genesis in the hypophysectomized rat.[1] It will also maintain, or repair damage to, the accessory reproductive organs of the castrated rat.[2] However, it does produce injury to the seminiferous tubules of young, growing, normal rats.[3]

The determinations of the number of spermatozoa in an ejaculation were obtained by counting them in a blood counting chamber (the diluent containing 5% soda and 1% formalin), multiplying the result by 1000 to obtain the number per cubic centimeter, and again multiplying the result by the number of centimeters of semen. The result plotted was the average of at least 2 to 4 determinations on each specimen.

Summary. The daily subcutaneous injection of 10 to 25 mg of testosterone depressed the spermatozoa count in a 67-year-old man. After its withdrawal the number of spermatozoa increased and during a second period of testosterone therapy the number of spermatozoa again decreased. The duration of the 2 periods of treatment, the daily dosage, and the variation in the spermatozoa counts are presented in the graph.

10528

Skin Transplantations Between Hairless and Haired Rats.*

HERBERT GERSHBERG. (Introduced by Ernst Fischer.)

From the Department of Zoology, University of Maryland.

The experiments reported here are an attempt to determine whether genetic hairlessness in the rat (inherited as a simple recessive) is due mainly to factors in the skin or to an endocrine abnormality. Emery[1] discusses a possible relationship between the hypophysis and the hairless condition. But Martin and Gardner,[2] feeding equivalent amounts of cysteine, cystine and glutathione to hairless rats, concluded that

1 Walsh, E. L., Cuyler, W. K., and McCullagh, D. R., *Am. J. Physiol.*, 1934, **107**, 508; Nelson, W. O., and Merckel, C., PROC. SOC. EXP. BIOL. AND MED., 1937, **36**, 825.

2 Callow, R. K., and Deanesly, Ruth, *J. Biochem.*, 1935, **29**, 1424; Moore, C. R., and Price, D., *Endocrinology*, 1937, **21**, 313; Moore, C. R., and Price, D., *Anat. Rec.*, 1938, **71**, 59.

3 Moore, C. R., Lamar, Jule K., and Beck, Naomi, *J. A. M. A.*, 1938, **111**, 11; Moore, C. R., and Price, D., *Anat. Rec.*, 1938, **71**, 59.

* The author wishes to express thanks to Dr. S. O. Burhoe for his help and suggestions.

1 Emery, F. E., *Am. J. Physiol.*, 1935, **111**, 392.

2 Martin, G. J., and Gardner, R. E., *J. Biol. Chem.*, 1935, **111**, 193.

the mechanism for the hydrolysis of glutathione and other peptide linkages involving S-containing groups is hereditarily absent in the hairless rat, and that this faulty mechanism is responsible for the hairless condition.

The question still remains as to whether the mechanism resides in the follicles or elsewhere. Nor is the possibility of endocrine complication precluded. Skin transplantation offers a possible approach to the solution. Crew and Mirskaia[3] attempted transplantation between recessive hairless and haired mice with no success. David,[4] working with mice, obtained on a normal host one successful hairless graft, but this was replaced by host skin before any definite conclusions could be made. One normal graft on a hairless mouse regenerated hair 3 weeks after grafting and remained well haired until fixation, 126 days after.

At birth and up until about 19 days of age the hairless rats cannot be distinguished from their haired litter-mates. About 18-21 days after birth depilation begins and is usually complete in 2 weeks. The adult has subnormal vitality and a shorter life-span, and the female is generally sterile and non-lactating.

All the rats were operated on as soon after weaning age as possible, since any attempt to use younger rats met with failure.

In a preliminary series, pieces of skin were exchanged between 3 hairless and haired rats in the region dorsal to the scapula. The reactions were definitely negative, the grafts scabbing off within 2 weeks. Moreover, since Crew and Mirskaia, using dorsal transplants had obtained no takes, it was decided to try ventral transplants. The ventral skin was noticeably much thinner, and the reaction of the host to the graft was more favorable. The results reported here are all on ventral transplants.

A. *Autotransplants.* Several pieces of skin were cut off and sutured back in the same site. With the 2 haired rats thus operated on, an initial loss of hair was followed by a reappearance of hair on the graft in one case 16 days, and in the other, 25 days after operation. The 4 hairless autotransplants were successful, the grafts undergoing no noticeable absorption. But 18-30 days after operation hair growths appeared on the original hairless grafts. This growth consisted of several long, straggly hairs, similar to those found on hairless rats several months of age. In addition, such a secondary growth of hairs on the back and abdomen was noticed on these and almost all the hairless rats which had been operated on.

