did not develop in any animal. When they were returned to the large cages all of the mice exhibited apparently normal activity. This test continued for 6 hours, the time required for the sensitivity to return to pre-injection level.

While the analgesic effect of dextro-amphetamine alone could not be determined in this experiment it is clear that the drug increased the analgesic effect of morphine while counteracting the narcotic effect of morphine. Antagonism, except with reference to analgesia, was further shown by the inhibition of the Straub reaction.

The method used in this experiment was not entirely satisfactory, but the results obtained are in agreement with those obtained in the dog experiments.

Summary. Experiments have been made on mice which demonstrate that dextro-amphetamine increases the analgesic effects of morphine while counteracting its narcotic action. Although a different method has been used in these studies the results agree with those obtained in dog experiments.

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Specificity of the Epiphyseal Cartilage Test for the Pituitary Growth Hormone.*

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Recently a procedure for the bioassay of the pituitary growth hormone was published in which the width of the uncalcified portion of the proximal epiphyseal cartilage of the tibia in hypophysectomized rats was used as the index of potency.[1] In order to investigate the specificity of this test it was considered necessary to determine the reaction of the epiphyseal cartilage to other hormones. This paper reports the effects of thyroxin, and of purified pituitary thyrotropic, adrenocorticotropic, and lactogenic hormones on the cartilage under the same conditions.

The procedure was exactly as described in the paper on the standardization of growth hormone: Female rats 26 to 28 days of age were hypophysectomized and after a 12- to 13-day post-operative period were injected daily intraperitoneally for 4 days with a particular hormone. Twenty-four hours after the last injection (17 to 18 days post-operative) the rats were autopsied and the proximal end of the tibia was split and fixed in neutral formol. After staining with silver nitrate the uncalcified portion of the epiphysis was measured with microscopic low power using a micrometer eye piece.

The results are summarized in Table I. After injection of thyroxin the cartilage width was slightly greater than in the controls; though the effect was small, it did approach that produced by the growth hormone unit.† No gradation of effect with increasing dosage was noted.

Pituitary thyrotropic hormone had no significant effect on the epiphyseal cartilage at doses as high as 0.6 mg. The preparation was kindly furnished by J. Fraenkel-Conrat.[2] Though not devoid of contaminants the preparation was highly potent having a mini-

* Aided by grants from the Board of Research of the University of California and the National Research Council Committee on Research in Endocrinology.

1 Evans, H. M., Simpson, M. E., Marx, W., and Kibrick, E., *Endocrinology*, 1943, **32**, 13.

† One growth hormone unit is defined as the daily dose of growth hormone which under these conditions produces an increase of 50 micra in the width of the uncalcified proximal epiphyseal cartilage of the tibia.

2 Fraenkel-Conrat, J., Fraenkel-Conrat, H., Simpson, M. E., and Evans, H. M., *J. Biol. Chem.*, 1940, **135**, 199.

TABLE I.
Effect of Hormones Other Than the Pituitary Growth Hormone on the Proximal Epiphyseal Cartilage of the Tibia.

Hormone	Daily dose, μg	No. of rats	Width of uncalcified cartilage: Mean, micra	Range, micra	Difference from control, micra
Thyroxin	30	15	191	138 to 248	+36
	15	39	201	146 to 286	+46
	5	31	186	120 to 287	+31
Thyrotropic hormone	600	7	184	169 to 210	+29
	200	8	157	120 to 177	+ 2
	67	7	160	143 to 186	+ 5
	22	8	139	115 to 184	—16
Adrenocorticotropic hormone	500	10	110	91 to 139	—45
	250	9	136	103 to 155	—19
	100	18	142	110 to 172	—13
	50	19	131	89 to 181	—24
	25	8	139	120 to 167	—16
Lactogenic hormone	4000	6	175	138 to 189	+20
	2000	8	179	169 to 198	+24
	1000	7	163	143 to 186	+ 8
	500	9	158	127 to 179	+ 3
Uninjected controls	0	103	155	108 to 205	0

TABLE II.
Effect of the Pituitary Growth Hormone on the Proximal Epiphyseal Cartilage of the Tibia.

Daily dose, μg	No. of rats	Width of uncalcified cartilage: Mean, micra	Range, micra	Difference from control, micra
150	15	285	220 to 309	+128
100	10	268	230 to 292	+111
50	25	249	197 to 292	+ 92
40	9	232	172 to 299	+ 75
20	19	210	151 to 308	+ 53
10	20	194	163 to 268	+ 37
5	9	175	140 to 220	+ 18
0	46	157	112 to 199	0

mum effective dose in one-day-old chicks of 20 μg.

