A Study On Some Aspects of Reciprocal Recurrent Selection in Mice

Thesis

Submitted to the

RAJENDRA AGRICULTURAL UNIVERSITY BIHAR

in partial fulfilment of the requirements

for the degree of

MASTER OF SCIENCE (ANIMAL HUSBANDRY)

BY

Subran Lal Shrest

B. V. Sc. & A H.

Post Graduate Department of Animal Genetics & Breeding

BIHAR VETERINARY COLLEGE

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DEDICATED

IN THE MEMORY

OF MY

LATE MOTHER

Dr. H.R.Mishra, M.S., Ph.D.(Minn.),U.S.A.,
Professor and Head,
Postgraduate Department of Animal
Genetics and Breeding,
Bihar Veterinary College,
PATNA.

I certify that this THESIS has been prepared under my supervision by Shri S.L.Shrest, a candidate for the degree of Master of Science (A.H.), with Animal Genetics and Breeding as major subject, and that it incorporates the results of his independent study.

H. R. Mishra

(H . R. MISHRA)

PATNA
Dated the 13th March,
1972.

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(S.L. Shrest).

C O N T E N T S

ABBREVIATIONS AND SYMBOLS USED

b	Regression coefficient
C.V.	Coefficient of variation
C.D.	Critical difference
cf.	Correction factor
C(b)	Corrected b
Cu.fre.	Cummulative frequency
d.f.	Degree of freedom
Fre.	Frequency
h^2	Heritability coefficient
I.S.	Intensity of selection
L	Litter
M.D.	Mean difference
M.S.	Mean sum of squares
N.S.	Non-significant
R.C.	Reciprocal cross
R.R.S.	Reciprocal Recurrent selection
S.E.	Standard error
S.	Summation
S.P.	Sum of product
S.D.	Selection differential
S.R.B.	Selective random breeding
6^2	Variance

CHAPTET - I

INTRODUCTION

INTRODUCTION

In the field of animal breeding, creation and utilisation of heterosis in successive generations is of vital concern. The commercial breeding of livestock depends upon how much heterosis could be produced by maintaining their vitality in subsequent generations. The heterotic type of animals are usually found to be better in many respects such as growth rate,efficiency of food utilisation, fertility, vitality and resistance to rigours of environment etc.

In agricultural field tremendous achievement has been made in producing commercial hybrid maize. Nearly 50 percent improvement has already been made in the yield of maize, grown commercially in the United States, since hybrid seeds started to be used in the early 1930's (Mangelsdorf, 1951).

This sort of success with animals, however, has been much less. The reasons may be the lower reproductive rate, longer generation interval and the greater amount of cost, space and labour required with animals. These factors add substantially to the difficulty of producing and testing the inbred lines in animals. Further, a large proportion of the lines die out from inbreeding depression before any useful level of inbreeding has been reached.

The utilisation of heterosis depends on certain genetic principles. The inbreeding and crossing alone cannot improve the genetic quality of the livestock, unless the method of selection is supplemented. The crosses made at random between inbred lines without selection mostly have a mean value equal to that of the base population. Some improvements can be expected from the effects of natural selection. As the lethal and severely deleterious genes produced by inbreeding are naturally eliminated. But this improvement will not be of much consequence. Crow(1948) calculated, on the basis of assumptions about the number of loci concerned and their mutation rates, that an improvement of 5 percent in fitness will be the maximum, that could be expected from the elimination of deleterious recessive genes. Therefore, the bulk of the improvement can be achieved, only by applying the artificial selection techniques to the economically desirable characters.

Now, the animal breeders are interested to see the effect of selection than to the effect of inbreeding. Because,in this method there is less risk of getting deleterious effects of genes.

The new techniques, which have been used are recurrent selection and reciprocal recurrent selection. In plant breeding, both the techniques of selection bring about substantial improvement to the production and utilisation of heterosis, specially in the production of commercial hybrid maize. However, Jenkins (1935) suggested the selection of inbred lines on the basis of general combining ability, which had been used extensively by many other workers. Most corn breeders began more intense selection for vigour within and among lines during the inbreeding process, and selection among lines for general combining ability. This method of selection was found to be best when there was incomplete dominance of genes at different loci.

Now-a-days, many breeders are using the methods of Recurrent selection and Reciprocal Recurrent selection in poultry and swine to improve the genetic quality and production of economic traits.

Hull (1945) proposed Recurrent selection to improve the specific combining ability of an inbred line. The principle of this method was to take greater advantage of the interaction of genes and the resultant over-dominance by selecting inbred lines. Although the idea of Recurrent selection developed out of convergent improvement proposed by Richey (1927), the aim was different in both the systems. The success of convergent improvement is dependent on the ability of the breeder to accumulate a greater number of genes having additive effects, whereas in Recurrent selection the ultimate success is dependent upon the accumulation of genes in two different parental lines, which interact to increase the advantage of crosses.

