covered in another rat 13 days following injection. This high degree of localization suggests that radio-silver might be of considerable value in a direct infiltration of a tumor mass. Also, in the intramuscular group in the two animals for which data are available for both liver and spleen, the spleen possessed considerably greater activity per milligram of wet weight than the liver. Slower release to the circulation is possibly involved.

With the intravenous and cardiac puncture injections of the dextrin-silver colloid, again there is seen a diminishing percentage of injected activity recoverable with increasing injection-sacrifice intervals. Also, activity levels in the various organs show a general downward trend. Excretion of silver in the feces is again indicated by the high activity of the gastro-intestinal tract and also by the activity found in fecal pellets passed during the ether anesthesia preceding death. The activity of the stomach and its contents was measured in three animals and found to be insignificant. Assuming silver excretion in the bile, it seems probable that some is reabsorbed since the mesenteric content of silver per unit of wet weight is several times that of the heart or residual carcass. The silver content of the inguinal lymph nodes is slight. The blood level of silver is seen to decrease with time. The continued presence of silver in the blood is suggestive of translocation of silver deposited in the various tissues.

Reference to Table III indicates high but variable concentrations of silver in the liver and spleen. The silver concentrations of the liver and spleen for all the rats in the intravenous group except 1 and 6 and for the 2 in the cardiac puncture group were averaged. No. 1 was omitted due to the brevity of the injection-sacrifice interval and No. 6 since the spleen sample was lost. The average for liver was 22.0 cpm/mg of wet weight and for spleen was 21.8. This seems to indicate that, in spite of wide individual variations, the phagocytic propensities of the 2 organs per unit weight are approximately the same for colloidal silver if a large group is considered. Bone marrow, lungs, and mesentery followed in order of decreasing activity. It is of interest, however, that with the mice the activity of bone marrow followed quite closely that of spleen and liver; whereas, with the rats it was considerably lower. However, the colloidal preparation, species, and mode of injection were different.

Summary. 1. Intramuscular injection of a dextrin protected radio-silver colloid results in a high concentration of the injected material at the site of injection. 2. Intravenous injection of a dextrin-silver colloid into rats and intraperitoneal injection of a gelatin-silver colloid into mice result in deposition of the silver in highest concentration in the reticuloendothelial system. 3. Considerable silver was eliminated through the intestines and feces. The possible causes of such elimination under the conditions of this experiment are discussed. 4. A method of preparing tissues of small bulk for determining radio-silver activity with the Geiger-Muller counter is described.

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Experimental Pulmonary Edema. IV. Pulmonary Edema Accompanying Trauma to the Brain.* (18018)

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Boyd in his textbook notes that "Pulmonary edema is a very common condition" and ". . . occurs in a bewildering variety of conditions . . ."(1). One of these is skull fracture

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1. Boyd, W., *The Pathology of Internal Diseases*, 4th Ed., Lea & Febiger, Phila., 1944, 213.

TABLE I.
Influence of Various Factors on Pulmonary Edema Resulting from Trauma to the Brain.

Exp. No.	Sex* M	Sex* F	Avg body wt, g	Lung edema % grp.	Lung edema Avg degree	Lung wt % body wt	Head injury	Treatment
1	5	5	210	0	0	.62 ± .09	0	
2	12	2	277	100	2.3+	1.04 ± .38	+	
3	8	0	260	100	2.6+	1.14 ± .25	+	Adrenalectomy
4	0	14	253	21	.3+	.76 ± .07	+	Pentobarbital
5	4	4	244	12	.1+	.62 ± .14	+	Etherized
6	10	0	267	30	.3+	.65 ± .25	+	Chloral hydrate
7	12	0	296	50	.6+	.59 ± .11	+	SKF-501
8	9	0	283	55	.5+	.68 ± .18	+	SY-2
9	10	0	202	50	1.2+	.85 ± .19	+	C-7337
10	0	12	191	75	1.7+	.78 ± .16	+	"

* Also indicates number of rats in each group.

