action than is available. The most promising approach would appear to be the study of tissues known to be deficient in enzymes for glycogen utilization(13).

*Summary.* A reciprocal relationship between phosphorylase and UDPG-glycogen transglucosylase activity has been demonstrated by a histochemical technic in individual fibers of resting rat skeletal muscle. In general, polysaccharide formed from glucose-1-phosphate was deposited in the large (white) type of fiber and that from UDPG in the small (red) fibers.

1. Larner, J., *Fed. Proc.*, 1960, v19, 971.
2. Robbins, P. W., Traut, R. R., Lipmann, F., *Proc. Nat. Acad. Sci. U. S.*, 1959, v45, 6.
3. Leloir, L. F., Olivarría, J. M., Goldemberg, S. H., Carminatti, H., *Arch. Biochem. Biophys.*, 1959, v81, 508.
4. Takeuchi, T., *J. Histochem. Cytochem.*, 1956, v4, 84.
5. ———, *ibid.*, 1958, v6, 208.
6. Takeuchi, T., Glenner, G. G., *ibid.*, 1960, v8, 227.
7. Dubowitz, V., Pearse, A. G. E., *Nature*, 1960, v185, 701.
8. George, J. C., Naik, R. M., *ibid.*, 1958, v181, 709.
9. Dubowitz, V., Pearse, A. G. E., *Histochemie*, 1960, v2, 105.
10. Villar-Palasi, C., Larner, J., *Arch. Biochem. Biophys.*, 1960, v86, 270.
11. Krebs, E. G., Fischer, E. H., *Ann. N. Y. Acad. Sci.*, 1960, v88, 378.
12. Cori, G. T., Green, A. A., *J. Biol. Chem.*, 1943, v151, 31.
13. Schmid, R., Robbins, P. W., Traut, R. R., *Proc. Nat. Acad. Sci. U. S.*, 1959, v45, 1236.

Received March 21, 1961. P.S.E.B.M., 1961, v107.

## Effect of Adrenalectomy and Successive Hydrocortisone Replacement on Thyroid Secretion Rate in Male and Female Rats.* (26691)

R. R. ANDERSON,† J. A. GROSSIE AND C. W. TURNER
*Dept. of Dairy Husbandry, University of Missouri, Columbia*

It has been suggested that adrenalectomy decreases thyroid function as a consequence of decreased metabolism(1), while other studies concerning exogenous administration of adrenocorticoids to animals have shown the following effects: a suppressive action of TSH release in normal rats(2,3); a stimulating action on TSH release in normal rats(4); a direct suppression on thyroid gland in hypophysectomized rats(5), normal rats(6) and normal chickens(7); reduction in peripheral utilization of thyroxine in normal rats(8); no effect in normal dogs(9); and a stimulating effect on thyroid gland in normal rats(10).

Determination of thyroxine secretion rate (TSR) has not been used to evaluate adrenocortical effects on thyroid function. Previous indices were $I^{131}$ uptake and release and thyroid cell height. With accurate technics for determining TSR in rats available(11), present work was undertaken to determine TSR in individual animals before and after adrenalectomy and after subsequent adrenocortical replacement.

*Materials and methods.* Mature male (34) and female (25) albino rats of Sprague-Dawley-Rolfsmeyer strain were used. They were fed Purina lab chow *ad libitum* and were maintained at a constant temperature of 78 ± 1°F. Initial body weights ranged from 200 to 460 g.

TSR determinations were made with use of $I^{131}$ by method of Pipes and Turner(12). Increments of 0.25 μg L-thyroxine ($T_4$) were used. Adrenalectomy (ADRX) was performed after normal secretion rates were obtained. Animals were maintained on 1% NaCl drinking water after ADRX and throughout glucocorticoid replacement therapy. Determination of TSR was commenced 2 weeks after ADRX. Replacement therapy

* Contribution from Mo. Agr. Exp. Sta. Journal Series No. 2287. Approved by Director. Aided in part by research grants from P.H.S. and U.S.A.E.C.
† Predoctoral fellow of N.I.H.