Recurrent selection differs from that of Reciprocal Recurrent selection as outlined by Comstock <u>et al</u>.(1949). In recurrent selection there will be one common tester stock (homozygous) which had been proved previously for its combining ability. The other stock, which we want to improve will be crossed with tester stock. Selection is to be based on the performance of the top crossed progenies. Selected individuals are interbred and new top crosses made for the next selection cycle. The importance of this method is to test the individual vigour from the cross-bred population in crosses with tester stock.

In the Reciprocal Recurrent selection, source 'A' stock is tested against source 'B' stock and vice-versa, whereas in recurrent selection, all selection materials are tested against the same tester. Thus, the difference between the two methods is in the tester stock.

Recurrent selection is found to be less effective, when there is partial dominance or incomplete dominance.

Comstock et al. (1949) suggested a modification of recurrent selection, which they termed Reciprocal Recurrent selection. In this method of selection two different stocks 'A' and 'B', which are genetically divergent to each other, are to be used. The individuals obtained from two different sources are crossed reciprocally. The cross-bred progenies are evaluated and the parents are selected on the basis of the best performance of the progeny. The selected individuals are then remated randomly to the members of their own line to produce next generation of parents, which serve as a source material for the new cycle of reciprocal recurrent selection.

This method has an advantage over other methods mentioned above, because this method of selection is effective at any level of dominance, regardless of genes showing complete or partial dominance. Thus, reciprocal recurrent selection does appear to be the safest and most efficient method to know the relative importance of partial dominance, dominance, over-dominance and additive genetic factor in determining combining ability.

In the present study the reciprocal recurrent selection was resorted to find out the improvement, in respect of body weight of mice at 28 days of age.

Since R.R.S.(Reciprocal recurrent selection) is being used in livestock improvement, specially in case of swine and poultry, and the informations obtained on mice may be of use in those species, a study on some aspects of R.R.S. has been planned, details of which are contained in the following chapters.

CHAPTER - II

REVIEW OF LITERATURES

REVIEW OF LITERATURES

The current interest in the field of animal breeding is to improve the economic traits of livestocks by reshuffling the genetic architecture of various characters and reorganising the size of genes, bringing together as many desirable genes as possible, through the media of different techniques of selection and breeding methods.

Many animal breeders have taken lot of pains for establishing different techniques of selection, their pattern, and response, modified by the mating system employed. If the limit has been reached, the nature of limit in genetic terms and the ways to overcome them have also been explored.

Now, any genetic study of livestocks, seems incomplete, unless there is some supporting work on laboratory mouse. In genetic research laboratory mouse is found to be of particular application to animal breeding research as a pilot study in an unknown situation. Further, it can be seen that selection in small animals can be very effective and that the genetic explanation of the results may become relatively simple. Research work on laboratory mouse gives some confidence, in the application of mouse results to the large animals because of its mammalian nature. And the preliminary results may be obtained with a relatively small expenditure and in a short time.

A considerable amount of work has been done in respect of growth rate and body weight in mice. The reason may be that the body weight of mice is easy to measure and other point may be the rapid live-weight gain and weight at particular age, especially at market age, which are among the most important of economic traits in farm animals.

Body weight, a polygenic trait which shows continuous variation depending upon the large number of genes which interact with one another and with the environment in complex ways. The environmental factor such as feeding and management, climatic factor and maternal effects, plays a great role in modifying the genetic expression of an individual.

A careful selection was carried out for body weight and side by side other unselected traits were also recorded such as litter size at birth, fertility percentage, mortality rate before weaning and sex-ratio etc.

The works of different workers on body weight, h^2 estimation and litter size at birth in mice have been reviewed here.

Goodale (1938) was the first to establish the feasibility of selecting for body weight in mice. He showed average body weight increase in 14 generations. The first five hundred males and females averaged (at 60 days) 26.0 gms. and 21.3 gms. in weight and the last 500 males and females averaged 36.4 gms. and 29.3 gms. in weight respectively.

Goodale (1941) further showed that the average body weight increased in 28 generations. The males and females' average body weight was 35 gms. and 44.0 gms. respectively.

MacArthur (1944) reported the average body weight increase in eight generations of his high and low 60-days weight. The average body weight of males and females in high line was 33.71 gms. and 28.43 gms. respectively, and in low line, the same was 16.14 gms. and 13.80 gms. respectively.

