

When 10 cc. of a solution of secretin⁶ was injected intravenously into a fasting dog, the flow of pancreatic juice was increased temporarily from an hourly rate of 2.8 drops per minute to 4 drops per minute. This acceleratory effect lasted 10 minutes⁷ and then the regular fasting rate of secretion was resumed. During digestion a prolonged acceleration occurred. Four hours after a meal consisting of meat the secretory pressure was 380 mm. in contrast to a previously fasting level of 300 mm.

Summary. Pancreatic secretion is continuous in fasting dogs. The rate of secretion is accelerated after the injection of secretin and during digestion. When the effects of these stimuli subside the flow of pancreatic juice continues.

5502

Action of Thyroxin on Tissue Metabolism.

ALEITA HOPPING. (Introduced by E. L. Scott.)

From the College of Physicians and Surgeons, Columbia University.

Magnus-Levy¹ showed that the thyroid gland increased metabolism. The manner in which this effect is brought about is still a matter for discussion.^{2, 3} Adler⁴ stated that thyroid action persisted after ergotamine and concluded a peripheral action. However, Abderhalden and Wertheimer⁵ found that ergotamine inhibited the effect of a previous thyroid injection. The great amount of work done on the direct effect of thyroxin on tissue metabolism has served to complicate rather than to clarify matters. Fleischmann,⁶ Rothschild,⁷ Simon,⁸ Paasch and Reinwein,⁹ Anselmino,¹⁰

⁶ Weaver, M. M., Luckhardt, A. B., and Koch, F. C., *J. Am. Med. Assn.*, 1926, **87**, 640.

⁷ Bayliss, W. M., and Starling, E. H., *J. Physiol.*, 1902, **28**, 325.

¹ Magnus-Levy, *Berl. klin. Wschr.*, 1895, **32**, 650.

² Plummer, *J. Am. Med. Assn.*, 1921, **77**, 243.

³ Kendall, *Tr. Ass. Am. Phys.*, 1918, 324; Kendall and Simonson, *J. Biol. Chem.*, 1928, **80**, 357.

⁴ Adler, cited by Reinwein, Helmuth and Singer, *Biochem. Z.*, 1928, **197**, 152.

⁵ Abderhalden and Wertheimer, *Pflüger's Arch.*, 1927, **216**, 697.

⁶ Fleischmann, *Biochem. Z.*, 1930, **187**, 324.

⁷ Rothschild, *Biochem. Z.*, 1930, **217**, 365.

⁸ Simon and Wiener, *Biochem. Z.*, 1929, **215**, 102.

⁹ Paasch and Reinwein, *Biochem. Z.*, 1929, **211**, 468.

¹⁰ Anselmino, Eichler and Schlossman, *Biochem. Z.*, 1929, **205**, 481.

Ellinger,¹¹ obtain negative results with the thyroid principle, while Wohlgemuth and Klopstock,¹² Weil,¹³ and Ahlgren¹⁴ find an increase in metabolism.

The method used in this work consists in placing (alligator) blood (6 to 10 cc.) in duplicate tonometers containing air under alveolar tensions (CO₂ 3%, O₂ 17%, in the alligator) and measuring by direct analysis of the pair, the O₂ and CO₂ contents at the beginning and end of a test period, maintaining the tonometers in a constant temperature bath. The gas phase was analyzed by the Haldane apparatus, the liquid phase by the Van Slyke manometric method of blood gas analysis. Calculating the volumes of oxygen consumed and carbon dioxide liberated, under standard conditions of temperature and pressure, allows the expression of the metabolism of the blood in terms of small calories* per hour per 1000 cc. of blood (with 500,000 red cells per cu. mm.). The work was done with bacteriological precautions, cultures of the blood being

TABLE I.

No. of Exp.	Temp. °C.	R. Q.	Small Cal.*	Character of Experiment	% change
21	25	1.30	10.9	Control	
22	25	0.72	11.6	Addition of thyroxin (3×10^{-6} g. per 1 cc. of blood)	
24	25	0.68	15.1	Control	
31	30	1.08	22.0	"	
32	30	0.99	21.8	Addition of thyroxin (7×10^{-6} g. per 1 cc. of blood)	-0.1
33	30	0.53	32.1	Injection of thyroxin 7×10^{-4} g.	+46
35	30	1.80	14.2	Incubation (7×10^{-6} g. in 1 cc.)	No change
36	30	0.90	14.4	Control	
37	30	0.70	13.9	"	
38a	30	1.16	18.6	Addition (6×10^{-6} g. in 1 cc.)	+17
39	30	0.99	15.7	Incubation (3×10^{-6} g. in 1 cc.)	+10
40†	30	0.81	24.0	Control	
41†	30	0.70	23.6	Injection (3×10^{-3} g.)	No change
43	30	0.86	68.8	" (4.5×10^{-3} g.)	+183
44	30	0.83	60.8	" "	+153
46	30	0.33	25.1	Addition of thyroxin (4×10^{-5} g. per cc. of blood)	+ 5
47	30	0.70	21.2	Addition of thyroxin (1×10^{-3} g. per cc. of blood)	- 10

*Small calory, the amount of heat necessary to raise the temperature of 1 gm. of water 1°C.

†Experiments No. 41 and 43 were run on the same animal.

‡Oxalate in isotonic concentration was used as an anticoagulant in previous experiments, heparin in this and later ones.

¹¹ Ellinger, *Z. f. phys. Chem.*, 1922, **119**, 11.

¹² Wohlgemuth and Klopstock, *Biochem. Z.*, 1926, **175**, 202.

¹³ Weil and Landsberg, *Biochem. Z.*, 1924, **207**, 186.

¹⁴ Ahlgren, *Skand. arch. f. Phys.*, 1925, **47**, supp. 225.

plated out at the end of the experiment, as a routine procedure, retaining only those showing negative results.

We find by this method of measuring tissue metabolism that the blood from an alligator injected with thyroxin (Squibbs) 3 days or so previously to the test may show an increase of from 150 to 190% above the control. Direct addition of thyroxin to the blood, on the other hand, has produced no change which has an interpretable significance.

We have been unable to demonstrate that incubation of thyroxin in the blood *in vitro* has an activating effect.

Further investigation is contemplated to confirm this metabolic increase in the tissues of the injected animal and to determine the mechanism by which it is brought about.

The considerable variations among the controls are apparently due to the different seasons, different laboratory conditions, different animals used, successive use of the same animal.¹⁵

5503

Effect of Adrenal Cortical Hormone Upon Respiratory Metabolism of Adrenalectomized Cats.*

W. W. SWINGLE, J. J. PFIFNER AND BRUCE WEBSTER.

From the Department of Medicine, College of Physicians and Surgeons, Columbia University, and Princeton University.

The material here presented represents an attempt to determine the effect of bilateral adrenalectomy on the respiratory exchange of cats, together with the changes in metabolism produced by the administration of the cortical hormone to these adrenalectomized animals. There is, in the literature, some confusion as to the effect of bilateral adrenalectomy on the metabolism of animals. Golyakowski¹ reported an increase in heat production after ligation of the blood supply of the adrenals in dogs. Marine and Baumann² reported an increase in metabolism in 53% of their rabbits where the adrenals were removed or injured by freezing. They noted no

¹⁵ Barron and Harrop, *J. Exp. Med.*, 1928, **48**, 207.

* This investigation has been aided by grants from the Josiah Macy, Jr., Foundation and Mrs. R. E. Breed.

¹ Golyakowski, *Vrach.*, St. Petersburg, 1899, **20**, 1017.

² Marine, D., and Baumann, E. J., *Am. J. Physiol.*, 1921, **57**, 135.