TABLE I. Effect of Adrenalectomy and Replacement Therapy on Thyroxine Secretion Rate of Rats (TSR in μg/100 g BW/Day).

| Phase | Normal | | | 2 wk after adrenalectomy | | | 2 wk after hydrocortisone replacement (150 μg/day) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sex | No. | TSR | Sex | No. | TSR | Sex | No. | TSR |
| Intact (1st phase) | ♂ | 34 | .93 ± .05 | | | | | | |
| | ♀ | 25 | .97 ± .06 | | | | | | |
| | Both | 59 | .94 ± .04 | | | | | | |
| Survivors, 2 wk after adrenalectomy (2nd phase) | ♂ | 18 | .90 ± .06 | ♂ | 18 | .75 ± .05* | | | |
| | ♀ | 21 | .98 ± .06 | ♀ | 21 | .67 ± .04† | | | |
| | Both | 39 | .94 ± .04 | Both | 39 | .71 ± .03† | | | |
| Survivors, 2 wk after hydrocortisone replacement of 150 μg/day (3rd phase) | ♂ | 10 | 1.00 ± .07 | ♂ | 10 | .83 ± .05 | ♂ | 10 | 1.05 ± .05 |
| | ♀ | 15 | 1.02 ± .07 | ♀ | 15 | .65 ± .05† | ♀ | 15 | 1.13 ± .06 |
| | Both | 25 | 1.01 ± .05 | Both | 25 | .72 ± .04† | Both | 25 | 1.10 ± .04 |

Significantly different from normal at: * 5% level of probability; † 1% level of probability.

of 150 μg hydrocortisone acetate/animal/day was given subcutaneously in 0.15 ml saline and gum arabic suspension.

Replacement therapy was commenced when TSR determination following ADRX was completed. It was continued through determination of third TSR, which was begun 2 weeks after start of hydrocortisone replacement.

*Results.* Original 34 normal male rats had average TSR of 0.93 ± 0.05 μg/100 g BW/day while 25 normal females had TSR of 0.97 ± 0.06 μg (Table I). No significant difference between sexes was shown. After ADRX 18 males that survived had TSR of 0.75 ± 0.05 μg, a decrease of 17%, while 21 surviving females averaged 0.67 ± 0.04 μg, a decrease of 32%. Reduction of TSR in males after ADRX was significant at 5% level from their normal control values, while reduction of TSR in females was significant at 1% level. At end of third TSR determination, which was started 2 weeks after replacement with 150 μg hydrocortisone/day, values on 10 remaining males averaged 1.05 ± 0.05 μg and on 15 females averaged 1.13 ± 0.06 μg. Although these values were slightly higher than their normal control values, no significant differences were found. Body weight was not affected by ADRX or hydrocortisone replacement.

*Discussion.* These data indicate that no sex differences are found in normal TSR of mature rats of this strain. ADRX caused significant reduction in TSR when an interval of 2 weeks was allowed for equilibration of thyroid with existing metabolic state. Recent work has indicated that underfeeding causes significant reduction in TSR of intact mice(13). Furthermore, ADRX is accompanied by marked reduction in feed consumption(14). Other work has shown that ADRX animals receiving saline consumed feed at a lower level than normal(15). Our own data on 6 mature male rats revealed that feed consumption was reduced significantly from a normal level of 14.9 ± .8 g/day to 9.7 ± 5 g/day following ADRX and while maintained on 1% NaCl drinking water. These observations lead us to suggest that reduced TSR after ADRX may be due in part to reduced feed consumption rather than ADRX *per se*.

Replacement therapy with 150 μg hydrocortisone acetate plus 1% NaCl was sufficient to return TSR to normal. It is suggested that hydrocortisone increased metabolic rate by systemic action on all cells of body and not selectively on thyroid cells. Hydrocortisone doses ranging from 1 to 10 mg/day, used by previous investigators studying adrenocortical-thyroid interrelationships are considered to be above physiological levels and not representative of normal conditions. It is suggested that level of hydrocortisone used in present experiment represents physiological requirement.