Lewis and Warwick (1953) studied the average body weight of mice in five generations of inbred and outbred lines at 21-days of age. The average body weight of small, medium and large line was 7.4, 9.2 and 11.3 gms. respectively in the inbred line, and in the outbred line the same was 7.3, 10.6 and 12.6 gms. respectively.

Falconer and King (1953) showed the mean six week weight increase from about 29.0 gms. in each of the parental strains, to 32.0 gms. after seven to nine generations of selection.

Falconer (1953) reported that his high and low lines diverged regularly over the eleven generations. His high line gained a total of 4 gms. in mean weight and the low line decreased in weight by 7 gms.

Hansson and Lindkvist (1962) showed the average body weight of mice at 21,28 and 42-days as 10.8, 15.5 and 21.4 gms. in females and 11.0, 17.0 and 25.5 gms. in males, respectively. The combined average body weight of male and female was 10.58, 15.88 and 23.07 gms. at 21, 28 and 42-days respectively.

Rahnefeld <u>et al</u>.(1963) studied the body weight of mice at 21 and 42 days in 17 consecutive generations. The change in mean growth resulting from the whole of the selection was 4.90 and 4.28 gms. respectively.

Eisen and Legates (1966) studied body weight and growth rate of 781 male and 767 female progeny in three generations of random bred albino mice. The genetic variances of the difference between males and females were large enough for post weaning growth rate and 8 week weight, but not for weight at three and six weeks.

Singh (1967) analysed the data for 24 generations in the S-line and 10 generations in the S'-line. The total change in the post weaning growth was 7.7 and 5.3 times its estimated genetic standard deviation in the S and S' lines respectively, and corresponding estimates for weaning weight were 4.3 and 2.2 gms. respectively.

Gall and Kyle (1968) observed body weights at every three days from birth to 60-days of age and every 6 days from 60-days to 96-days in 4 lines of mice. Mean 96-days body weights for the four lines were 25.4, 29.7, 48.8 and 49.1 gm. for males, and 19.9, 23.8, 38.5 and 38.2 gms. for females respectively.

Slawinski (1970) made the reciprocal crossing of four inbred strains of mice in respect of body weight at all ages and found that it tended to be higher in the F_1 than in the F_2 and F_3 generations. Upto 42-days of age the rate of growth was slower in the F_2 and F_3 generations than in the F_1, but from 42 to 84 days the F_2 and F_3 mice had a faster rate of growth than the F_1.

Schmitz (1970) studied more than 7500 mice over three generations that were raised in all reciprocal combinations within F_1, F_2, F_3 and Ist and 2nd back cross. The analysis of his data indicated that body size was inherited predominantly in an additive fashion. The genetic portion of the variability was estimated to be 17.6, 21.3 and 33.9 percent at 28, 42 and 60-days of age respectively.

Non-additive Genetic Variance:

Some of the workers tried to explore the non-additive genetic variance with respect to body weight, but they failed to explore and doubted whether non-additive variance even exists with respect to body weight.

Mason et al.(1960) observed reduced growth rate in the hybrids at 21 and 45 days.

Newman (1960) conducted reciprocal recurrent selection in mice. He took two strains of mice that had been selected to, or near to, the limit for body weight. Thus the additive variance was largely exhausted and reciprocal recurrent selection was applied in an attempt to capitalise on any non-additive variance that might have been left. He failed to note any improvement over five cycles of selection.

Carmon (1960) observed the general combining ability effects for weights at 21 and 45 days which he found highly significant at both ages. Line differences in general combining ability effects between the best and poorest lines were 1.42 gms. for 21 days weight and 2.72 gms. for 45 days weight. Specific combining ability was non-significant for weight at either age and highly significant maternal effects were found for weight at both 21 and 45 days.

Miller et al (1963) studied a total of 2879 mice. They found no evidence of any non-additive hereditary variance with respect to three and six weeks body weight.

Kidwell and Howard (1969) made a diallele cross among four inbred lines. Weight was measured at birth and at weekly intervals through ten weeks of age. Environmental variance of inbreds and hybrids were similar at all ages. Relative to mean, heterosis increased between birth and 4 week, but decreased steadily thereafter. Although not significant, general combining ability accounted for 0-8.06 percent of total variance.

White et al.(1970) made crosses among three lines of mice in all possible crosses and reciprocal crosses. Two of the lines had been subjected to long term selection for increased and decreased body weight at 6 weeks. Data were obtained on 258 litters totalling 1284 mice at 56-days primarily to study relationships between heterosis and sex for body weight gain. Significant differences in heterosis were observed in pure and reciprocals and sex effects for weights at 12, 21, 42 and 56 days. The male showed more negative heterosis than females in some of the crosses.

Heritability:

Heritability of a metric character is one of its most important properties. It expresses the proportion of the combining ability was non-significant for weight at either age and highly significant maternal effects were found for weight at both 21 and 45 days.

