al.,[5] Graessle and Frost,[6] and Sullivan *et al.*[7]

Therapeutic failures, as a result of a particular strain of an infecting parasite acquiring or possessing a tolerance to the drug, have been known since the advent of chemotherapy. The superior therapeutic action effected by the use of more than one chemotherapeutic agent was pointed out by Laveran[8] in his work with trypan red and arsenous acid in experimentally induced trypanosomiases. The rational of a plan of drug rotation in the case of certain bacterial infections was pointed out by Feirer, Meader and Leonard[9] and again by Duemling and Horton.[10]

Ungar[11] first demonstrated the synergistic effect *in vitro* and *in vivo* of chemotherapeutic agents (para-aminobenzoic acid and sulfapyridine) on an antibiotic (penicillin) and Carpenter, Bahn, Ackerman, and Stokinger[12] pointed out the advantages of combining 3 chemical substances with penicillin in order to prevent the development *in vitro* of drug-fast strains of the gonococcus. Although sulfactin is active against the same types of microorganisms against which penicillin is active, it nevertheless has a possible role in the field of chemotherapy.

It will be noted that the sensitivity of the staphylococcal strain to sulfactin at the beginning of the studies (Table I) is slightly different from that found for the parent culture later in the studies (Table II). A possible factor in explanation of this may be that a different lot of stock solution was employed in the later tests but this is not a complete explanation.

The magnitude of the resistance to sulfactin developed by a strain of staphylococci was intermediate between the increase of the same strain of staphylococci to penicillin and the increase in resistance of a strain of *Escherichia coli* to streptomycin.[13]

Summary. A strain of staphylococci in becoming resistant to penicillin did not show an increase in its resistance to sulfactin. A similar strain of staphylococci in becoming resistant to sulfactin did not show an increase in its resistance to penicillin. The increase in resistance to sulfactin developed by the strain of staphylococci was intermediate between the increment in resistance developed by staphylococci to penicillin and the increase in resistance developed by a strain of *E. coli* to streptomycin.

5 Eisman, P. C., Marsh, W. S., and Mayer, R. L., *Science*, 1946, **103**, 673.

6 Graessle, O. E., and Frost, B. M., PROC. SOC. EXP. BIOL. AND MED., 1946, **63**, 171.

7 Sullivan, M., Stahly, G. L., and Birkeland, J. M., *Science*, 1946, **104**, 397.

8 Laveran, M. A., *Comp. rend. Acad. Sci.*, 1904, **139**, 19.

9 Feirer, W. A., Meader, P. D., and Leonard, V., *J. Urol.*, 1926, **16**, 97.

10 Duemling, W. W., and Horton, S. H., *U. S. Naval Med. Bull.*, 1947, **47**, 605.

11 Ungar, J., *Nature*, 1943, **152**, 245.

12 Carpenter, C. M., Bahn, J. M., Ackerman, H., and Stokinger, H. E., PROC. SOC. EXP. BIOL. AND MED., 1945, **60**, 168.

13 Kelner, A., and Morton, H. E., *J. Bact.*, 1947, **53**, 695.

16607

Quantitative Chemical Analysis of the Adrenal Glands of Wild Norway Rats.

JOHN NICHOLS. (Introduced by A. T. Miller, Jr.)

From the Department of Anatomy, University of North Carolina, Chapel Hill, N. C.

Rogers and Richter[1] pointed out that the wild Norway Rat has an adrenal gland 2-3 times as large as that of the domestic albino Norway Rat. This difference in size is limited to the cortex. Since the cortical hor-

1 Rogers, P. V., and Richter, C. P., *Endocrinology*, 1948, **42**, 46.

TABLE I.

	Wt of animal in g	Total fat	Total cholesterol	Source
Wild Norway	250-475	6.5% ± 1.2*	3.7% ± 0.8*	This paper
Domestic				
Wistar	300	8.7	5.1	Nichols[2]
Sprague-Dawley	200		5.48	Tepperman[3]
Long-Evans	(Adult)		5.28	Sperry[4]
Sprague-Dawley	250		5.84	Sayers *et al.*[5]
Yale	24-day-old		3.03	Sayers *et al.*[6]
Long-Evans	284		3.45	Levine[7]

$$* = \pm \sqrt{\frac{\Sigma d^2}{N}}$$

mone is likely formed from the cholesterol present in the gland it would be interesting to compare the cholesterol concentration in the adrenals of the two strains of animals. Such data are not in the literature. Accordingly the following study was carried out.

The adrenal glands of 41 wild Norway Rats* were subjected to a chemical analysis which has been previously described.[2] These rats were trapped during a typhus survey program currently being carried out in this state. They varied in size from 250 g to 475 g and were about equally distributed between the two sexes. Pregnant females were not used.

Results. The results were tabulated in comparison with the findings of other investigators on the adrenal of the domestic rat.

