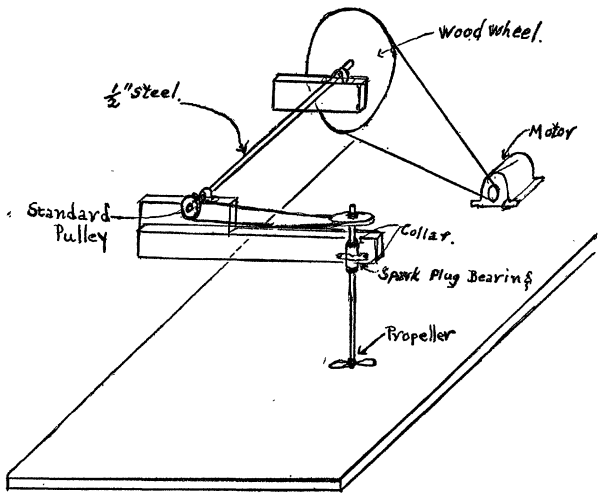

FIG. 1

in diameter. I had some turned out of wood of 12- and 16-inch diameter with a groove along the edge. By using a standard pulley 4 inches in diameter and drilling holes through the web, I made the hub for the larger pulleys. The wooden pulleys were bolted on to the smaller one which could be clamped by means of set screws to the shaft. Sometimes an old sewing machine wheel can be used, but they are rather heavy and unwieldy.

I was somewhat stumped for a vertical bearing to use on the vertical agitator shafts. I finally found that by taking out the center of an ordinary spark plug, placing a shaft in it and then filling it up with lead, thus forming a bearing, I had a very good bearing which would stand up for quite some time. The shaft and agitator bearings were fastened to ordinary two by fours and securely braced. The use of standard home workshop parts which are usually easy to procure in any city makes for a very flexible arrangement, especially where rather heavy materials in fairly large batches are to be mixed for long periods of time.

K. B. HUMPHREY

WATERLOO, WIS.

SPECIAL ARTICLES

THE BIOLOGICAL EFFECTS OF THYMUS EXTRACT (HANSON)[1]

FOLLOWING the continuous administration of thymus extract to successive generations of parents, marked acceleration in the rate of growth and development has been observed during the early life of the offspring, particularly of the third and later generations. Thus the rate of development encountered in the fifth generation of young rats born of four generations of thymus-treated forebears is almost beyond belief.

A small colony of white rats was secured from the Wistar Institute on June 16, 1933. These were divided into test and control groups. The test animals have been subjected to date to intraperitoneal injection of 1 cc of thymus extract (Hanson) daily, even during the periods of pregnancy and lactation. Litter mates born to these rats have been mated in pairs and these have likewise been so treated and the effects on parents and on the offspring noted. Thus original test animals of the first generation (F_0) have undergone continuous treatment since June 16, 1933; the F_1 generation since September 10, 1933; the F_2 generation since September 25, 1933; the F_3 generation since January 19, 1934; and the F_4 generation since April 15, 1934. In the young treatment has usually been begun from the 16th to the 20th day after birth in the prepubertal group and from the 40th to the 60th day in the mature group.

The extract used in these experiments was prepared by Hanson[2] in 1930 briefly as follows: The thymi from 2 to 6 weeks old calves were extracted in 0.5 per cent. HCl solution with the aid of heat. This extraction differs from the extraction from parathyroids by Hanson simply in the degree of acidity used in its preparation. This preparation is extremely stable and is entirely potent and satisfactory for injection in rats even after being kept at room temperature from 2½ to 4 years. The extract was golden yellow in color and resembled bouillon in taste and smell. It has a pH of about 5.0 and is non-toxic in relatively large doses and non-irritating locally on injection.

In summarizing the results of treatment in the second generation (F_1), it might be said that treatment of the parents with thymus extract (Hanson) apparently results in an increased number of litters, an increase in the size of the litters, an increased birth weight and a decreased infant mortality compared with our controls. In later litters born to such parents, evidences of precocity appear, *i.e.*, increased birth weight, earlier eruption of the teeth, appearance of fur, opening of the eyes, descent of the testes and opening of the vagina.

The accruing precocity in successive generations of rats of the third, fourth and fifth generations is shown in the accompanying table.

[1] From the Philadelphia Institute for Medical Research (the Samuel Bell, Jr., Laboratory) in the Philadelphia General Hospital, the Laboratories of the Philadelphia General Hospital, Philadelphia, Pennsylvania, and the Hanson Research Laboratory, Faribault, Minnesota. With the technical assistance of Arthur Steinberg, B.S.

[2] *Jour. American Medical Association*, 94: 653, 1930.