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Heritability:

Heritability of a metric character is one of its most important properties. It expresses the proportion of the total variance attributable to the average effects of genes and shows the degree of resemblence between relatives. The most important function of the heritability in the genetic study of metric characters is its predictive role, expressing the reliability of the phenotypic value as a guide to the breeding value and this value determines their influence on their next generation. Therefore, by knowing the heritability of the population, we can easily predict the progress made in the course of breeding.

Available relevant literature on coefficients of heritability estimates as reported by different workers, have been reviewed hereunder:-

Lewis and Warwick (1953) calculated heritability estimates for overall generations at 60-days which was 42 percent and 37 percent, respectively for the outbreds and the inbreds. They also estimated heritability coefficient in 2 to 5 generation which was 33 and 21 percent for the outbred and inbred groups, respectively.

Falconer (1953) computed heritability estimates for upward and downward selection and he observed 20 percent heritability for upward and 50 percent for downward selection at 42-days of age.

Rahnefeld et al.(1963) obtained overall heritability estimate of body weight of mice separately in males and females. The overall estimate was 0.243 ± 0.074 and 0.264 ±0.07 for males and females, respectively. Gross realised value was found to be 0.187 and 0.163.

Eisen and Legates (1966) estimated these values for body weight of mice at 3 and 6 weeks of age. The heritability was 0.010 and 0.084 at 21 and 42 days respectively.

Rahnefeld et al.(1966) studied the reciprocal crossing of two unrelated inbred lines. Selection was practised for growth from weaning to 42-days of age for over 29 generations. The observed heritability of growth rate of female for litter size was 0.190 ± 0.047 and 0.040 ± 0.037 respectively.

Singh (1967) estimated genetic variance for weaning weight and postweaning growth of mice in two lines. He found that the genetic variance for weaning was 0.116 and 0.250, and for postweaning growth 0.540 and 0.336 for two lines, respectively. The heritability figure estimated for weaning weight and postweaning weight was 0.082 and 0.236 respectively.

Eisen et al. (1970) reported 10 generations of selection for 12-day litter weight in 4 replicate lines of mice. The four lines followed a similar linear pattern of response. The average realised h^2 was 0.11 ± 0.02 and the observed genetic gain was 0.25 ± 0.04 gms. per generation.

Mean litter size at birth:

The available literature on this trait has been reviewed as follows :

Venge (1960) reported the average litter size at birth to be 5.32 for the first parity and 6.33 for the second parity.

Hiraiwa and Hamajima (1960) found that the average litter size at birth and at weaning was 5.32 ± 0.09 and 4.70 ± 0.12 respectively.

Dadlani and Prabhu (1962) reported the average litter size at birth to be 5.53 ± 0.11, 7.56 ± 0.30 and 8.30 ± 0.31 for first, second and third parity respectively.

Hansson and Lindkvist (1962) studied litter size at birth under two methods of breeding, conventional and rotational cross breeding upto seven generations. In the conventional breeding litter size at birth was 6.81, 6.82, 6.49,6.99, 5.58 and 5.59 respectively from first to seven generation, and these values for rotational cross breeding were 6.53, 6.48, 6.63, 5.99, 5.43, 5.82 and 5.65 respectively from first to seven generations.

Wilson and Edwards (1963) reported an increase in litter size in mice. The mean litter was raised from 6.8 to 10.7 by super ovulation. The mortality rate after birth was high in large litters.

Shibata (1966) noted that the litter size at birth was 6.14 and 8.75 in the two pure bred strains respectively, and 7.56 and 8.13 respectively for reciprocal mating group. Further, Shibata (1967) reported an average litter size in three inbred albino strains of mice and their F_1 and F_2 hybrids to be 5.84, 6.25 and 6.67 in the three strains respectively.

The available literatures on reciprocal recurrent selection in poultry and swine have been reviewed hereunder:

Comstock and Robinson (1957) reported the study of reciprocal recurrent selection in poultry. Estimates were made on 8-week weight of chickens at the Nichols Poultry Farm, Kingston, New Hempshire. In a test cross, 48 chicks from 12 dams were included, the expected progress was 0.062, 0.074 and 0.069 lb. per cycle in the three crosses.

Kusner et al.(1962) reported an experiment of reciprocal recurrent selection with poultry, conducted at Stud Farm Kucino in Moscow Privince in 1957. Reciprocal crosses were made with Russian whites bred on the Farm (K) and Russian whites from the Stud Farm Arzenka (A) which are stated to be of a different type; egg production averaged 158.1 for A male x K female and 167.6 for K male x A female. In 1958 males and females were selected on their daughters egg production in the first 3-3½ months; A male x A female averaged 168.1 eggs and K male x K female, 144.0 eggs. In 1959 reciprocal matings made between male (A) x (K) female, averaged 179.8 eggs and those of (K) male x (A) female produced 187.7 eggs.

