days after the operations. The mammary glands of the adrenalectomized and ovariectomized animals were comparable to the glands of adrenalectomized rats, and possessed more bud-like projections than the glands of the unoperated rats. These results were confirmed by the use of other litters. It was thus evident that the ovary was not responsible for the changes in the mammary glands of the adrenalectomized underfed individual. It seems quite probable that adrenalectomy allows more substances which are necessary for the growth of the mammary glands to pass through the capillary walls into the tissue spaces.

Summary. The mammary glands of underfed albino rats grow more rapidly upon adrenalectomy. This enlargement is not due to increased sexual activity resulting from the adrenalectomy.

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Relation of Skim Milk Feeding to Cataract Production.*

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Mitchell and Dodge[1] reported that 68% of the rats placed on a synthetic diet containing 70% lactose developed mature bilateral cataracts and on a diet containing 50% lactose, 27% of the rats became similarly afflicted. Since skim milk solids contain about 50% of lactose, it was thought that skim milk might be dangerously high in lactose. However, cataracts have never been observed in this laboratory in rats on a skim milk or whole milk diet but have been observed in rats receiving skim milk containing added galactose. In this connection it was thought advisable to make a study of the relation of lactose and galactose to nutritional cataract in animals on a skim milk diet.

Day[2] and others[3] have reported a type of nutritional cataract

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1 Mitchell, H. S., and Dodge, W. M., Jr., *J. Nutrition*, 1935, **9**, 37.

2 Day, P. L., Darby, W. J., and Langston, W. C., *J. Nutrition*, 1937, **13**, 389.

3 O'Brien, C. S., *Arch. Ophth.*, 1932, **8**, 880; Yudkin, A. M., *J. Am. Med. Assn.*, 1933, **101**, 921; Guha, B. C., *Nature*, 1935, **135**, 395; Bourne, M. C., and Pyke, M. A., *Biochem. J.*, 1935, **29**, 1856.

caused by riboflavin deficiency and it has been found that this type of cataract is different than that caused by feeding lactose and galactose.

Experimental Skim Milk Diets. Because young rats could not be raised on mineralized skim milk alone or on rations high in galactose, it was necessary to raise them on mineralized whole milk until they weighed 80 to 100 g each and then change them to the experimental diets of fresh mineralized skim milk containing the dissolved sugars. All animals were irradiated 10 minutes daily and 10 micrograms of crystalline carotene were added to each 100 cc of milk. The onset of cataract was determined by the first appearance of opacity in the lens of the eye. No instruments were used to identify any other changes in the eye structure.

Observations were made on 40 rats on a skim milk diet for 125 to 150 days and no indication of cataract was evident. After these observations, rats were placed on skim milk with added lactose and galactose. Table I shows a summary of the experimental results obtained on skim milk diets. Skim milk with sufficient galactose added to make the free galactose content of the solids 20% did not cause cataract within 90 days. However, when the solids were made to 30% galactose, bilateral cataracts developed in all animals in 28 to 30 days. When the galactose content of the solids was made to 40% cataracts developed in 20 to 23 days. Addition of lactose to skim milk to make the lactose content of the solids 70% did not cause cataract within 90 days.

In view of Day's work,[2] additional quantities of riboflavin were fed with the skim milk with added galactose to determine if there existed any relation between the riboflavin content of milk and the incidence of cataract in these experiments. However, feeding 100

TABLE 1.
Skim Milk Diets and Results Obtained with Each Diet.

Diet Skim Milk*	No. of rats	Cataract
	4	None within 150 days
Plus lactose to make lactose content of solids 70%	3	" " 90 "
Plus equal amounts of glucose and galactose to make sugar content 70%	3	" " 90 "
Plus galactose to make 20% of solids	3	" " 90 "
Plus galactose to make 30% of solids	3	All animals, both eyes, 28-30 days
Plus galactose to make 30% of solids plus 100 gamma riboflavin per rat per day	3	" " " " 28-30 "
Plus galactose to make 40% of solids	3	" " " " 20-23 "
Plus galactose to make 40% of solids plus 100 gamma riboflavin per rat per day	3	" " " " 20-23 "

* Previous observations made on 40 rats not included in this table.

micrograms of riboflavin per rat per day did not delay the onset of cataract in any cases.

