SUMMARY AND CONCLUSIONS

CHAPTER 1.

Histochemical changes in glycogen content and phosphorylase activity of the pigeon breast muscle subjected to disuse atrophy were studied from 1 to 60 days. Of the two types of muscle fibres present in the pigeon breast muscle the broad, white glycogen-loaded fibres which are well adapted for anaerobic metabolism were found to lose their glycogen store and phosphorylase activity during the early days of atrophy. On the other hand, the narrow, red fat-loaded fibres which are well adapted for aerobic metabolism were found to acquire more glycogen and phosphorylase activity during the same period. The staining reaction of these fibres for phosphorylase presented a mosaic pattern. However, a few narrow fibres showed no increase in glycogen content and phosphorylase activity.

The histochemical observations also revealed that the majority of the broad fibres were reduced in size, filled with fat and separated by connective tissue during the later stages of atrophy. Such fibres disappeared or completely engulfed by connective tissue. Very few narrow fibres showed such changes. In certain regions an entire fasciculus containing both types of fibres was found to be replaced by fat and connective tissue.

CHAPTER 2.

Histochemical changes in succinic dehydrogenase acti-
vity in the pigeon breast muscle were studied 1 to 60 days of disuse after immobilization of the wings. The red, narrow fibres showed lower enzyme activity after seven days of atrophy. On the other hand in the white broad fibres, a uniform increase was observed. A corresponding increase in the number of mitochondria was also seen in the white fibres during the period. These changes in the two types of fibres were less conspicuous during the later stages of atrophy. Thus the general level of oxidative metabolism in the muscle as a whole was lowered inspite of the slight increase in the white fibres. It is suggested, that in both red and white fibres there was a shift in metabolism from aerobic to anaerobic or vice versa.

CHAPTER 3.

Histochemical studies on cholinesterase activity in the pigeon breast muscle subjected to disuse atrophy were carried out. The activities of both acetyl and butyryl cholinesterase showed an increase by the 7th day following immobilization of the wings. Thereafter a decrease was noted and by the 30th day it was more or less normal. Despite the significant variations in the enzyme activities, no alterations in the morphological structure of the neuromuscular junctions was observed. The significance of these changes in disuse atrophy is discussed.

CHAPTER 4.

A quantitative study of the electrolytes, calcium, sodium and potassium showed significant differences in the
muscle and blood when the pigeon pectoralis was under disuse. Calcium and potassium content of the muscle increased, during the initial stages of atrophy whereas there was a decrease in the concentrations of sodium. The variation seen in the concentrations of the electrolytes have been correlated with the metabolic shift occurring in the muscle when the wings are immobilized. The striking relationship between the muscle and serum electrolytes observed in the present study is suggestive of a high permeability of the muscle cells established during atrophy.

CHAPTER 5.

The capacity for fatty acid oxidation (Sodium butyrate) by the pigeon breast muscle under induced muscular atrophy was determined at varying time intervals during atrophy. It was observed that during atrophy the muscle homogenate is incapable of oxidizing fatty acids under in vitro conditions. The respiratory quotient of the muscle (muscle slices) during atrophy showed a value above 1 indicating a high conversion rate of carbohydrates into fat. These observations indicate that during atrophy there is increased lipid synthesis and a shift in the metabolic pattern of the muscle. The significance of these findings is discussed.

CHAPTER 6.

The histochemical changes in the red and white fibres of the pectoralis muscle of the pigeon after complete inactivation of the muscle by denervation have been studied
with respect to the localization of glycogen, fat, phosphorylase, succinic dehydrogenase, pentose cycle dehydrogenases, β-hydroxy butyric dehydrogenase, lipase, Tween 20 esterase, acid and alkaline phosphatases. It was observed that the majority of the red fibres which are normally adapted to an aerobic metabolism changed to one of glycolytic metabolism, whereas the glycolytic white fibres shifted to aerobic metabolism. The accumulation of lipid in the intra-cellular spaces and the higher activity of the pentose cycle enzymes indicated increased fat synthesis. The significance of these observations is discussed.

CHAPTER 7.

A quantitative study of glycogen, phosphorylase, succinic dehydrogenase and lipase was carried out on the denervated pigeon breast muscle at varying periods of atrophy (7 to 30 days). A drastic depletion in the content of glycogen was noticed immediately after denervation, the lowest level being observed on the 30th day. Phosphorylase on the other hand increased during the initial stages of atrophy and then gradually decreased reaching the minimum by the 30th day. Succinid dehydrogenase and lipase were also seen to reduce gradually well in accord with the increase of atrophy. These findings are discussed with reference to the metabolic disturbance in the muscle.

CHAPTER 8.

Histochemical observations on the muscle biopsy
samples of human muscular dystrophy patients were made in order to evaluate the findings obtained with experimentally induced atrophy in the pigeon breast muscle. Glycogen, fat, phosphorylase, UDPG glycogen transglucosylase (Glycogen synthetase) succinic dehydrogenase, dihydrolipoic dehydrogenase, lipase, Tween 20 esterase, acid and alkaline phosphatase were studied histochemically. In dystrophic muscle glycogen got depleted from the fibres in which it was normally present. On the other hand narrow red fibres gave a positive reaction for glycogen. Large deposits of fat were noticed in between the fibres. Phosphorylase also got depleted from the broad, white fibres. Succinic dehydrogenase and lipase activities were very much reduced in the muscle fibres whereas an increase in the activities of $\beta$-hydroxy butyric dehydrogenase and pentose cycle enzymes was observed. Alkaline phosphatase activity was mostly confined to the degenerated regions and to the connective tissue. Only very little activity was seen in the case of acid phosphatase.

The above mentioned findings are suggestive of active fat synthesis taking place but diminished fat utilization during atrophy.

CHAPTER 9.

Quantitative assessments of lipase levels in the muscle biopsy samples of muscular dystrophy patients were made. In the cases where the morphological derangement was less prominent, the lipase activity was seen to be high.
On the other hand in those cases which were severely afflicted with the disease the enzyme level was very much reduced. This possibly suggests that during the initial stages of dystrophy the enzyme activity was in favour of fat synthesis. As the fat deposition takes place the enzyme activity also diminishes.