portance of infection in the death of neutron-irradiated mice, will be discussed in a later communication which will report the results of antibiotic therapy.

Summary. 1. Single, 90-minute irradiation with fast neutrons within the lethal range (175-250 rep) resulted in early deaths among CF No. 1 female mice with a significant peak in the mortality curve 4-8 days after exposure. Among 129 neutron-irradiated mice (216-265 rep: LD_{60-98}—30 days), sacrificed for bacteriological examination, positive cultures of heart's blood and/or spleen were first obtained on the 4th day, and coincided with the onset of mortality. Between the 4th and 8th days after exposure, approximately 40% of the sacrificed mice showed positive cultures. 2. After comparable irradiation with gamma rays (Co^{60}), from 750-1300 r, deaths occurred later, with a peak approximately 12-14 days post-exposure. Gamma-irradiated mice (900-940 r) were found to have positive blood and/or spleen cultures during the latter part of the second week. There seems to be a close correlation between bacteremia and time of death following these 2 ionizing radiations. 3. All the microorganisms recovered in cultures were found to be members of the normal enteric flora of the mouse. 4. The bacteremia, as measured by colony counts on heart's blood, was less severe in the neutron-irradiated than in the γ-irradiated mice.

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Received July 19, 1954. P.S.E.B.M., 1954, v87.

Measurement of Glomerular Filtration Rate in the Dog.*† (21305)

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Although it is well established that the clearances of inulin and exogenous creatinine in the dog are essentially identical, there is no direct evidence that either of these substances is excreted solely by glomerular filtration in the mammalian kidney. There is, however, direct histochemical evidence that the ferrocyanide ion is filtered at the glomerulus and is neither reabsorbed nor secreted by the tubular epithelium. This has been demonstrated in the rabbit(1,2), in the dog(3) and in the puppy(4). Van Slyke *et al.*(5) compared the renal clearances and extraction percentages of ferrocyanide, exogenous creatinine and inulin in the dog and concluded that they were excreted by the same mechanism. The wide spread of their data, however, and their use of the single intravenous injection technique, leave their conclusion open to criticism. Berliner *et al.*(6) reported that 109 clearance

* Presented before the Am. Physiol. Soc. Sept. 14, 1950.

† Supported by Grant from the U. S. Public Health Service.

TABLE I. Clearance Ratios.*

Clearance ratio	No. of periods	Avg ratio	Range in ratios	Ratios between .95–1.05, %	Ratios between .90–1.10, %	Plasma conc., mg %
All C/I	87	.998	.845–1.17	71 = 82	85 = 97.5	C .38–11.1 I 9 –57
En C/I	55	.999	.91 –1.17	46 = 83.5	54 = 98.5	C .38– .915 I 11 –57
Ex C/I	32	.990	.845–1.06	25 = 78	31 = 97	C 1.4 –11.8 I 9 –48.5
All C/All F	92	1.008	.90 –1.15	62 = 67.5	90 = 98	C .38–11.8 F 2.1 –23
All C/Fh	67	1.006	.90 –1.10	49 = 73	67 =100	C .38–11.8 F 6.6 –23
All C/Fl	25	1.013	.90 –1.15	13 = 52	23 = 92.5	C .5 – .915 F 2.1 – 3.2
En C/All F	60	1.006	.90 –1.15	39 = 65	58 = 96.5	C .38– .915 F 2.1 –18.6
Ex C/All F	32	1.010	.92 –1.08	23 = 72	32 =100	C 1.4 –11.8 F 6.6 –23
All F/I	82	.987	.88 –1.11	58 = 70.5	77 = 94	F 2.1 –23 I 9 –57
Fh/I	61	.981	.88 –1.11	43 = 70.5	57 = 93.5	F 6.6 –23 I 9 –57
Fl/I	21	1.009	.88 –1.07	15 = 71.5	20 = 95.5	F 2.1 – 3.2 I 19 –45

* C = Creatinine; En = Endogenous; Ex = Exogenous. I= Inulin; F = Ferrocyanide; h = High conc.; l = Low conc.

comparisons of ferrocyanide and exogenous creatinine in the dog showed that the ferrocyanide clearance averaged 96.6% of the simultaneous creatinine clearance. A consistent difference of this magnitude may be due to some systematic error or could be due to a real difference in excretion mechanisms. It seemed desirable, therefore, to reinvestigate the renal excretion of ferrocyanide by the dog as well as the mechanism of excretion of endogenous creatinine.