THYMUS-TREATED RATS CONTRASTED WITH CONTROLS

	Controls	F_1	F_2	F_3	F_4
Average birth weight in gms	4.6	5.0	5.2	5.7	5.7
Ears opened (days)	2½–4	2	1–2	1	1
Teeth erupted (days)	9–10	4.7	1–2	1	1
Hair appeared (days)	14–17	10–14	4–6	4–5	3
Eyes opened (days)	14–17	12–15	4–6	4–5	3
Testes descended (days)	35–40	15–29	5–9	4–6	4–5
Vagina opened (days)	60–70	35–45	23–31	21–25	18–19

Weight curves of rats under the influence of thymus extract reveal a markedly accruing acceleration in the third, fourth and fifth generations. This is shown in the accompanying figure in which C represents the controls, F_1 the second generation, F_2 the third, F_3 the fourth and F_4 the fifth generation under the effects of excess of thymus. The shaded areas represent the growth curve of more than 2,000 Wistar rats between October 7, 1933, and January 30, 1934. A study of these curves indicates that treated animals of the third, fourth and fifth generations at all times from the fourth to the fortieth day weighed more than double the control rats and at all times up to thirty days of age outweighed the rats of the Wistar Institute. Between the third and the twentieth day our fifth generation rats exceeded the Wistar rats in weight by more than 100 per cent. After the sixtieth day these curves tend to come together, so that eventually the test animals are not perceptibly larger than the controls. Giants do not result. Thymus effects concern primarily early growth and development.

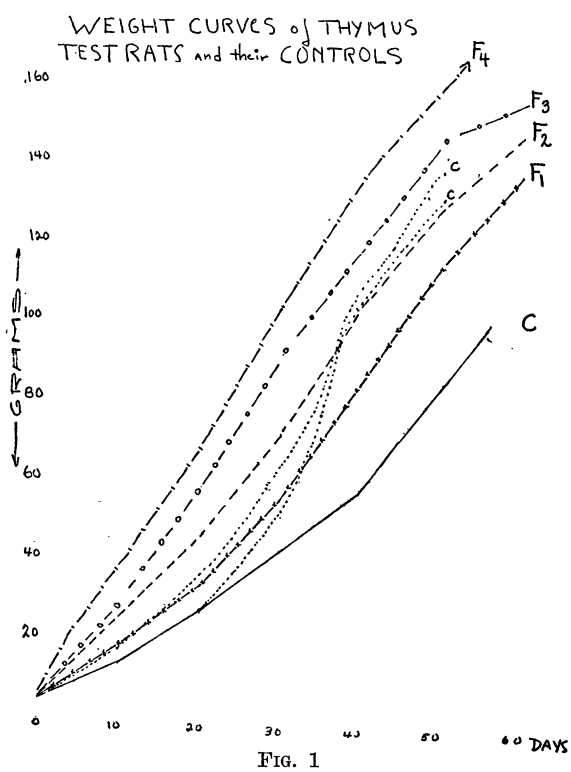

FIG. 1

The psychical precocity is as striking as the physical in the thymus-treated strain of rats. Thus fifth generation (F_4) test animals appear almost as capable and alert as normal rats of 16 to 20 days of age. Weaning is possible at 3 days of age. Animals weaned as early as the third day have fared as well or better than their litter mates left with their parents.

The thymus treated animals appear to be healthy, contented and docile. Their actions, asleep or awake, resemble those of normal controls in every way. They do not resent the needle to any great extent, apparently suffering no pain or distress following the injection of thymus extract.

Thymus extract administered to the parents accelerates the rate of growth and development in the young. The normal relation of growth and development to time is disturbed and precocity results. Accruing acceleration in growth and development is encountered in succeeding generations born to thymus-treated parents. The results with the thymus extract have led us to adopt the same procedure in the study of other hormones and glandular products with the idea of amplifying evidence of their effects.

L. G. ROWNTREE
J. H. CLARK
A. M. HANSON

ISOLATION OF THE INFECTIVE PRINCIPLE OF VIRUS DISEASES

A NUMBER of attempts have been made to concentrate the infective principle of virus diseases, particularly of tobacco mosaic. Considerable success has been attained in these efforts and the results are of great interest. If the virus is non-living the isolation of the virus as a definite chemical compound might be anticipated as the end result of such efforts. Without attempting a discussion of the living or non-living character of the causative agents of virus diseases, the following calculations are of interest in relation to the isolation of the infective principle.

Assume the molecular weight of the infective principle to be 100,000; then 100,000 grams of pure infective principle will contain 6.06×10^{23} molecules and one molecule will weigh $10^{-18} \times \frac{1}{6.06}$ grams. Assume the number of infective particles per cubic centimeter of juice to be 1,000,000; then one cubic centimeter of juice will contain $10^{-12} \times \frac{1}{6.06}$ grams of infective material. To secure 0.1 gram of pure infective material,