our strain of *Sal. typhimurium* and CF 1 mice.

Summary. 1. Citric acid content (γ/g wet wt) of blood, diaphragm, duodenum, heart, kidney, liver, lung, and spleen was determined colorimetrically in the following groups of mice: (a) normal mice, (b) mice exposed to simulated altitude of 20,000 ft for 3 to 4 months, (c) mice given daily intraperitoneal injections of 1 mg cortisone acetate for 2 weeks, and (d) mice starved for 17 hours. 2. Mice of group (b) had 20-30% less tissue citrate than control mice. In group (c) there was no change in tissue citrate except in kidney, which increased, and in spleen, which decreased. Tissues from starved animals showed a significant increase in citrate in all tissues. Thus the change observed in group (b) cannot be correlated with cortisone injections nor with a reduced blood sugar level induced by inanition. 3. Altitude exposed mice are more susceptible to *Sal. typhimurium* infection than control mice.

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Relation of Number of Transplants to Total Volume of Regenerating Adrenocortical Tissue.* (23445)

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Wyman and tum Suden(1) found that the total amount of adrenocortical tissue regenerating in intramuscular autoplastic transplants in rats is fairly constant for each sex, irrespective of number of masses implanted or present, and suggested that a functional factor limits the growth of transplants. Eversole, Edelmann and Gaunt(2) pointed out the considerable variability in amount of tissue regenerating from single grafts in different sites and suggested that the principle stated by Wyman and tum Suden would hold only for a given site. In the Wyman and tum Suden study the transplants were measured during the third month after operation or later. Komrad and Wyman(3) found that resumption of function of adrenal transplants, beginning about one week after operation, proceeds in a progressive or stepwise manner, presumably reflecting an increase in volume of the secreting tissue. In a study of the effect of x-irradiation on growth of transplants(4) considerable variation in size of grafts was noticed at 14 days postoperation. An attempt was made, therefore, to assess the relation of number of implants or of surviving transplants to total volume of regenerating adrenocortical tissue in intramuscular grafts during the earlier stages of regeneration, and to find the time at which a limitation of growth appears.

Methods. Male rats of the Wistar strain, 35 days of age, weighing 80 to 120 g at operation, were maintained on Purina laboratory chow and tap water *ad libitum*. After operation saline drinking water was given for the duration of the experiment. The bisected adrenal glands were transplanted to the spinotrapezius muscle. Approximately equal numbers among the 56 rats used received one, 2, 3, or 4 implants of half a gland each. The rats were sacrificed at 9, 14, 21, or 90 days after operation and the number of regenerated transplants was determined. The fixed (Gilson's) tissues were serially sectioned in paraf-

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TABLE I. Relation of Number of Transplants to Total Volume of Regenerating Adrenocortical Tissue in Rats.

Age of transplant (days)	No. of transplants growing	No. of rats	Avg vol/rat (mm^3)	Avg vol/transplant (mm^3)	Avg cell depth/transplant	Avg cell depth/age group*
9	1	4	.05	.05	9.3	15.7
	2	4	.38	.19	15.3	
	3	3	1.1	.38	20.6	
	4	2	1.4	.34	14.1	
14	1	4	.27	.27	17.8	36.0
	2	5	1.6	.82	34.9	
	3	3	2.3	.76	31.1	
	4	4	3.0	.74	30.4	
21	1	4	2.5	2.5	55.5	58.8
	2	6	2.7	1.4	48.6	
	3	3	3.3	1.1	44.9	
	4	3	6.4	1.6	52.3	
90	1	3	7.0	7.0	74.0	89.1
	2	4	11.3	5.7	93.8	
	3	3	12.4	4.1	74.8	
	4	1	11.0	2.7	64.2	
Sham operated rats: intact adrenals	Day 9	3	15.0	7.5	72.6	82.0
	" 14	3	15.3	7.7	75.4	
	" 21	4	20.7	10.3	72.1	
	" 90	1	18.3	9.1	88.0	

* Calculated from greatest cell depth/animal.

fin at 24 μ and stained (H & E). Each section was projected, outlines of the adrenocortical masses were traced, the areas were measured (sq mm) by planimetry, and volumes (cu mm) were calculated. The volume of cortical tissue in the adrenals of 11 sham operated rats of the same postoperative ages was similarly determined. Cell depth measurements were made by counting the number of nuclei in a straight line between the capsule and the inner edge of the largest mass of regenerated tissue in the transplant.

