is associated with a progressive decrease in the percentage of reticulocytes and an increase in the number of red blood cells. Only a few rats were used for the reticulocyte estimations during the first 3 weeks of life but it is believed that the figures are fairly representative. When the rat pups are weaned at 21 days of age, the reticulocytes have dropped to a 25% level. The values for the other blood constituents are in accord with those in the literature, the maximum hemoglobin being 17 gm. % (approx.) and the maximum red blood cell count being 9-10 millions for our young stock adults.

Since young adult rats, 2 to 3 months old, show a very low and constant reticulocyte count (2 to 3%), it would appear that such a criterion might be used as another index of the physiological condition of the stock colony. Thus, values above this level might indicate a condition of potential anemia. Hence, it might serve as an additional basis of comparison for the stock rats of different laboratories. It is conceivable that such information might help in the interpretation of some of the conflicting data on nutritional anemia reported by different investigators.

Summary. The percentage of reticulocytes in the blood of young rats bred from an original Wistar strain varying in age from birth to 3 months was determined. These data have been correlated with growth, hemoglobin level, total hemoglobin and red blood cell count. The drop in the hemoglobin level during the nursing period is associated with a progressive decrease in the number of reticulocytes. Rats from our colony 2 to 3 months old show 2 to 3% (.2 to .3 millions per c.mm.) of reticulocytes. The significance of the number of reticulocytes in young adult stock animals as a possible criterion of potential anemia has been indicated.

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Picrotoxin-Stramonium Antagonism.

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The actions of picrotoxin and stramonium on the upper central nervous system suggest the possibility of their possessing some degree of mutual antagonism. The site of the principal action of picrotoxin upon the central nervous system has been localized by

serial sections of the brain in various species of experimental animals. As described in a standard text[1]: "The seat of action thus seems to move upward as the higher parts of the central nervous system become more developed, the chief effects arising from the spinal cord and medulla and optic lobes in the frog and from the cerebrum and midbrain in mammals." Picrotoxin effectively antagonizes the depressant action of barbituric acid derivatives as shown by Maloney and Tatum.[2, 3] Regarding the chief location of action of the barbituric acid derivatives, Bastedo states[4] "The action of these drugs is most pronounced on the midbrain."

Stramonium has come to be the chief drug used in relieving the symptoms of Parkinsonism, following its introduction by Juster.[5] Clinical reports[6, 7] indicate an action by stramonium in this condition that is superior to the action of its known alkaloidal constituents, individually. McAlpine[8] has described pathologic changes in the *substantia nigra* as the chief lesion in post-encephalitic Parkinsonism. The lesions described are considered responsible for the symptoms of motor imbalance relieved by the action of stramonium.

Available information would therefore suggest the possibility of an antagonism in the chief central nervous effects of picrotoxin and stramonium, particularly in the region of the midbrain. Interest in such an antagonism is heightened by the increasing use of stramonium and an increasing interest in the action of picrotoxin. It was decided to test the effect of stramonium upon the convulsant action of picrotoxin.

The experiments were carried out upon the white rat. Picrotoxin was injected subcutaneously in 0.5% strength in distilled water by means of a syringe calibrated in 1/100 cc. graduations. The minimal convulsive dose of picrotoxin was found to be 0.4 mg. per 100 gm. weight. All rats injected with this dose developed convulsions. Five of 8 rats injected with 0.35 mg. picrotoxin per 100 gm. weight developed convulsions. None of the rats injected with 0.3 mg./100

[1] Cushny, A. H., Pharmacology and Therapeutics. Lea and Febiger, Philadelphia, 1928.

[2] Maloney, A. H., Fitch, R. H., and Tatum, A. L., *J. Pharm. and Exp. Therap.*, 1931, **41**, 465.

[3] Maloney, A. H., and Tatum, A. L., *J. Pharm. and Exp. Therap.*, 1932, **44**, 337.

[4] Bastedo, W. A., Materia Medica, Pharmacology and Therapeutics. W. B. Saunders and Co., Philadelphia, 1932.

[5] Juster, M. E., *Revue Neurologique*, February, 1925.

[6] Menard, O. J., and Hurxthal, L. M., *New Eng. J. Med.*, 1931, **205**, 759.

[7] Gragman, L., *Med. J. and Rec.*, 1930, **131**, 21.

[8] McAlpine, D., *Brain*, 1926, **49**, 525.

TABLE I.
Minimal Convulsive Dose of Picrotoxin.

Rat No.	Wt.	Picrotoxin mg./100 gm.	Result	Time min.
97	43	0.25	No convulsion	
19	80	0.30	" "	
93	50	0.30	" "	
96	48	0.30	" "	
98	47	0.30	" "	
99	50	0.30	" "	
100	49	0.30	" "	
101	69	0.35	Convulsion	27
102	54	0.35	"	30
20	144	0.35	No convulsion	
25	55	0.35	" "	
26	60	0.35	" "	
92	48	0.35	Convulsion	28
95	42	0.35	"	23
106	160	0.35	"	25
1	90	0.40	"	20
7	57	0.40	"	19
8	61	0.40	"	20
9	53	0.40	"	21
21	157	0.40	"	25
46	36	0.40	"	39
47	36	0.40	"	27

In each instance the first dose of Picrotoxin received by the animal.

gm. developed convulsions. These results are presented in Table I.