[3] Crew, F. A. E., and Mirskaia, L., *J. Genetics*, 1931, **25**, 17.

[4] David, L. T., *J. Exp. Zool.*, 1934, **68-69**, 501.

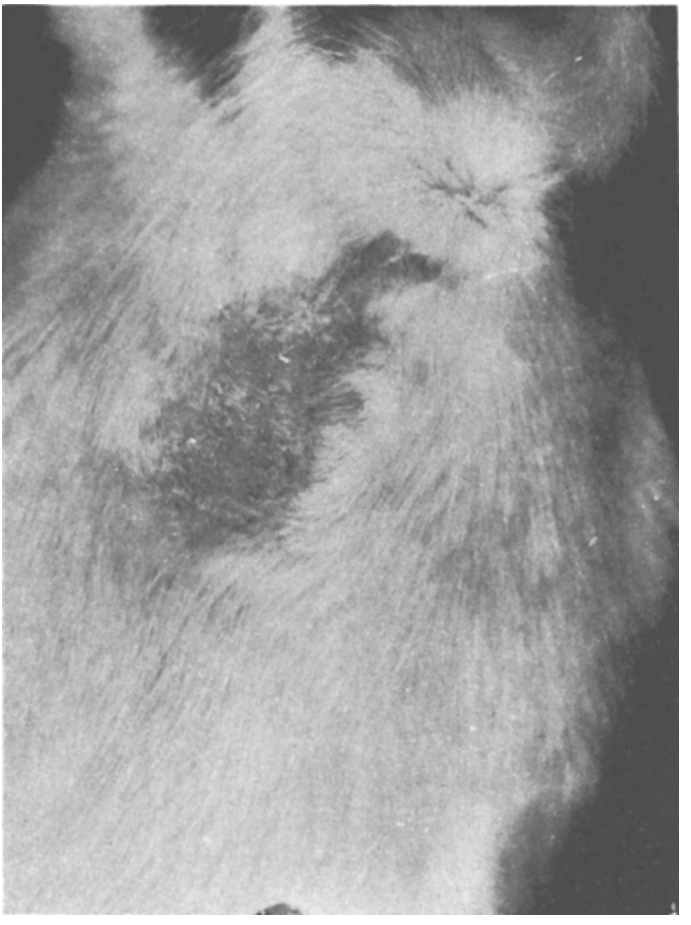

FIG. 1.
Hairless transplant on haired rat, 74 days after transplantation.

B. *Homoiotransplants.* Pieces of skin were exchanged between 6 hairless litter-mates. The reactions were antagonistic; the tissue was absorbed quickly or scabbed off. One graft "took" for 40 days and was then absorbed. On this graft a growth of several fine hairs occurred 23-26 days after operation.

Eighteen pieces of skin were exchanged between hairless and haired rats. Both series of grafts "took" equally well, but 2-4 weeks later most of the grafts in both series either scabbed or were absorbed. Therefore, although data on 25 rats are available, only 3 grafts can be called successful. Two are hairless transplants on haired rats, the other a haired transplant on a hairless rat.

Fig. 1 shows the successful hairless graft on haired rat No. 5,

74 days after operation. Twenty-five days after operation a few isolated fine hairs were noticed on the graft. These shed off after 10-12 days and were followed by a similar growth 14-17 days after. No subsequent hair growths occurred there after the second. The skin at this time showed the characteristics of hairless skin, being rough, thickened, and having a pinkish brown color. It became thicker with age and could very easily be identified by touch from the surrounding host skin. Observations on this graft were made up until the 80th day after operation, at which time the feeding experiment was begun.