Griesback (1962) tested reciprocal recurrent selection technique for improving combining ability of two strains of chickens. Selection was based on the 10th weeks body weight of the crossbred progeny. Reciprocal recurrent selection brought about a progressive increase in the body weight of both purebred and crossbred broiless from the strains under selection. Broiless from the selected strains were 11.3 percent heavier at 10 weeks of age than those from their unselected counterparts at the end of the experiment.

Saadeh *et al*.(1968) studied the effectiveness of reciprocal recurrent and within-strain selection in improving rate of egg production in 7 generations. Selection intensity amounted to approximately 25 percent in each selected population of each generation. The pooled h^2 estimates based on sire components of variance were 0.10 ± 0.16 and 0.12 ± 0.15 for rate of lay to 260 and 500 days of age respectively. Dam components of variance gave h^2 estimates of 0.24 ± 0.20 and 0.27 ± 0.19.

Andrews and Stephenson (1970) studied the recurrent selection from 1959 to 1964, using inbred sires from white leghorns, Rhode Island Reds and White Playmouth Rocks. The Cornell Random bred control leghorn population was the common female parent. The progeny from the female selected for combining ability with specific inbred lines were referred to as types 1, 3 and 4 respectively. The mean egg production of type 3 during the period for breeder selection from first egg after 22 weeks to 34 weeks of age was 81 percent and significantly greater than in types 1 and 4 by 2.9 and 5 percent respectively. Selection increased egg production by 0.63±0.53, 1.81 ± 0.27 and 0.53 ± 0.42 per generation in types 1, 3 and 4 respectively.

Biswas *et al*.(1971) studied the reciprocal recurrent selection upto 5 generations in swine in two pure bred stocks and compared it with intrapopulation index selection.

Both the R.R.S. and I.S. groups were derived from the same foundation stock. Two groups were formed from each of the two breeds, one selected on the basis of pure bred performance (I.S.) and the other on the basis of cross bred progeny performance (R.R.S.). The relative merits of the two selection methods in improving cross bred progeny performance were evaluated by analysing contemporaneous cross bred (test cross) performance in the two selection groups. The data were analysed separately for single cross and three-bred cross matings (litter size at birth and average pig weight at birth and 21 days of age). They found that R.R.S. was superior to I.S. for litter size whereas I.S. was superior to R.R.S. for average pig weights (where significant differences were obtained).

CHAPTER - III

MATERIALS AND METHODS

MATERIALS AND METHODS

Source and collection of data:

For the present study the mice were brought from I.V.R.I. Izatnagar, except for 12 males that were obtained from Rajendra Memorial Medical Institute, Patna.

The experiment started with the foundation stock of 84 females and 180 males. These females were grouped into three groups of A, B and C, each consisting of 28 females. The groups were made randomly. The 180 males were randomly divided into two groups and out of these groups, 7 males from each group were randomly selected and allowed to mate with the females of group 'B' and 'C' respectively. For the 'A' group females, 7 males were introduced from outside to bring in more variation in the flock.

Now, these groups were allowed to mate randomly for the establishment of the base population. And the progenies coming out from the base population were selected on the basis of individual performance and body weight at 28-days of age.

From the base population of group A and B, 60 females and 15 males were selected in both the groups A and B for reciprocal crossing. The 60 females of group A were mated to 15 males of group B and viceversa. Thus, the reciprocal population of group A and B were raised.

On the basis of higher mean litter weight at 28 days of age, 40 dams and 10 sires were selected in both the groups of A and B, and they were re-mated randomly to the members of their own group to have the parents for next cycle of reciprocal recurrent selection. Thus, the progenies coming out from these groups constituted the re-mated population of group A and B.

In the group 'C' selective random breeding was practised during the whole tenure of the study. Twentyeight females and seven males were utilised from the foundation stock and base population, and 40 females and 10 males were used in the 2nd and 3rd generation (table 3.1).

TABLE 3.1

Showing the number of mice utilised in different groups as parents in the course of experiment

Group	Generation							
	Foundation stock		Base population (Ist R.C.)		Remating groups after selection of parents		2nd R.C.	
	M	F	M	F	M	F	M	F
A	7	28	15	60	10	40	15	60
B	7	28	15	60	10	40	15	60
C*	7	28	7	28	10	40	10	40

* = selective random breeding were practised.

R.C. = reciprocal crossing.

M = male.

F = female.

TABLE 3.2

Showing number of progenies raised from birth to 21,28 and 42 days of age.