Discussion. In their paper Rogers and Richter present an interesting discussion based largely on the fact that the lean, aggressive, wild rat has a "faster pace of living" than does the obese, sedentary, domestic rat. It is well known that the adrenal cortex is an important factor in stresses not far different from this (Selye[8]). The adrenal cortical hormone is a cyclopentophenanthrene compound closely related to cholesterol and the adrenal gland is a rich source of cholesterol. There is every reason to believe that the hormone is formed from the cholesterol present in the gland. (This is true of all glandular structures which arise from embryonic lateral plate mesoderm.) Sayers *et al.*[6] found that the adrenal cholesterol became depleted upon administration of adrenotropic hormone. Mason *et al.*[9] have reported an increased urinary output of keto-steroids in humans after administration of adrenotropic hormone. At least one biologically active compound can be formed from cholesterol; Bloch[10] fed cholesterol labeled with deuterium to pregnant women and recovered it as pregnandiol in the urine.

From the data presented here it is apparent that both total fat and cholesterol are present in lower concentration in the adrenals of wild rats than in domestic rats. Assuming the 5% figure to be the correct one for the cholesterol concentration in the adrenal of the domestic rat, the wild rat has approximately 66% as much cholesterol. However, since Rogers and Richter[1] have shown the cortex of the wild rat to be 2-3 times larger

* These rats were kindly made available by Drs. H. F. Schoof and G. C. Barden of the State Health Department, Raleigh, N. C.

2 Nichols, J., *J. Aviation Med.*, 1948, **19**, 171.

3 Tepperman, J., Tepperman, H. M., Patton, B. W., and Nims, L. F., *Endocrinology*, 1947, **41**, 356.

4 Sperry, W. M., and Stoyanoff, V. A., *J. Nutrition*, 1935, **9**, 131.

5 Sayers, G., Sayers, M. A., Liang, T. Y., and Long, C. N. H., *Endocrinology*, 1945, **37**, 96.

6 Sayers, G., Sayers, M. A., Fry, E. G., White, A., and Long, C. N. H., *Yale J. Biol. and Med.*, 1944, **16**, 361.

7 Levine, L., *Endocrinology*, 1945, **37**, 34.

8 Selye, H., *J. Clin. Endocrinology*, 1946, **6**, 117.

9 Mason, H. L., Power, M. H., Rynearson, E. H., Ciaramelli, L. C., Li, C. H., and Evans, H. M., *J. Clin. Endocrinology*, 1948, **8**, 1.

10 Bloch, K., *J. Biol. Chem.*, 1945, **157**, 661.

than the cortex of the domestic rat, it is apparent that the wild rat has much more cholesterol available for hormone production than does the domestic rat of comparable size. The writer is unable to offer any explanation for the disparity in the two sets of figures by different investigators shown in the table.

It should be pointed out that these rats were caught in spring steel traps and in some cases may have remained in the trap for as long as 12 hours. The emotional disturbances and trauma associated with this may have caused a lowering of the original cholesterol.

Summary. Quantitative analysis of the adrenal glands of the wild Norway rat reveals that the total fats comprise 6.5% of the gland and that of this 3.7% are cholesterols. These figures are lower than the values for the adrenal gland of the domestic rat. However, since the cortex of the adrenal gland of the wild rat is 2-3 times larger than that of the domestic rat, the wild rat has much more cholesterol available for hormone production.

16608

Complement Fixation in Human Sera Following Murine Typhus.

E. R. RICKARD.

From the International Health Division, Rockefeller Foundation, and Florida State Board of Health.

Complement-fixing antibodies for murine typhus have been shown to persist in the sera of both human beings and rodents for long periods of time following infection.[1-3] The complement fixation test has been employed, therefore, to estimate the past incidence of typhus in human[4] and rodent[5] populations. For this reason, an appraisal of the accuracy of the test as an indicator of past infection should be of interest. During a recent state-wide survey of murine typhus in Florida,[6] clinical and epidemiological records were completed on 2055 persons who, during the years 1944, 1945 and 1946, had had typhus or had been strongly suspected of having had the disease. The present report will describe the results of complement fixation tests performed upon the sera of 404 persons whose cases were investigated during the survey.

Methods. All persons from whom serum specimens were obtained had had fever and constitutional symptons sufficiently severe to confine them to bed for a period of at least 10 days. Furthermore, all these persons had had relatively close contact with rats and their ectoparasites, and there was epidemiological evidence that they could have contracted typhus.

Sera were collected aseptically at intervals varying from 7 days to 3 years and 11 months following the onset of illness, and were stored at icebox temperature for periods varying from 7 days to 4 months before examination. Immediately before testing they were inactivated by exposure to a temperature of 56°C for 30 minutes.

Antigen* was prepared by the Cox method[7] from the yolk sacs of chick embryos infected

1 Bengtson, I. A., *Pub. Health Rep.*, 1941, **56**, 649.

2 Bengtson, I. A., and Topping, N. H., *Am. J. Pub. Health*, 1942, **32**, 48.

3 Bengtson, I. A., *Am. J. Pub. Health*, 1945, **35**, 701.

4 Davis, D. E., and Pollard, M., *Pub. Health Rep.*, 1946, **61**, 928.

5 Davis, D. E., and Pollard, M., *Am. J. Trop. Med.*, 1946, **26**, 619.

6 Rickard, E. R., and Riley, E. G., *Am. J. Pub. Health*, to be published.

* We are grateful to Dr. Herald R. Cox of the Lederle Laboratories for furnishing the antigens used in this study.

7 Cox, H. R., *Pub. Health Rep.*, 1938, **53**, 2241.