On the hairless transplant on haired rat No. 344, (Fig.2) a growth

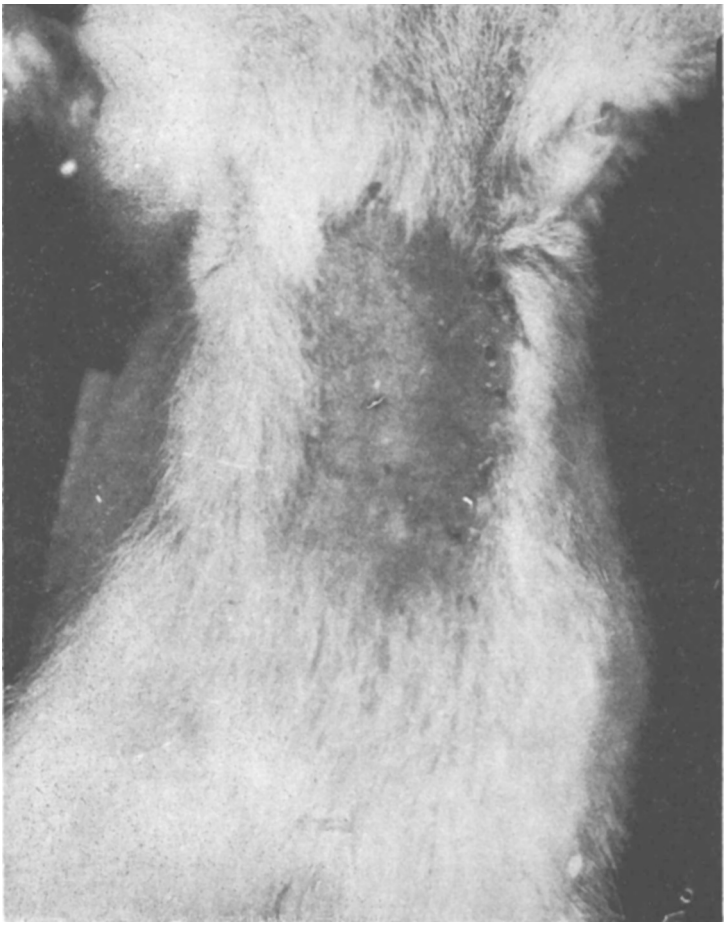

FIG. 2.
Hairless transplant on haired rat, 3 weeks after transplantation.

of several long hairs occurred 16-18 days after operation. This shed 8-10 days after. Unlike the other hairless transplant this one had not, after 9 months, undergone degeneration, but remained soft and pliable although hairless. Normal hairless skin of this age is considerably more thickened and wrinkled. Thus it seems that the effect of operation is to stimulate a few follicles to produce long hairs, but the hairless skin remains "hairless" even though in a "haired" environment.

The one successful haired graft on a hairless rat produced an abundant supply of hair. This growth began after 13 days and reached its peak about 2 weeks later. Forty-three days after operation the transplant underwent absorption which was complete within one week. In rats 21, 1296, 25, and 346 the second superficial layer scaling off the graft contained a new growth of numerous short hairs, the older hair having come off with the first layer.

The results of the transplants thus point to the conclusion that the factors for hairlessness reside principally in the skin. In the presence of so small a number of "takes", no conclusions as to the optimum age or sanguinity of host and donor can be ventured. However, the 3 "takes" were syngenesiotransplants; that is, donor or host were litter-mates. The operation was performed when the rats were comparatively young (19 days of age). Relative to this, a personal communication from Crew suggests the use of young animals. The most antagonistic reactions were encountered in the dorsal homoiotransplants in which the grafts sloughed off early as scabs. These reactions are very probably due to the thickness of the skin on the dorsum of the hairless rat, since no such sloughings were encountered in any of the ventral transplants.

C. *Stimulative Effect of Operation.* Crew observed a growth of fine hairs over the dorsum of hairless mice about 15 days after transplantation. David states that this growth was probably the periodic partial regeneration which naturally occurs in these mice. My experiments partially confirm Crew's, since my controls, the remainder of the hairless stock, have never shown any appreciable regeneration of hair. No difference in stimulative effect is manifested by the type of graft; *i. e.*, autotransplant or homoiotransplant, nor by the sex of the animal. These results, however, demonstrate that the operation itself produced such a regrowth of hairs.

Abdominal growth occurred before the dorsal growth. The amount of growth varied inversely with the age of the animal at the time of operation; only very little hair growth was observed in animals older than 80 days.

