in the duct epithelium of submaxillary gland, whereas activity in the clamped kidney is higher than normal. Simultaneously there is a widening of ducts in the salivary gland comparable to that seen in cortical tubular system in the kidney. Adrenalectomy is followed by increased G6PD activity in the macula densa and a high normal activity in the submaxillary gland.

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Spontaneous Hydronephrosis in the Rat.* (25893)

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Investigators using the Slonaker-Addis albino rat have long been aware of the frequent occurrence of spontaneous hydronephrosis in this strain. Recent interest in experimental production of pyelonephritis in the rat stimulated us to study this phenomenon in more detail.

Animals used represent a widespread strain of albino rats. Slonaker brought originators of the colony to California in 1903 from the Neurological Dept., University of Chicago. From the same colony, at a later date, the Wistar Institute Colony was derived. Thomas Addis used these rats to start the Stanford University Colony in 1924. In 1948 Addis moved a portion of the colony to Cedars of Lebanon Hospital, where it has been referred to as the Slonaker, and more recently, the Slonaker-Addis strain. Since 1924, the colony has been inbred, and great care taken to prevent cross-breeding with other strains.

Methods and results. Presence of hydronephrosis was determined by simple inspection of sliced kidney. Hydronephrosis of all degrees was seen, but in the majority of instances resembled that shown in Fig. 1. Groups of male and female rats weighing 90-120 g, and 200-350 g were sacrificed to determine incidence of hydronephrosis in the colony as a function of age and sex. The results are shown in Table I. In all instances, hydronephrosis occurred in the right kidney. Absence of hydronephrosis in adult female rats was striking, and it was suggested that pregnancy might be responsible. A group of 50 pre-puberty female rats were allowed to mature. Twenty-five females were mated and survived a normal pregnancy. The other 25 were allowed to mature without becoming pregnant. There were no deaths in either group. All animals were sacrificed after achieving a weight in excess of 200 g. Hydronephrosis was not found. Thus, right hydronephrosis, found in approximately 45% of immature female rats, disappears as animals mature regardless of whether or not they have borne young. Hooded rats of Long-Evans strain, as well as albino rats of Wistar strain, were inspected for hydronephrosis, and none was found (Table I). *X-ray Technic.* Presence of hydronephrosis can be determined without sacrificing the animal by intravenous urography. The x-ray technic most suitable is as follows: 42 kilovolts, 1/60 sec., 300 milli-

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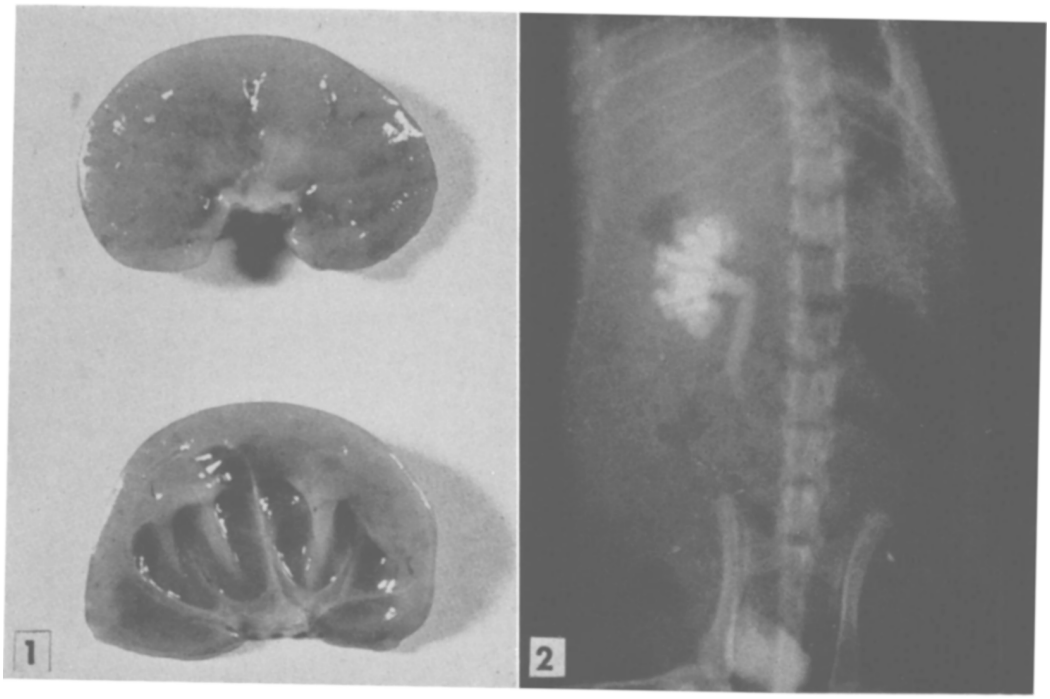

FIG. 1. Normal right kidney above, hydronephrotic right kidney below.
FIG. 2. X-ray exposure 10 min. after intrav. inj. of renografin®. Dye has already been excreted through left kidney.

amperes, non bucky screen, 38″ distance, using 8-10 inch cone. Rats were anesthetized with ether and injected intravenously with 0.5 ml of 60% renografin®/100 g body weight. A single film taken after 10 minutes reveals the presence of hydronephrosis. (Fig. 2).