Notes:

Exp. 3—Adrenalectomy 3 hr before.
4—Received 1 cc 5% sodium pentobarbital by stomach tube. All animals were comatose.
5—Deep ether anesthesia.
6—Given .5 g/kg chloral hydrate in 7.5% sol by stomach tube. Produced deep narcosis.
7—SKF-501 is an adrenergic blocking agent, N-(9-fluorenyl)-N-ethyl-β-chlorethylamine HCl, obtained from Smith, Kline & French. 2 mg/kg in 1.5 cc saline were given 30 min. before the test.
8—SY-2 is an adrenergic blocking agent, N-dimethylamino-2-propyl-1-thiodiphenylamine HCl, obtained from Parke, Davis Co. A dose of 2.5 mg/kg in 2 cc was given i.v. 30 min. before the test.
9—C-7337 is an imidazoline derivative: 2[N-p'-tolyl-N-(M'-hydroxyphenyl)-aminomethyl] imidazoline HCl with adrenergic blocking properties which was obtained from Doctor F. F. Yonkman of Ciba. The dose used was 50 mg/kg by stomach tube 2 hrs before the test.
10—Compound used in Exp. 10 was administered intraperitoneally 30 min. beforehand.

and there are numerous reports of lung edema following head injuries(2-9). Pulmonary edema due to epinephrine injections(10), toxic doses of ammonium salts(11) and hypoglycemia(12) is in all cases prevented by sympathetic nerve blocking agents. The influence of these and other factors upon the lung edema due to skull fracture in the rat has been determined.

Experimental. Albino rats at rest had their heads between 2 laterally placed wooden blocks one of which was fixed. A sudden static force sufficient to produce a fatal head injury was applied to the other block. This caused no pain, unconsciousness being instantaneous and the animals were dead in a matter of seconds or several minutes at most during which their were clonic convulsive movements. Almost without exception rats killed in this manner showed some degree of pulmonary edema. It was graded by inspection (0, 1± - 4±) and a quantitative measure made by recording the weight of the lungs in relation to body weight. It is true that when quantitative estimations of the degree of pulmonary edema present at autopsy are desired rapid exsanguination gives the most satisfactory preparation of the lungs (13). This was used in earlier experiments and in the present animals insofar as there was any blood flow.

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Results. The experiments are summarized in Table I. The pulmonary edema produced by brain trauma (Exp. 2) is very striking. The absence of the adrenals (Exp. 3) failed to influence it.

Narcosis produced by various agents (Exp. 4, 5, 6) protected against the development of pulmonary edema. Adrenergic blocking agents (Exp. 7, 8, 9, 10) were also effective in varying degree.

Discussion. As has been noted above, the occurrence of other types of experimental pulmonary edema is also inhibited by adrenergic blocking agents(10,11,12). It has likewise been reported that narcosis prevents experimental pulmonary edema due to epinephrine in some species(14) inhibits ammonium pulmonary edema(11) and confers the best protective effect against the lung edema due to massive intracarotid infusions of saline(15). There is every indication that these various types of pulmonary edema are fundamentally similar in their origin and result from nerve stimuli of central origin, *i.e.*, they are all types of neurogenic pulmonary edema. The mechanisms through which these stimuli produce the edema is less clear. Visscher's group has stressed(16) the acute bradycardia and rise in pulmonary venous pressure associated with pulmonary edema. They find(16,17) that these changes precede the pulmonary edema due to increased intracranial pressure. The latter is essentially the same as the pulmonary edema which is produced more rapidly by traumatic injury of the brain. Campbell and Visscher(17) report that bilateral cervical vagotomy performed immediately beforehand in guinea pigs prevents or reduces the degree of lung edema due to increased intracranial pressure. We have examined the effect of this in brain trauma in guinea pigs and it is true that the lung edema is less severe. The most noticeable effect is the failure of a bradycardia to ensue. A tachycardia may even result. However bilateral cervical vagotomy alone eventually leads to the development of pulmonary edema and the problem appears to be not so simple as a question of efferent sympathetic stimuli from the brain which may be reduced by narcosis or adrenergic blockade and prevented by interrupting their flow through section of the vagi.

Summary. Experimental pulmonary edema occurs in the rat in a matter of seconds as a result of a blow to the calvaria causing fatal trauma to the brain. This edema is prevented or reduced in degree by agents which produce a deep narcosis and by adrenergic blocking compounds. The mechanism of its production is discussed in relation to other types of experimental pulmonary edema.

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Prolytic Changes in Chicken Erythrocytes Exposed to *Micrococcus aureus* Toxins.* (18019)

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Bernheimer(1,2) exposed human erythrocytes to the toxin of *Clostridium septicum* for

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