Adrenocorticotropic hormone prepared by Li[3] in electrophoretically pure form, and containing 20 adrenal-repair units per mg, was definitely not a stimulant of the epiphyseal cartilage; in fact, the discs were consistently narrower than those of the hypophysectomized controls. A similar result has been reported for a 15-day injection period by Marx, Simpson, Li, and Evans.[4]

The epiphyseal cartilage of rats injected with lactogenic hormone prepared by Lyons,[5] and containing 25 to 30 international units per mg, was slightly wider than that of controls. The increase was not significant, however, even when the substance was injected in doses as high as 4.0 mg daily.

For purposes of comparison, the response to the hypophyseal growth hormone as regards width of the epiphyseal cartilage is shown in Table II. In these experiments, a "cysteine treated globulin fraction"[6] was used, con-

[3] Li, C. H., Simpson, M. E., and Evans, H. M., *Science*, 1942, **96**, 450.

[4] Marx, W., Simpson, M. E., Li, C. H., and Evans, H. M., *Endocrinology*, 1943, **33**, 102.

[5] Lyons, W. R., *Cold Spring Harbor Symposium on Quant. Biol.*, 1937, **5**, 198.

taining approximately 25 growth hormone units per mg (body weight test in hypophysectomized rats),[7] but less than 1% of any of the other known pituitary hormones. It will be noted that in the case of the growth hormone, markedly larger effects were secured, increasing with increasing dosage. This was not the case with any of the other hormones here employed.

Summary. 1. Purified anterior hypophyseal hormones other than the growth hormone were administered to hypophysectomized rats for a period of 4 days and measurements made of the width of the uncalcified portion of the proximal epiphyseal cartilage of the tibia. 2. While adrenotropic hormone slightly decreased the cartilage width, thyroxin and the thyrotropic as well as the mammotropic hormones caused slight enlargement of the epiphyseal cartilage. The effect was smaller, however, than the response caused by a single growth hormone unit, at all dose levels tested, and the effect did not show gradation with dosage which is a characteristic of the growth substance.

[6] Marx, W., Simpson, M. E., and Evans, H. M., *J. Biol. Chem.*, 1943, **147**, 77.

[7] Marx, W., Simpson, M. E., and Evans, H. M., *Endocrinology*, 1942, **30**, 1.

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A Comparison of Regeneration and Respiration Rates of Tubularia.*

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Barth[1] showed that oxygen can be made the determining factor in the polarity and rate of regeneration of Tubularia stems. In an attempt to find the metabolic basis of regeneration, Barth[2] investigated the relation between oxygen consumption rates and regeneration rates, and found a general parallelism between the two at various oxygen tensions. In the same study a comparison of the oxygen consumption rates of regenerating versus resting stems showed comparatively little difference between the two groups. This important finding indicated that while the process of regeneration depended on some portion of the aerobic metabolism, a relatively small part of the overall respiration was involved. Moog and Spiegelman[3] were able to show with the use of various respiratory poisons that complete inhibition of regeneration could be obtained without any parallel effect on respiration that was measurable.

These findings imply that the stimulatory effect on regeneration of increased oxygen tensions is a non-specific one and can be interpreted as a general influence on all oxygen consuming systems.

Goldin[4] found that at oxygen tensions at which normal regeneration rates might be expected, complete inhibition could be obtained by lowering the hydrogen ion concentration sufficiently. Therefore it was of importance to determine whether the pH effect on regeneration was mediated through its effect on the overall oxygen consumption or whether it was of a more specific nature such as was found with some of the respiratory inhibitors.

Methods. Young, unbranched Tubularia stems of uniform diameter were selected from colonies gathered from the waters of Cape Cod

* This investigation was carried on with the aid of a Rockefeller grant administered by Dr. H. B. Steinbach.

[1] Barth, L. G., *Physiol. Zool.*, 1938, **11**, 179.

[2] Barth, L. G., *Biol. Bull.*, 1940, **78**, 366.

[3] Moog, F., and Spiegelman, S., PROC. SOC. EXP. BIOL. AND MED., 1942, **49**, 392.

[4] Goldin, A., *Biol. Bull.*, 1942, **82**, 243.