Group	Generation															
	Foundation stock				Base population (Ist R.C.)				Re-mated population				2nd R.C.			
	days				days				days				days			
	1	21	28	42	1	21	28	42	1	21	28	42	1	21	28	42
A	176	159	159	159	471	407	407	400	378	299	299	298	428			
B	225	205	205	203	458	342	342	338	336	268	267	266	413			
C	217	197	197	196	208	171	171	166	265	209	206	205	187			
Total	618	561	561	558	1137	920	920	904	979	776	772	769	1028			

Description of the experiment on breeding programme:

The experiment was conducted on the mice in the Genetics Laboratory of Bihar Veterinary College, Patna.

The males and female mice were counted and weighed individually, using the weighing balance, specially designed for the mice work. Males and females were kept in cages separately after giving distinguishing mark with the help of picric acid solution.

The foundation stock constituted 142 females and 180 males of different age groups. Out of this stock 84 female and 180 male progenies were used in the study. The selection of males and females was made on their individual phenotype basis.

Ist phase of breeding programme:- Only those males and females were selected that had body weight above 35 gms. and 16 gms. respectively. Dams, deformed and underweight individuals were discarded.

A random distribution of females was made to the cages having four females in each cage. Altogether 84 females were selected and kept in different cages. In this way 21 cages were arranged. These 21 cages were again randomly arranged in three groups, 'A', 'B' and 'C'. Thus, each group consisted of 7 cages and 28 females.

In the females of group 'A', males were introduced from outside source (brought from Rajendra Memorial Medical Inst.) to create genetic variation in the stock,as two stocks from different sources were needed for the study.

There were only 12 male mice brought from outside and out of them 7 male mice were selected, having body weight above 21 gms.

In the females of group 'B' and 'C', 7 males out of 90 males in each group were selected from the existing stock, having body weight above 35 gms. One male for each four females was allotted randomly in both the 'B' and 'C' groups. Full-sib and half-sib matings were avoided. Group 'C' was kept as a selective random mating group in which only selective random breeding was practised during the experimental period.

For the establishment of base population, random breeding was practised in the foundation stocks of groups 'A','B' and 'C'. The males were kept with the females, allotted to them for a period of 16 days. They were then removed and discarded. The pregnant females were segregated and each kept in separate cage for getting litters.

The litters, so produced were weighed at 21, 28 and 42 days of age to see the rate of growth and obtain heritability estimates at these periods.

The progeny obtained from the foundation stock were weaned at 28 days of age and sexes were separated after marking every individual by picric acid solution.

GROUP 'A':

Out of 28 dams, 22 gave birth to 176 progeny. The conception rate was 78.5 percent. Only 159 progeny were raised upto the stage of maturity and 17 progeny died before weaning. The mortality rate was 9.6 percent. Out of 159 individuals, 76 were female and 83 male. Only 60 female and 15 male were selected for reciprocal crossing. The selection of individual was made on the basis of individual performance (body weight at 28 days). The selected males and females were having the weight above 13.0 and 7.5 gms. respectively.

GROUP 'B':

The 27 dams produced 225 progeny. The conception rate was 96.4 percent. Only 203 progeny could be raised upto 42 days of age and 21 died before weaning. The mortality rate was 9.3 percent. There were 110 females and 93 males. For reciprocal crossing 60 female and 15 male were selected from this stock. Selection was practised in the same way as in group 'A'. The selected males and females had the body weight above 15 and 8 gms. respectively.

GROUP 'C':

Out of 28 dams, only 26 dams produced 271 young ones.

The conception rate was 92.8 percent. The progeny raised upto 42 days of age were 95 male and 101 female and the rest 20 progeny died before weaning. The mortality rate was 12.4 percent. Out of 196 individual, 40 female and 10 male were selected on the individual performance. Selected males and females had body weight above 15 and 12 gms. respectively. But, due to short supply of cages, only 28 female and 7 male could be raised to get the F_1 individuals.

<u>2nd phase of breeding programme:-</u> Group 'A' and 'B' were mated reciprocally : 15 male of group 'A' were allotted randomly to 60 female of group 'B' and vice versa, in the ratio of one male to 4 female. In this way 15 cages in group 'A' and 15 in 'B' were arranged. Males were kept with the females as in previous matings (16 days) and then removed, and maintained them separately. The pregnant females were segregated and kept separately for getting young ones. Thus, 60 cages in group 'A' and 60 in group 'B' were arranged for getting litters of individual females.

In the group A, in which females of A and males of B were mated, 57 dams produced 471 young ones. The fertility rate was 95 percent. A total of 400 progeny were raised upto the age of maturity in which there were 204 female and 196 male, out of which 64 died before weaning. The mortality rate was 13.5 percent. The cross-bred progeny were evaluated at 28 days of age. According to the highest mean litter weight of the cross-bred progeny, 40 dams and corresponding 10 sires were selected.