Results. The volume of regenerated adrenocortical tissue increased with age but at 90 days after operation it was still less (about half) than that present in intact adrenal glands (Table I). This may have some relation to the intermediate position between intact and adrenalectomized animals that transplanted rats exhibit with respect to function as tested by stress tests(3). The cell depth at 90 days, however, was about the same as that of intact adrenals so the difference in volume resulted from the difference in form between the discrete single masses of the transplants and the hollow shell of an intact cortex. The equivalence of cell depths may indicate that at this time the transplants had reached the limit of their regenerative capacity.

During the first 2 weeks after operation, total volume of tissue per rat increased with the number of transplants regenerating while, except for the one transplant animals which lagged behind, average volumes and cell depths per transplant were roughly equivalent. At 21 days, however, the rats with one, 2, or 3 transplants had about the same total volume of tissue while the volumes per transplant showed an inverse relationship to number of grafts. The 4-transplant group had about twice as much tissue. The cell depths for all 4 groups were about the same. At 90 days the total volume of regenerated tissue per rat was about the same irrespective of number of transplants, so volumes per transplant for the entire series were inversely proportional to number of grafts. Again the cell depths for the 4 groups showed rough equivalence. In the sham operated control animals the volumes of their intact adrenals increased somewhat with increasing age but not remarkably, reaching a maximum at 21 days after operation when the rats were about 56 days old.

Discussion. From these data we may conclude that during the first 2 weeks after intra-

muscular implantation adrenocortical grafts while progressively resuming their function, are unable to deliver enough cortical secretion to establish the pituitary-adrenal equilibrium which is thought to regulate size and performance of adrenocortical tissue(1). After 2 weeks, however, the equilibrium becomes established, imperfectly at 21 days but completely at 90 days, and the amount of cortical tissue which can regenerate becomes more a function of time than of the number of regenerating masses.

Summary. The total volume of adrenocortical tissue regenerating in intramuscular autotransplants in rats during the first 2 weeks after operation is proportional to number of transplants growing. Thereafter, the total volume is about the same irrespective of the number of implants made or transplants regenerating, so the volumes per transplant are inversely proportional to the number of grafts. Average volume of regenerating tissue and cell depth increases with increasing age of transplant. At 90 days after operation the cell depth is like that of intact adrenal glands but the volume is less. Apparently transplants cannot deliver the amount of cortical secretion necessary to establish a pituitary-adrenal equilibrium until after 2 weeks of growth.

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Effect of Insulin on Clearance of Emulsified Fat from the Blood in Depancreatized Dogs.* (23446)

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The metabolic abnormality that underlies development of lipemia has not been determined. The frequent occurrence of this condition in association with uncontrolled diabetes and its disappearance with treatment suggests that carbohydrate metabolism is in some way linked to development of lipemia. Similarly, the presence of extreme lipemia in patients with von Gierke's disease seems indicative that abnormal carbohydrate metabolism is in some manner related to lipemia. Since diabetes and von Gierke's disease represent different disorders it is apparent that lipemia may arise from various metabolic disturbances. The blood lipids in these diseases are generally considered to be of exogenous origin(1) although this has not been proven and is in fact, contradicted by numerous clinical examples of severe and worsening lipemia despite a diminished food intake. In the diabetic there is rough parallelism between fasting blood sugar and degree of lipemia(2). Inasmuch as fat utilization is increased in the diabetic state, there has been no reason to suspect that failure to oxidize fat by liver and extrahepatic tissues could cause high-fat levels in the blood. Neither is there any connection between impairment of fat synthesis in diabetes(3) and the lipemic state. Stanley and Thannhauser(4) and Lever and Waddell (5) have indicated that there is slowed passage of fat from the blood in patients with idiopathic hyperlipemia.

It has long been known that insulin lowers the fat and cholesterol levels of the blood(1) and that it will prevent elevation of blood lipids and hepatic fat accumulation in ani-

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