2. Schiller, S., Mathews, M. B., Jefferson, H., Ludowieg, J., and Dorfman, A., *ibid.*, 1954, v211, 717.
3. Dische, Z., *J. Biol. Chem.*, 1947, v167, 189.
4. Mathews, M. B., Roseman, S., and Dorfman, A., *J. Biol. Chem.*, 1951, v188, 327.
5. Meyer, K., and Rapport, M. M., *Science*, 1951, v113, 596.
6. Stoffyn, P. J., and Jeanloz, R. W., *Arch. Biochem. Biophys.*, 1954, v52, 373.
7. Schiller, S., and Dorfman, A., to be published.

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Comparative Effects of Periodic Bleedings on Serum Glycoprotein Concentrations in Guinea Pig and Rat.* (22397)

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Increased concentrations of the carbohydrate-containing proteins of serum have been reported for a wide variety of physiologic and pathologic states(1). Precise information relative to the physiologic mechanisms involved in their formation or function is, however, still not available(2). Inasmuch as serial determinations are necessary in many experimental studies, the present investigation was undertaken to determine the effect of repeated bleedings, at weekly intervals on the serum concentrations of total glycoprotein, seromucoid and total protein, and on the hematocrit and hemoglobin values of blood in normal guinea pigs and rats.

Materials and methods. Guinea pigs. Adult, male, hybrid guinea pigs were housed 2 per cage and were maintained on a diet of Purina rabbit pellets, supplemented with lettuce, and tap water, *ad lib. Rats.* Adult, male, Sprague-Dawley rats were housed 2 per cage and were maintained on a diet of Purina laboratory chow and tap water, *ad lib. Bleeding.* The animals were bled by cardiac puncture, under light ether anesthesia, at weekly intervals for a total of 5 bleedings. At each bleeding 1.3 ml of blood per 100 g of body weight were removed, the sample representing approximately 20% of the total blood volume(3). Several animals died from the effects of the repeated hemorrhages. Data are presented for those that survived the experimental period. *Chemical analyses.* Total serum glycoprotein, seromucoid, total serum protein, hemoglobin, and hematocrit values were determined by methods previously reported(4,5). *Statistical analyses.* The mean, standard error of the mean, t, and probability values were determined by standard statistical procedures(6).

Results. Summaries of the results of the chemical analyses and hematologic data for the guinea pig and for the rat are presented in Tables I and II respectively.

The animals of both species continued to gain weight throughout the course of the experiment. A slight stimulation of growth followed the first bleeding; however, the average weekly weight increment gradually decreased.

No statistically significant increases occurred in the concentration of the serum components in comparison with base line values. In the guinea pig, a significant decrease was observed in the total serum glycoprotein at the third bleeding. Significant decreases in seromucoid levels occurred in the rat at the third and fourth bleedings. The diminished concentrations of seromucoid were reflected in significantly lower seromucoid-total glycoprotein ratios. Although a significant hypoproteinemia was exhibited by the rat at the second bleeding, total serum protein values

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TABLE I. Effects of Periodic Bleedings on Serum Glycoprotein Concentrations in the Guinea Pig.

Bleeding No.	1	2	3	4	5
No. of animals	18	18	18	18	18
Wt (g)*	769 ± 30.0	792 ± 31.4	808 ± 30.5	821 ± 30.1	831 ± 23.6
Total serum glycoprotein (mg %)*	117 ± 2.2	114 ± 2.5	109 ± 2.1†	114 ± 2.0	115 ± 2.4
Seromucoid (mg %)*	34 ± .5	35 ± 1.2	33 ± 1.0	34 ± .8	34 ± .8
Total serum protein (g %)*	4.9 ± .07	5.0 ± .09	4.8 ± .09	5.0 ± .06	5.1 ± .08
Total glycoprotein ÷ total protein × 100 (%)*	2.4 ± .03	2.3 ± .03	2.3 ± .04	2.3 ± .03	2.3 ± .04
Seromucoid ÷ total glycoprotein × 100 (%)*	29.0 ± .48	30.7 ± .57	30.3 ± .78	29.8 ± .45	29.6 ± .37
Hematocrit (%)*	45 ± .7	40 ± .9‡	40 ± .7‡	40 ± .7‡	42 ± .5‡
Hemoglobin (g %)*	14.7 ± .25	13.6 ± .35†	13.3 ± .23‡	14.3 ± .29	13.4 ± .21‡

* Including stand. error of mean.

Statistically significant differences from baseline values are indicated:
† P = <.05 >.01. ‡ P = <.01.

were in the normal range at subsequent hemorrhages. Total glycoprotein-total protein ratios did not diverge from the normal in either species.

Statistically significant decreases occurred in hematocrit and hemoglobin levels in both species. In the guinea pig, the reductions were most pronounced following the initial bleeding. Repeated hemorrhages, however, had a much greater effect on the blood values of the rat. The diminution in both hemoglobin and hematocrit concentrations at the termination of the study was twice as great as that of the guinea pig.

Discussion. The restoration of the serum glycoproteins and proteins to essentially normal levels in the interval between bleedings, notwithstanding decreased hematocrit and hemoglobin values, is indicative of a rapid rate of synthesis. Although transient decreases occurred in the concentrations of different serum components, the response of both species to periodic bleedings was similar.

The results demonstrate that blood samples may be obtained from adult, male guinea pigs and rats at weekly intervals without highly significant alterations in the concentrations of the serum glycoproteins. It must be recognized, however, that the bleeding regimen engenders a mild anemia.