Fig. 3 shows an example of marked secondary growth, about a

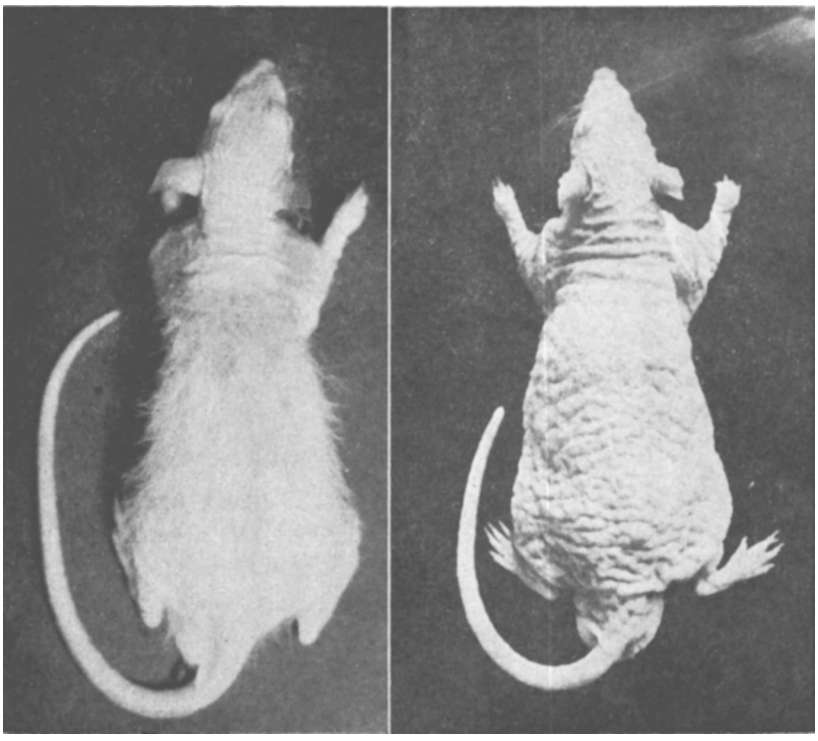

FIG. 3.
Comparison between operated hairless rat with secondary hair growth and unoperated hairless rat of the same age.

week after the hair began to shed, in comparison with a control of approximately the same age. It should be mentioned that this secondary growth as stimulated by the operation skipped one hair cycle; thus, instead of occurring in the following period of hair growth it occurred in most of the cases in the second cycle after the operation.

The fact that this growth occurs not only at the site of operation but all over the body deserves further investigation.

Effect of Cysteine. The transplantations afford evidence that the hairless skin is the local expression of a gene complex. This seems difficult to connect with the results of Martin and Gardner unless we assume that the enzyme suggested by them is present in the skin of haired rats and not present in hairless skin. By feeding cysteine to the haired rat it was felt that it should be possible to reach a concentration in the blood by which the hairless transplant would be stimulated. The 2 rats with the hairless grafts were fed daily supplements of 50 mg of cysteine-HCl for 2 months, but there

was no increase in the hair on the graft. Two other rats, both hairless, one a litter-mate and one 111 days of age, were fed the same amount for the same length of time, but no change in the hair was apparent. The hairless skin of my rats may have been too old to be stimulated, since the youngest rat was 59 days old, whereas rats 30 days old were used by Martin and Gardner. However, Roberts,[5] using rats 28-42 days old, has repeated the work of Martin and Gardner and obtained no secondary growth on the hairless rats.

Summary. The results seem to indicate that the factors for hereditary hairlessness of the rat reside principally in the skin. The effect of operation on the hairless rat is to stimulate a secondary growth of hair, the amount of growth decreasing with the age of the rat. This growth is not confined to the site of operation but occurs over the whole body.

10529 P

Diagnosis of Pancreatic Disease; Limitations of Present Blood Diastase Test, Suggestion for Increasing its Effectiveness.

J. M. MCCAUGHAN.

From the Department of Experimental Surgery, St. Louis University.

Although the diastatic activity of the blood was known as long ago as 1846[1] it was not until Wohlgemuth[2] developed his method of quantitative estimation that the subject began to receive the attention of clinicians. Since that time other more accurate methods have been devised for the micro-estimation of diastase in blood and urine.[3]

Clinical experience with the method in the diagnosis of pancreatic disease has led to the conclusion that it is one of the most valuable diagnostic procedures available particularly in acute pancreatitis.[4] Unfortunately, the value of the test is limited by the fact that the rise and subsequent fall in the concentration of the diastase after mechanical obstruction of the pancreatic ducts takes place over a comparatively short period of time, usually 2 to 3 days to attain a maximum height and 10 to 14 days to recede to normal.

With this restriction in mind, it is obvious that normal values

[5] Roberts, E., *J. Biol. Chem.*, 1937, **118**, 627.

[1] *Magendie Gaz. med. de Par.*, 1846, **1**, 73.

[2] Wohlgemuth, J., *Bromchem. Z.*, 1908, **9**, 1.

[3] Somogyi, M., *J. Biol. Chem.*, 1938, **125**, 399.

[4] Cole, W. H., *Am. J. Surg.*, 1938, **40**, 245.