Anatomical findings. It is apparent from inspection of intravenous urograms that hydronephrosis is associated with at least partial obstruction of the right ureter at junction of its upper and middle third in the male, and slightly higher in the female (Fig. 2). The right ureter crosses ventral to the ileolumbar artery and vein, then courses toward the bladder in close association with and just to the right of the inferior vena cava, and very near the midline. As the ureter enters the pelvis, it swings somewhat more laterally to enter the bladder (Fig. 3). The left ureter on the other hand is well lateral to midline structures throughout its course from kidney to bladder.

TABLE I. Incidence of Spontaneous Right Hydronephrosis in the Rat.

Wt, g	Sex	No. animals	Hydronephrosis	%
	Slonaker-Addis strain			
90–120	♂	23	14	61
	♀	25	11	44
200–350	♂	26	12	46
	♀	26	0	0
	Long-Evans strain			
90–100	♂	14	0	0
	♀	11	0	0

In the male, the right internal spermatic artery leaves the aorta distal to renal arteries and crosses ventral to the right ureter at the point where ureter crosses the ileolumbar vessels, thus the ureter lies between the ileolumbar vessels dorsally and the internal spermatic vessels ventrally (Fig. 3). It is invariably at this point that the right ureter is obstructed. It should be stressed that anatomical relationships described above exist whether hydronephrosis occurs or not. However, when hydronephrosis and hydroureter do occur, it is always by obstruction at the point indicated. No such crossing of ureter by the left internal spermatic artery occurs, since the left

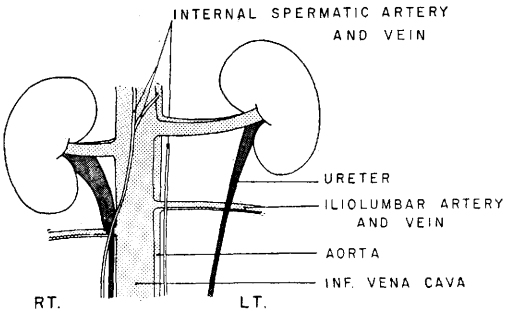

FIG. 3. Anatomic relationships of ureters in Slonaker-Addis albino rat. Note partial obstruction of right ureter as it lies between internal spermatic, and ileolumbar vessels.

ureter is lateral to this vessel, throughout its course.

In the female, the course of ureters is similar to that seen in the male; however, obstruction to the ureter occurs where it is crossed by the ovarian vessels.

In the Long-Evans strain, the anatomical relationship of the right ureter is similar to that of the left ureter. Both structures course from kidney to bladder well lateral to the internal spermatic arteries.

Bacteriological findings. Hydronephrotic right kidneys, and nonhydronephrotic left kidneys were removed aseptically. The organs were minced and cultured aerobically and anaerobically on blood agar plates. Aliquots of tissue were placed in brain-heart infusion broth and thioglycollate broth. Cultures were held 48 hours. Results are shown in Table II.

From a total of 42 hydronephrotic kidneys only 4 contained microorganisms. *Escherichia coli* was grown from 2 kidneys. In one of these the growth was heavy and in one, only a few organisms were found. A heavy growth of *Escherichia coli* was obtained from a single left kidney. One must conclude that the majority of hydronephrotic kidneys are sterile and that one is nearly as likely to culture organisms from the normal left kidney. Thus, it does not appear that the hydronephrotic lesion of the right kidney greatly predisposes this kidney to spontaneous infection regardless of length of time the lesion is present.

TABLE II. Results of Culture of Minced Hydronephrotic Rat Kidney and Normal Left Kidney.

No. animals	Wt, g		*E. coli*	Pneumococcus	Sterile
15	90–120	R. kidney	0	1	14
		L. "	1	1	13
27	200–300	R. "	2	1	24
		L. "	0	0	27

Aside from dilation of the renal pelvis, the hydronephrotic kidney is essentially normal. There is no significant abnormality of glomeruli or renal tubules and histology of renal vasculature is normal. There is no histological evidence of interstitial infiltration of pyelonephritis. Serial sections of the ureter taken from above, through and below site of obstruction fail to reveal any abnormality in structure of the ureter.