The present data are in accord with the conclusions of Robscheit-Robbins *et al.*(7) with regard to the relative rates of restoration of the serum proteins and hemoglobin. They observed in "doubly depleted" dogs that the serum proteins returned to normal levels much more rapidly than hemoglobin values.

The existence of pronounced species differences in serum glycoprotein concentrations is indicated by a comparison of the baseline values in Tables I and II. This observation has been previously reported(8) and has been confirmed in the current study.

Summary. The effects of repeated bleed-

TABLE II. Effects of Periodic Bleedings on Serum Glycoprotein Concentrations in the Rat.

Bleeding No.	1	2	3	4	5
No. of animals	20	20	20	20	20
Wt (g)*	338 ± 7.8	356 ± 9.2	365 ± 9.0	374 ± 10.1	376 ± 11.5
Total serum glycoprotein (mg %)*	155 ± 3.8	156 ± 3.2	163 ± 2.2	152 ± 2.4	160 ± 3.3
Seromucoid (mg %)*	22 ± 1.7	21 ± 1.2	17 ± .6†	17 ± .6†	21 ± 1.9
Total serum protein (g %)*	6.3 ± .08	6.0 ± .10†	6.4 ± .09	6.3 ± .12	6.2 ± .08
Total glycoprotein ÷ total protein × 100 (%)*	2.5 ± .05	2.6 ± .04	2.6 ± .03	2.4 ± .03	2.6 ± .05
Seromucoid ÷ total glycoprotein × 100 (%)*	14.2 ± .93	13.5 ± .63	10.4 ± .36‡	11.2 ± .33‡	13.1 ± .93
Hematocrit (%)*	47 ± .5	44 ± .5‡	44 ± .6‡	43 ± .4‡	41 ± .7‡
Hemoglobin (g %)*	15.1 ± .21	14.2 ± .17‡	14.3 ± .26†	13.6 ± .21‡	12.5 ± .31‡

* Including stand. error of mean.

Statistically significant differences from baseline values are indicated:
† P = <.05 >.01. ‡ P = <.01.

ings at weekly intervals on the serum concentrations of total glycoprotein, seromucoid, and total protein and on the hemoglobin and hematocrit values of blood have been investigated in adult, male guinea pigs and rats. No significant increases occurred in levels of the serum components. Transient decreases were observed in the total serum protein and seromucoid of the rat and the total serum glycoprotein of the guinea pig. Statistically significant decreases occurred in hematocrit and hemoglobin values following the first and ensuing hemorrhages.

1. Winzler, R. J., *Methods of Biochemical Analysis*, v2, Interscience Publishers, Inc., New York, 1955, 279.

2. Weimer, H. E., Redlich-Moshin, J., and Nelson, E. L., *J. Immunol.*, 1955, v74, 243.

3. Burke, J. D., *Physiol. Zool.*, 1954, v27, 1.

4. Weimer, H. E., and Moshin, J. R., *Am. Rev. Tuberc.*, 1953, v68, 594.

5. Weimer, H. E., Voge, M., Quinn, F. A., and Redlich-Moshin, J., PROC. SOC. EXP. BIOL. AND MED., 1955, v90, 494.

6. Snedecor, G. W., *Statistical Methods*, 4th edition, Iowa State College Press, Ames, 1946.

7. Robscheit-Robbins, F. S., Miller, L. L., and Whipple, G. H., *J. Exp. Med.*, 1945, v82, 311.

8. Weimer, H. E., Carpenter, C. M., Redlich-Moshin, J., Little, M. S., and Nelson, E. L., *Physiol. Zool.*, 1954, v27, 341.

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Localization of Specific Cholinesterase About the Eccrine Sweat Glands of Human Volar Skin.* (22398)

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Eccrine sweating of the palms and soles in man occurs almost exclusively in response to non-thermal stimuli, usually emotional or mental(1); the response to heat is minimal and delayed(2). In sharp contrast to this, eccrine sweating of the rest of the skin is due primarily to thermal stimulation(1). Indeed, emotional and thermogenic sweating have been regarded as separate functions controlled by different mechanisms(3). The idea of different control mechanisms is partially supported by published pharmacologic evidence. On the one hand the glands of the general skin are stimulated to secrete sweat by cholinergic drugs and are inhibited by anticholinergic drugs but not by antiadrenergic drugs (4). These results accord with the demonstrated cholinergic innervation of the glands of the general skin(4). On the other hand the glands of the palms and soles have been reported to show little sweating in response to cholinergic drugs(5,6) and a reduction of spontaneous sweating in response to dibenamine, a potent adrenergic blocking agent(7). A possible inference, therefore, is that the volar glands have primarily an adrenergic innervation and the general skin glands have a cholinergic innervation. More recent studies, however, seem to indicate that the volar glands are also specifically stimulated by cholinergic drugs in the same concentrations as are effective for the general skin(8,9). Also, mental sweating of the palms was not inhibited by adrenergic blocking agents but was readily inhibited by the anticholinergic substance atropine(8). Furthermore, systemic administration of epinephrine does not evoke eccrine sweating(7), although local injection into the skin irregularly elicits the appearance of local sweat in both volar and general skin(4). This latter effect may be due to the stimulation of the myoepithelial cells surrounding the sweat gland tubules causing them to contract and eject preformed

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