Synthetic Diets. In connection with this work, synthetic lactose and galactose rations were fed. The ration had the following composition:

Sugar (see Table II)	70
Purified casein (ether extracted)	20
Brewers yeast (ether extracted)	6
Salts	4

One microgram of crystalline carotene was added to each gram of ration and the animals were irradiated 10 minutes each day. Since it has been shown[4] that the blood sugar of animals on skim milk is higher after feeding than of animals on whole milk, the above ration was made fat-free and lard added in some experiments to determine if fat had any effect on cataract formation. The data obtained (Table II) are quite similar to those obtained on the skim milk diets. Of the 12 animals fed the basal diet containing 70% lactose only one showed a slight sign of cataract. When the basal ration contained 35% of galactose and 35% of dextrin or glucose bilateral cataract appeared in all animals in 28-30 days. On the basal ration containing 60% galactose and 10% dextrin bilateral cataract appeared in all rats in 17 to 20 days. Addition of 20% of fat to the ration containing 60% of galactose apparently had no effect other than dilution of the ration since cataracts appeared in 18 to 22 days. Addition of fat and skim milk to the lactose rations as shown in Table II was of no value since cataracts did not appear on the 70% lactose ration alone.

It is apparent from these data that the development of cataract under the conditions of the experiment described is dependent upon

TABLE II.
Synthetic Rations and Results Obtained with Each Diet.

Basal Ration	No. of rats	Cataract
(70% lactose)	4	One in 60 days, none in others within 90 days
(70% lactose) plus 15 cc skim milk per rat per day	4	None within 90 days
(70% lactose) 80 parts, lard 20 parts	4	" " 90 "
(galactose 35%, dextrin 35%)	4	All animals, both eyes, 28-30 days
(galactose 60%, dextrin 19%)	4	" " " " 18-20 "
(galactose 60%, dextrin 10%) 80 parts and lard 20 parts	4	" " " " 18-22 "
(70% lactose) (later experiment)	8	None within 90 days

[4] Schantz, E. J., Elvehjem, C. A., and Hart, E. B., *J. Biol. Chem.*, 1938, **122**, 381.

the amount of galactose in the diet. It is also apparent that the rats used in this work were much less susceptible to this type of nutritional cataract than the animals used by Mitchell, since cataracts could not be produced on a 70% lactose diet. Mitchell[5] has shown that different strains of rats vary in their susceptibility to cataract and it is possible that rats very susceptible to cataracts would develop this condition on a skim milk diet.

No cataracts developed in rats on a 70% lactose ration, with the exception of one slight case in one animal, while all animals developed definite cataracts in 20 to 30 days on a ration containing 35% galactose and 35% dextrin. It would appear rational to explain the above observations on the premise that during the hydrolysis of lactose in the intestinal tract galactose is liberated slowly enough for the animal to metabolize this sugar, whereas, when free galactose is ingested the system is then flooded with galactose and cataract results. Mitchell[6] has shown cataract formations of this variety to be paralleled with high blood galactose. Since the onset of cataract was not delayed by the addition of riboflavin to the milk diets, the cataracts produced by the feeding of galactose are undoubtedly different than those resulting from riboflavin deficiency. The fat added to the ration apparently acted as a diluent in the ration. However, the presence of fat does slow up the absorption of, and probably aids, in the metabolism of galactose, which may account for some of the delay.

Conclusions. The development of cataract in the rat is dependent upon the amount of galactose consumed in the diet. Skim milk alone was not sufficiently high in lactose to cause cataract formation in the rats used in this work.

[5] Mitchell, H. S., Merriam, O. A., and Cook, G. M., *J. Nutrition*, 1937, **13**, 501.
[6] Mitchell, H. S., *J. Nutrition*, 1936, **12**, 447.