All convulsive reactions occurred between 19 and 30 minutes following the injection of picrotoxin (with the single exception of rat No. 46, delayed until 39 minutes). Rats appearing on the verge of convulsions began to show signs of recovery about 40 minutes after receiving picrotoxin, appearing fully recovered in 120 minutes or less. Though one might anticipate from these facts an early and complete freedom from the effects of picrotoxin, there is an evident increased susceptibility to the action of the drug, rapidly acquired, though doses are spaced 24 hours or even several days apart (Tables II and III). Results in Table I are therefore restricted to reactions following the first injection of picrotoxin.

Rats weighing 225 to 325 gm. develop convulsions with relatively small doses of picrotoxin. Though the number of animals was not

TABLE II.
Increased Sensitivity to Picrotoxin Injected Daily. Rat No. 93.

Date	Wt.	Picrotoxin mg./100 gm.	Result	Time min.
10/11	50	0.30	No convulsion	
10/12	50	0.30	Convulsion	37
10/13	51	0.30	"	14
10/14	52	0.25	"	28
10/15	52	0.20	No convulsion	

TABLE III.
Increased Sensitivity to Picrotoxin Injected at Intervals.* Rat No. 7.

Date	Wt.	Picrotoxin mg./100 gm.	Result	Time min.
10/27	57	0.40	Convulsion	19
11/13	100	0.40	"	16
11/17	110	0.40	"	?
11/25	110	0.40	"	24
12/ 3	132	0.35	"	20
12/28	163	0.30	"	20

* Second-Fifth injections given with stramonium in protective amounts. I was interested in seeing if the convulsive seizure itself had anything to do with the increased sensitivity toward picrotoxin developed as a result of repeated doses of that drug. I protected several rats against the convulsions by means of a prior injection of a protective amount of stramonium. It did not seem to make any difference in the sensitivity of the animal. The second dose on Nov. 13th, being the 6th dose without stramonium, the remaining doses in natural sequence.

sufficient to justify setting a definite figure, it was evident that approximately 0.25 mg. picrotoxin per 100 gm. weight is a convulsive dose for rats of this weight group. Large rats require a longer time (30 to 40 minutes) to develop convulsions, than do rats of less than 100 gm. weight.

Rats of 20 gm. weight or less respond with convulsions with a dose of picrotoxin of 0.4 mg./100 gm., the minimal convulsive dose indicated in Table I, and become convulsive in less than 20 minutes.

The alcohol content of a U.S.P. tincture of stramonium was removed by evaporation in a water bath until the volume was 40% of the original. Distilled water was added to restore the original volume. This solution of stramonium injected subcutaneously, failed to cause any symptoms, at least so far as activity was concerned, until a dose of 0.5 cc./100 gm. weight was reached, when voluntary movements seemed slightly decreased. But little increase in this effect was noticed as the dose was increased until a dose of 1.0 cc./100 gm. was reached. The animal would then exhibit spasmodic, exaggerated movements while otherwise appearing depressed. The exhibition of mixed spasmodic movements and depression was increased when the dose of the stramonium solution was increased to 2.0 cc./100 gm.

The alcohol-free tincture of stramonium acted as an antagonist of limited power when injected at least 10 minutes prior to the picrotoxin. The limitation of capacity in antagonistic action on the part of stramonium was apparently due to an increased irritability of the central nervous system caused by doses of the stramonium solution of 1.0 cc./100 gm. weight and larger. Table IV indicates the an-

tagonistic action of stramonium toward the minimal convulsive dose of picrotoxin.

TABLE IV.
Antagonism of Stramonium (alcohol-free tincture) Toward the Minimal Convulsive Dose of Picrotoxin.

No. Rats	Stramonium*	Picrotoxin.	Result
10	.4 cc./100 gm.	.4 mg./100 gm.	Convulsions in 9 animals
10	.5 cc./100 gm.	.4 mg./100 gm.	Convulsions in 1 animal
10	.6 cc./100 gm.	.4 mg./100 gm.	No convulsions

* Each dose of stramonium given 10 minutes prior to picrotoxin injection. Doses of 1.0 to 2.0 cc./100 gm. weight of the stramonium solution did not prevent the development of convulsions in rats given 0.5 mg. picrotoxin/100 gm.

Conclusions. 1. Stramonium exhibits an antagonistic action toward the convulsant stimulation of picrotoxin in rats. 2. The antagonistic action of stramonium is limited by an evident stimulant effect in large doses upon the central nervous system. 3. It is suggested that the stimulant action of stramonium in large doses upon the central nervous system may be, in part at least, an explanation of the therapeutic value of stramonium upon the partially destroyed cells of the *substantia nigra*, in the large doses found desirable in Parkinsonism. 4. There is a possibility that the picrotoxin-stramonium antagonism might serve as a means of the biological standardization of stramonium.

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A Piezo Electric Myograph.

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In the experiments here reported, the piezo-electric properties of Rochelle Salt crystal have been employed to record the tension developed by contracting muscle. For references to the literature on the piezo-electric effect the reader may consult the comprehensive bibliography of W. G. Cady.[1] The widespread use of the piezo-electric effect for measuring forces and pressures lead to its consideration as a means of recording muscular tension. It offers an instantaneous response without friction, inertia or moving parts, which is particularly well adapted to the measurement of the tension devel-

[1] Cady, W. G., *Proc. Inst. Radio Engineers*, 1928, **16**, 521.