The selected females were re-mated to the males of their own group; 4 female and one male were randomly distributed in each cage, and thus 10 cages were arranged to have the next generation for continuing the cycle.

All the cross-bred progeny and unselected dams and sires were discarded after recording their weight at 42 days.

In the group B, in which females of B and males of A were mated, 56 dams produced 458 young ones. The fertility rate was 93.3 percent. Out of 458 young ones, 338 could be raised upto 42 days of age and 116 progeny died before weaning. The mortality rate was 25.3 percent. There were 169 male and 169 female at 42 days of age. Forty dams and 10 sires were selected on the basis of highest mean litter weight. Selected females were re-mated to the males of their own group to get the parents for the next generation. Cross-bred progeny, unselected dams and sires were discarded after recording the weight of cross-bred progeny at 42 days of age.

In the group 'C', in which selective random breeding was practised. Out of 28 dams, 27 produced 208 young ones. The fertility rate was 96.4 percent. Out of 208 young ones, 170 could be raised upto the stage of maturity, and 38 died before weaning. The mortality rate was 17.7 percent. There were 90 female and 76 male at 42 days. Out of this stock 40 female and 10 male were selected on the basis of individual performance (body weight at 28 days of age). Females and males were randomly arranged in 10 cages in the ratio of 4 female and 1 male, to get the first generation.

3rd Phase of breeding programme :- In both the groups, A and B, females were mated with the males of their own group, which were selected on the basis of higher mean litter weight.

In group A, where female individuals were mated to the males of their own group, 378 progeny were produced by 38 dams. The fertility rate was 95 percent. Out of 378 young ones, 299 were raised upto the stage of maturity, and 79 died before weaning. The mortality rate was 20.8 percent. There were 130 male and 169 female progeny at 42 days of age. Out of 299 individuals, 60 female and 15 male were selected on the basis of individual performance (at 28 days of age) for second reciprocal crossing.

In group B, out of 40 dams, 35 produced 336 young ones. The fertility rate was 87.5 percent. Out of 376 progeny, 268 could be raised upto the stage of maturity, and 68 individuals died before weaning. The mortality rate was 25.3 percent. There were 148 male and 118 female from which 60 female and 15 male were selected on the basis of body weight at 28 days of age for second reciprocal crossing.

GROUP 'C':

Thirtysix dams, out of 40, produced 265 offspring. The fertility rate was 90 percent. Out of 265 young ones, 205 could be raised upto the stage of maturity, and 59 died before weaning. The mortality rate was 22.2 percent. There were 99 female and 106 male progeny at 42 days of age. In 205 individuals, 40 female and 10 male were selected on the basis of individual performance to get the 3rd generation of progeny.

Feeding practices :

Cooked meals were provided to the mice ad lib. The flour halwa was prepared and served twice a day, in the morning (at about 7 to 8 A.M.) and in the evening (at about 4 to 5 P.M.). The meals were served in a small porcelain and aluminium cups as well. The constituents of the feed supplied were as follows for 100 adult mice.

Wheat flour	...	1 kg.
Milk ...	...	1 litre
Common salt	...	1 oz.
Sharkliver Oil	...	11.5 ml.
Univite c̄ choline	...	6.5 ml.

The above ration was considered adequate both for maintenance, growth and reproduction of the mice.

Preparation of meal:- First of all, the wheat flour was cooked under low flame. On the appearance of a little brownish colour, milk was added gradually and mixed thoroughly. Thereafter salt was added. After putting off the flame and when the flour meal becomes cool, the Shark Liver Oil and Univite with Choline were added and thoroughly mixed.

Fresh water was supplied at regular intervals through small vials fitted up with jet droppers, just to prevent the excess flow of water and the device through which the mice might drink as much as water, they liked. The vials were fitted in the top cover of the cage so that at the time of taking food they might have an easy access to drink water.

Housing :

The mice were raised comfortably in a metal cage, measuring 10" x 7½" x 6", with an open wire mesh cover. The cage was made up of thin galvanised iron sheet from all side except the top which was made up of wire mesh for providing ample air, light and exercise to the mice. The space available in the cage was found to be sufficient for the accommodation of 4 to 5 adult mice or one dam with her litter.

All the cages were properly arranged and kept in the mice laboratory in such a way that each mice could get proper ventilation and freshness of the surroundings.

Bedding :- The paddy husk was used for the bedding purpose, so that the floor of the cage could not become soiled and damp due to urine of the mice. The husk absorbs the urine and keeps the floor dry and cage free from corrosion. Mice usually urinate in a particular corner, so a little more paddy husk in that corner was provided.

