This technique has value in several important areas of inquiry in the field of emotionality. The fact that far less floor space is taken up by a standard rat cage than by Hall's 8 ft of apparatus makes it possible to house more rats in the laboratory. This consideration is of importance in studying the inheritance of differences in emotion. When many selectively bred filial generations of rats are required, laboratory space will be at a premium. The strange situation test of emotionality demands little space. Also, in investigating the intercorrelations between emotionality and other responses such as fighting, delay in starting in a runway, and running in an activity wheel, it is customary to determine the emotionality of one rat at a time in the open field. Most laboratories can give space to only one open field test. However, by placing many standard cages in strange situations the emotional defecation of several rats may be simultaneously determined. This will result in a substantial saving in the experimenter's time. A large number of the most emotional rats and the least emotional rats can be selected in a matter of days instead of weeks.

References

1. HALL, C. S. *J. Comp. Psychol.*, **18**, 385 (1934).
2. PARKER, M. M. Unpublished Ph.D. dissertation, Ohio State Univ. (1939).
3. ROYCE, J. R. *Psychol. Bull.*, **47**, 235 (1950).
4. HALL, C. S. *J. Comp. Psychol.*, **17**, 89 (1934).
5. YOSHIOKA, J. G. *J. Genet. Psychol.*, **41**, 406 (1932).
6. DIXON, W. J., and MOOD, A. M. *J. Am. Stat. Assoc.*, **41**, 557 (1946).

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Stimulation of the Reticuloendothelial System with Choline[1]

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The reticuloendothelial system (RES) has several vital known roles and probably has several other still unknown functions. Among the known actions of the RES is its role in the production of antibodies, phagocytosis of negatively charged colloids, effect on intermediary metabolism of some lipids, and protective action against radiation effect.

Various methods including whole body radiation (*1*) and cortisone (*2*) have been shown to depress the RES. However, because of the vital functions of the RES, the development of a factor which can excite this system to hyperfunction was considered most important. With the exception of various so-called anti-reticulocytotoxic sera, whose action still remains in doubt, and histamine, no practical means has been at hand to stimulate the RES. The requirements of such an activator include lack of toxicity as well as side effects. These criteria exclude vital dyes such as trypan blue. Such substances induce a hyperfunctional state by first producing RES damage (*3*).

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[2] This work was done during the tenure of an established investigatorship of the American Heart Association.

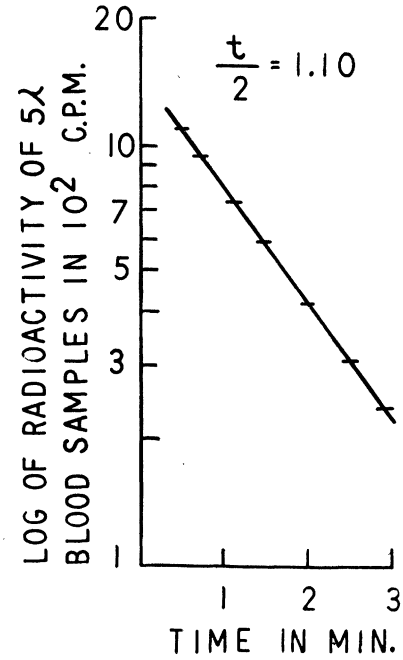

FIG. 1. Disappearance velocity of colloidal $CrP^{32}O_4$ from the circulation of a mouse. The $t/2$ value is the time wherein 50% of the radioactivity has left the vascular bed.

It had been pointed out in *in vitro* experiments by Chevremont (*4*) that of many substances tested, choline was the only compound that stimulated histiocyte formation in tissue culture. Later, Smulders (*5*) indicated that by injecting choline he could find an increased number of athrocytes in the liver in frogs by using histological techniques. As part of the search in this laboratory for a physiologic RES activator, choline was used to determine whether or not it activated the RES in mammals.

Both histologic and radioautographic studies in this laboratory (*6*) demonstrate that chromium phosphate is exclusively picked up by the RE cells. Using the rate of phagocytosis of negatively charged colloidal $CrP^{32}O_4$ as an indicator (*7–9*), experiments with intramuscularly injected choline were performed. It could be demonstrated that choline caused an RE hyperfunction of the order of 100% compared to saline injected controls.

Phagocytic velocity in each mouse was measured by plotting the radioactivity of each of 7 consecutively drawn 5 lambda blood samples against time (Fig. 1). As can be seen, the disappearance velocity is an exponential function. From this curve, the biological half-life $(t/2)'$ of the colloid in the vascular bed can be calculated. Hence, the $t/2$ value is that time wherein 50% of the $CrP^{32}O_4$ disappears from the blood.