Procedure. Nine trained unanesthetized female dogs were the subjects for 97 clearance comparisons in 21 experiments. Inulin, sodium ferrocyanide and creatinine, when it was given, were injected subcutaneously or given by constant intravenous infusion. Urine was collected through an inlying urethral catheter into a volumetric flask, and the bladder was washed with saline at the end of each period. An arterial blood sample was collected as nearly as possible at the midpoint of the period. *Chemical Techniques.* Inulin was determined in diluted urine and cadmium filtrates of serum by a modification of the resorcinol technique. Creatinine, both endogenous and exogenous, was determined by the technique of Hare(7). Ferrocyanide in concentrations greater than 5 mg% was determined by the method of Husson(8). A modification of this technique was devised for use at lower concentrations.

Results. The data obtained are summarized in Table I. In the 82 periods in which simultaneous clearances of inulin, ferrocyanide and creatinine were compared, all 3 agreed within 5% in 44 (53.5%), and within 10% in 76 (93%). The clearances ranged from 30-110 cc/min.

Discussion. Since on the average, over a wide range of plasma concentrations, no 2 clearances differ by as much as 2%, all the substances studied seem to be cleared at the same rate. Only 9 individual ratios, out of a total of 261, showed that any 2 clearances differed by more than 10%, and in nearly every case the serum concentration of one or both substances was changing during that period.

A systematic error in chemical technique will show up in the final average ratio of all the periods. It should be pointed out here

that some serum samples have been encountered from which added ferrocyanide cannot be completely recovered either by the Husson technique or the modified procedure. Recovery is complete from most serum samples, but the possibility that there is some binding of ferrocyanide to serum protein *in vivo* has not been ruled out. However, the fact that the ferrocyanide clearance agrees with both inulin and creatinine clearance so closely at high and low plasma concentrations, indicates that the ferrocyanide determined in the serum must approximate very closely that which is filterable at the glomerulus.

Conclusion. Inulin, exogenous and endogenous creatinine, and ferrocyanide ion are all cleared at the same rate by the dog kidney, and probably exclusively by glomerular filtration.

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Received July 26, 1954. P.S.E.B.M., 1954, v87.

Vitamin B_{12} and Sub-Optimal Levels of Pantothenic Acid in Chick Nutrition.* (21306)

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The syndrome caused by the lack of pantothenic acid was reported by Norris and Ringrose(1) to be characterized by retarded and rough feather growth, definite, crusty, scab-like lesions in the corners of the mouth, and sometimes a cracking of the epithelium between the toes.

The pantothenic acid requirement for the chick has been placed at 5.5 mg/kg by Bauernfeind *et al.*(2) and at 14.3 mg/kg by Jukes(3). More recently, the National Research Council (4) recommended the use of 11.0 mg/kg of feed. The requirement of the chick for vit. B_{12} has been placed at 11.0 μg/kg by the National Research Council(4).

In view of the reports by Evans *et al.*(5) and Yacowitz *et al.*(6) concerning the effect of vit. B_{12} upon the pantothenic acid content of the liver, it appeared desirable to investigate the effect of vit. B_{12} upon the pantothenic acid metabolism when a sub-optimal amount (based on the National Research Council recommendations of 1950) of pantothenic acid was fed. In addition, the effect of pantothenic acid on B_{12} metabolism was investigated. This was done by making observations on growth, deficiency symptoms, and liver storage of B_{12} and pantothenic acid in 4-week old chicks.

Material and methods. Unsexed New Hampshire chicks were randomly distributed into 8 groups of 12 birds each. The birds were weighed, wing-banded, and placed in electrically heated batteries with raised wire floors. After the initial weighing, the chicks were weighed at weekly intervals during the 4 week experiment. The basal diet consisted of 25% purified soybean protein†, 67% glucose (cere-

* Cerelose was supplied through the courtesy of the Corn Products Refining Co., Argo, Ill. Folic acid was supplied by Lederle Laboratories, Pearl River, N. Y.; biotin by Hoffmann-La Roche, Inc., Nutley, N. J.; and the rest of the B-vitamins by Merck and Co., Rahway, N. J. Methionine was obtained from Dow Chemical Co., Freeport, Texas.

† Drackett 220 obtained from the Drackett Co., Cincinnati, O.