*Summary.* L-thyroxine secretion rates (TSR) averaged 0.94 μg/100 g/day in 34 male and 25 female albino rats. No sex dif-

ferences were found. TSR determined 2 weeks after ADRX while on 1% NaCl replacement therapy was significantly reduced by 17% in males and 32% in females. TSR determined after 2 weeks of hydrocortisone replacement (150 μg/day) in addition to 1% NaCl was found to return to normal level. Body weight was not affected by treatments. It was suggested that reduced TSR after ADRX may be due, in part, to reduced feed consumption rather than ADRX *per se*.

1. Fluckiger, E., Verzar, F., *J. Endocrinol.*, 1955, v13, 39.
2. Brown-Grant, K., *Endocrinology*, 1955, v56, 607.
3. Inbar, S. H., Freinkel, N., *Metabolism*, 1956, v5, 652.
4. Halmi, N. S., Barker, S. B., *Endocrinology*, 1952, v51, 127.
5. Verzar, F., Vidovic, V., *J. Endocrinol.*, 1952, v8, 321.
6. Perry, W. F., *Endocrinology*, 1951, v49, 284.
7. Shellabarger, C. J., *ibid.*, 1954, v55, 100.
8. Bastenie, P. A., Ermans, A. M., *ibid.*, 1958, v62, 245.
9. O'Neal, L. W., Heinbecker, P., *ibid.*, 1953, v53, 239.
10. Beck, R. N., *ibid.*, 1958, v62, 9.
11. Grosvenor, C. E., Turner, C. W., PROC. SOC. EXP. BIOL. AND MED., 1958, v99, 517.
12. Pipes, G. W., Turner, C. W., *Mo. Agr. Exp. Sta. Res. Bull. No. 617*, 1956.
13. Pipes, G. W., Grossie, J. A., Turner, C. W., PROC. SOC. EXP. BIOL. AND MED., 1960, v104, 491.
14. Cowie, A. T., Folley, S. J., *J. Endocrinol.*, 1946-48, v5, 282.
15. Benson, G. K., PROC. SOC. EXP. BIOL. AND MED., 1960, v103, 132.

Received April 14, 1961. P.S.E.B.M., 1961, v107.

## An Interferon Appearing in Cell Cultures Infected with Measles Virus.* (26692)

EDWARD DE MAEYER,† AND JOHN F. ENDERS
*Research Division of Infectious Diseases, The Children's Hospital Medical Center, and Department of Bacteriology and Immunology, Harvard Medical School, Boston, Mass.*

Several virus-cell systems have recently been shown to produce substances capable of inhibiting growth of related and unrelated viruses. The mode of action of these inhibitors has been clearly distinguished from interference due to viral components. Isaacs' interferon(1), Cooper and Bellett's Transmissible Interfering Component(2) and Ho and Enders' Viral Inhibitory Fluid(3) all seem to be similar. Ho and Enders(4) noticed that fluids of tissue culture, infected with the measles virus retarded growth of poliovirus and inhibited its cytopathic effect. We have been able to confirm these findings and to demonstrate that they depend upon the presence of an interferon-like agent which will be referred to subsequently as measles interferon. By this designation we do not imply that it is identical with influenza interferon as described by Isaacs and Lindemann, but only that, in our opinion, it represents one of a class of substances with similar properties. The evidence supporting this opinion will be presented.

*Materials and methods. Cell cultures.* Primary cultures of human amnion cells were prepared from trypsinized human amnion membranes. The culture medium consisted of equal parts of bovine amniotic fluid and Hanks' saline solution, enriched with 5% horse serum. This medium will be referred to as "regular BAF medium"(5).

Chick cell cultures were prepared from 9 to 10-day old chick embryos. Growth medium consisted of regular BAF medium with 2% chick embryo extract.

* This investigation was conducted under the sponsorship of Commission on Viral Infections of Armed Forces Epidemiological Board, and was supported in part by The Surgeon General, Dept. of the Army, Washington, D. C.

† Fulbright Scholar—Supported by R. I. T. (Belgium) and Lederle International Fellowship Committee. Present address: The Rockefeller Inst., New York City.