Discussion. A strain of inbred albino rats is described in which a striking incidence of spontaneous right hydronephrosis occurs. This abnormality is caused by partial obstruction of the ureter by either internal spermatic or ovarian arteries and related to the right ureter which lies in close relationship to midline inferior vena cava. Absence of hydronephrosis in adult female rats must in some way be related to altered anatomical relationships secondary to growth and does not depend on pregnancy or failure of young females with hydronephrosis to survive. Hydronephrosis did not predispose the right kidney to infection. Cultures revealed a low incidence of significant infection in either hydronephrotic right or normal left kidneys and histological sections of the hydronephrotic kidney did not reveal evidence of pyelonephritis. Aside from any interest that this abnormality may have for the anatomist, urologist, or geneticist, the strain may prove useful for study of experimental pyelonephritis.

Summary. 1) Spontaneous right hydronephrosis occurs in approximately half the animals in an inbred strain of Slonaker-Addis albino rats. The lesion disappears in female rats as they exceed 200 g weight. 2) The abnormality is produced by partial constriction of the right ureter by the ovarian or spermatic artery. 3) Hydronephrosis does

not appear to predispose the animals to spontaneous infection in the abnormal kidney.

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Hepatic Glucose Production in Developing Chicken Embryo. (25894)

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Previous studies by Nemeth(1) and Weber and Cantero(2) have demonstrated an absence of glucose-6-phosphatase activity in fetal guinea pig and rat liver. This enzyme is also absent or of low activity in Von Gierke's disease and is believed to be the primary enzymatic defect which leads to glycogen storage and hypoglycemia characteristic of this disease(3). Since glucose-6-phosphatase activity is not found in fetal liver of 2 species examined the suggestion has been made that Von Gierke's disease may represent a prolongation of the fetal state(1). On 3 occasions we were able to examine specimens of human fetal liver obtained by therapeutic abortion during the fourth to fifth months of gestation. In all cases appreciable glucose-6-phosphatase activity was found. These studies have prompted an investigation of embryonic development of hepatic gluconeogenesis and hepatic glucose formation. Since the avian embryo develops as an isolated system without a constant supply of glucose from the maternal circulation, it seemed possible that glucose-6-phosphatase activity would appear early in embryonic development. In the present study the onset and extent of glucose-6-phosphatase activity during development of the chicken embryo has been investigated. The activity of β-glucuronidase was also determined since both glucose-6-phosphatase and β-glucuronidase are localized in the microsomal subcellular fraction of liver. The overall metabolic potential of embryonic liver for gluconeogenesis and glucose formation was investigated. Liver slices were incubated with pyruvate-2-C^{14} and incorporation of labeled carbon into glucose, glycogen, fatty acids and CO_2 was determined.

Materials and methods. Chicken embryos of one to 7 days of development were rapidly separated from the yolk sac and chorioallantoic membrane and homogenized in water. After the seventh day of incubation the liver was large enough to be quantitatively removed from the embryo. Livers were frozen in a dry ice bath, weighed and homogenized with water, 1 ml/100 mg of tissue. Microsomes were prepared from pooled samples of livers from several dozen 13- to 15-day chicken embryos, homogenized in cold 0.25 *M* sucrose, and the microsomal fraction collected in the Spinco Ultracentrifuge (Model L) according to the method of Hogeboom *et al.*(4). The microsomal fraction was resuspended in isotonic KCl to make a final volume equivalent to 1.0 to 1.5 ml/g of liver. *Enzyme assays.* Glucose-6-phosphatase activity was assayed by release of inorganic phosphate from glucose-6-phosphate incubated in citrate buffer, pH 6.5 as previously described(5). Glucuronidase activity was determined using phenolphthalein glucuronide as a substrate and acetate buffer, pH 5.0 according to the method of Fishman and Bernfeld(6). *Liver incubations.* Approximately 500 mg (wet wt.) of tissue slices were incubated with 5 ml of Hastings medium(7) containing pyruvate-2-C^{14} (40 mM) as added substrate. All flasks were gassed for 5 minutes with 95% oxygen: 5% carbon dioxide and incubated for 90 minutes at 38°. The incubation medium was analyzed initially and finally for glucose(8) and pyruvate(9) and the tissue slices analyzed for glycogen(10) and fatty acids(11). For radioassay pyruvate was plated and counted as the dinitrophenylhydrazone, glucose as phenylglucosazone, CO_2 as barium