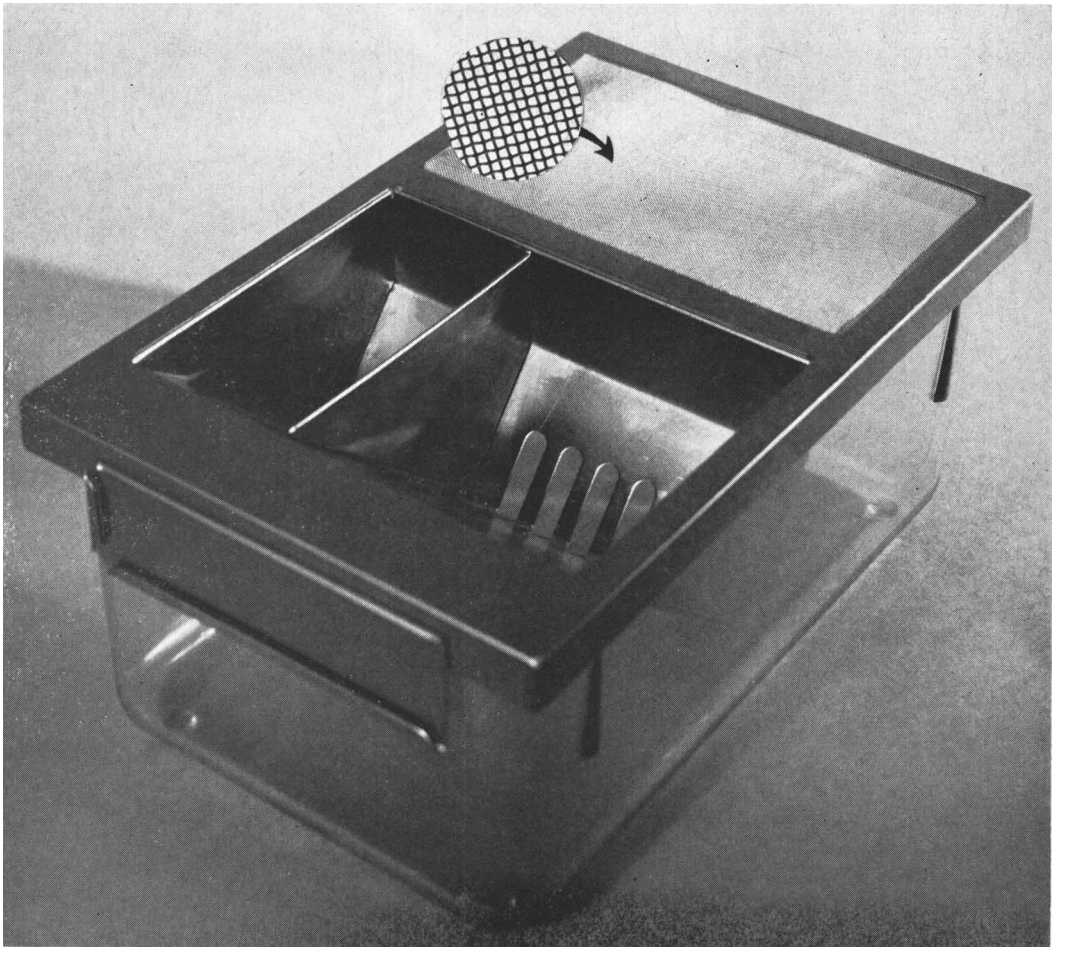

FIG. 2. Stainless steel cover with 40 × 40 wire mesh insert (double crimp, square mesh, stainless steel screen with 40 openings/linear in).

Thomas L. Duffy for providing the ammonia determinations.

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