Five series of 10 DBA, 90-day-old mice obtained from Rockland Farms were injected with 0.2 mg of

choline in saline, twice daily for 3 days. The mean $t/2$ value of 50 choline-treated mice was 0.61 min compared with the mean $t/2$ value of 1.10 min for 30 control animals. Statistical analyses of the differences between the two groups showed that they were highly significant ($P < 0.01$).

The effect of choline on the regenerative capacity of the RES and further studies on other substances are now in progress. The ability to stimulate the phagocytic velocity of the RES indicates a probable activation of RE cells. To what extent phagocytic velocity is indicative of other functions of the RE cells still remains to be established.

References

1. GABRIELI, E. R. *Yale J. Biol. and Med.* (in press).
2. HELLER, J. H. *Federation Proc.*, **12**, 65 (1953).
3. GABRIELI, E. R. Abstract, International Physiological Congress, Montreal (1953).
4. CHEVREMONT, M. *Arch. biol. (Liége)*, **54**, 377–407 (1943).
5. SMULDERS, J. *Ibid.*, **62**, 133 (1951).
6. GOULIAN, D. *Federation Proc.*, **12**, 211 (1953).
7. GABRIELI, E. R. *Verhandl. anat. Ges.*, **22**, 25 (1950).
8. ———. *Acta Physiol. Scand.*, **23**, 283 (1951).
9. ———. *Acta Path. Microbiol. Scand.*, **31**, 195 (1952).

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Increased Translocation of Plant-Growth-Modifying Substances Due to Application of Boron[1]

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Translocation of growth-modifying substances such as 2,4-dichlorophenoxyacetic acid (2,4-D) and its salts and esters from leaves to other parts of plants is associated with translocation of photosynthates (*1–4*). Gauch and Dugger (*5*) found that boron accelerated translocation of sucrose applied externally to leaves of bean and tomato plants. Stark and Matthews (*6*) increased the percentage of soluble solids (mostly sugars) of cantaloupe fruits by spraying the plants with a dilute solution of boric acid. Seemingly, this indicates that boron accelerated translocation of sugars to the fruits.

The present investigation was undertaken to determine if boron would accelerate translocation of growth-modifying substances from leaves to stems by affecting translocation of sugars.

In preliminary experiments in darkness, translocation of radioactively tagged 2,4-D (C^{14} of COOH group) from the primary leaves to the stems of bean plants was greater when tips of treated leaves were immersed in an aqueous solution containing 50 ppm of boron and 10% sucrose than when they were immersed in a sugar solution without boron. An aqueous mixture containing 30 μg (γ) of 2,4-D and 0.1% Tween 20 was spread evenly on the upper surface of the proximal half of one primary leaf of each plant. The remaining half of the leaf was immersed in the solution containing boron (as boric acid) and sucrose. Leaves of control plants were treated with 2,4-D in the same way; some were immersed in a 10% sucrose solution and others in a solution containing 50 ppm of boron. Five plants were used for each type of treatment. After 48 hr the stems were dried, ground, and assayed for radioactivity with a flow counter (*7*). In successive experiments translocation of the 2,4-D was increased by approximately 43, 47, and 50% by boron in the sugar solution as compared with the sugar solution alone. Boron alone failed to affect translocation of the 2,4-D.

TABLE 1

EFFECT OF BORON (APPLIED AS BORIC ACID), SUCROSE, AND BORON PLUS SUGAR ON THE TRANSLOCATION OF 2,4-DNH$_4$ BY BEAN PLANTS*

Treatment	Plant								Av.
	A	B	C	D	E	F	G	H	
2,4-DNH (0.9 γ)$_4$	14	21	0	24	23	0	0	24	13.2
2,4-DNH + sucrose (0.9 γ)$_4$ (2000 γ)	0	16	0	0	0	7	0		3.3
2,4-DNH + sucrose + B (0.9 γ)$_4$ (2000 γ) (160 γ)	38	37	45	33	52	44	29	29	44.7
2,4-DNH + B (0.9 γ)$_4$ (160 γ)	47	26	32	11	27	22	34	27	28.2

* Figures represent degrees of stem curvature that developed during a 3-hr period immediately following treatment of 1 primary leaf on each plant.

FIG. 1. Stem curvatures of bean plants due to application of 0.9 μg of 2,4-DNH$_4$, 2000 μg of sucrose, and 160 μg of boron to the right leaf of each plant (right row) compared with that induced by an equal amount of 2,4-DHN$_4$ and sugar. Photographed 3.5 hr after treatment.

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