Cotton was supplied to the pregnant mice for making nest to protect the newly born litters from cold. The cotton also served as a protection against a radical change in temperature.

Sanitation :

The entire breeding work is dependent upon the proper health maintained by the animals and for this purpose strict sanitary measures were adopted.

Every day paddy husk was removed from the cage. The cages were properly cleaned and dried. Feeding pots and water vials were cleaned daily. Before using any cage for rearing up the mice, the entire cage will all its components was thoroughly washed by clean water and then dried. Dettol wash of the cages was resorted twice a week.

Identification :

Identification of the individual is essential to keep the records properly. There are many methods used for identification of individual mice such as touching with picric acid solution, amputation of one or more toes or by punching the ears etc. In the present experiment the picric acid solution was used for identification purpose. The different parts of the mice were marked by picric acid solution which correspond the number of that mice. Marking of the mice was done in the following pattern :-

Head	Back	Tail	L.E.	R.E.	L.F.L.	RFL	LHL	RHL	Lt.Ab.	Rt.Ab.
1	2	3	4	5	6	7	8	9	10	11

L.E. = left ear R.E. = right ear LFL = left fore leg
RFL =right foreleg. LHL.=left hand leg RHL = right hand leg
Lt.Ab.=left abdomen. Rt.Ab.=right abdomen.

Temperature and humidity :

To keep the optimum temperature and humidity in the mice laboratory several measures were taken. The laboratory is well equipped with fan, light and exhaust fan. The "Khus tatti" was used on the gate and window during summer to control the radical change of temperature. Every time khus tatti was kept moistened by sprinkling water. Strong (1967) has indicated that mice would remain well at temperatures between 70° to 80°F and humidity 50 to 60 percent.

As the laboratory room was not airconditioned, the exact range of temperature and humidity could not be maintained. However, efforts were made to keep the temperature and humidity under reasonable check. The average temperature and humidity of the laboratory room were recorded during the period of study as given below.

TABLE 3.3

Showing monthwise and season wise average humidity percent and temperature recorded in the mice laboratory.

Months	Humidity %	Temp. °F	Season	Humidity %	Temperature °F
April	60.55	78.31			
May	64.67	81.17	Summer	64.27	80.30
June	67.61	81.42			
July	76.15	81.55			
August	85.00	83.01	Rainy	74.44	82.71
September	70.98	84.48			
October	65.64	81.82			
November	57.11	74.06			
December	57.51	67.08	Winter	57.23	68.17
January	57.09	63.38			

Method of Selection :

The process of selection consists in differential reproduction of a group of individuals as compared to the whole population from which the group has come.

The basic effect of selection is to change the array of gene frequencies and the frequency of gametes carrying certain gene combinations.

The process of selection consists of two parts - natural selection and artificial selection.

The natural selection operates through natural agencies whereas the artificial selection is resorted to by breeder.

The proportion of the animal which are allowed for mating, taken from the original stock will alter the mean expression of the character in the population. Many characters respond to selection, both for increased and for decreased expression, but it is not always possible to predict the effectiveness of any kind of selection. The pattern of response varies, it may be a slow continuous process lasting over many generations or it may be rapid during the first few generations after which selection line reaches a plateau at which no further response occurs.

Selection is found to be effective when there are recognisable differences between individuals,of a population. Some of the variation is environmental in origin, which is not inherited and contributes nothing towards promoting a response to selection. It is very difficult to eliminate all non-genetic variation. The variation which is genetic in origin inherited and contributes a major part to the success of any selection procedure.

Since, selection operates on genetic variation, it is important that this should be present at the start of the selection experiments. It is very difficult to change the mean expression of a character where there is little variance, because selection cannot go beyond the potential of the foundation stock.

The amount of selection can be measured by finding out the selection differential. The selection differential as defined by Lush (1945) is "the average superiority of the selected animals over the average of their generation, weighted by the number of offspring". In other words, the average superiority of the selected parents over the mean value of their entire generation is known as the selection differential. This shows some relation to the proportion of animals chosen as parents.

The selection differential based on the percentage of animals chosen as parents for breeding and is measured in standard deviation. The standardised selection differential is known as the "intensity of selection".

The standard deviation, which measures the variability, is a property of the character and the population. To measure the intensity of selection, selection differential is divided by the phenotypic standard deviation (Falconer, 1960).

The intensity of selection depends only on the proportion of the population included in the selected group. It is the mean deviation of the selected individuals, in units of phenotypic standard deviations.

The change produced by the selection in the population is the response to selection. Response is the difference of mean phenotypic value between the offspring of the selected parents and the whole of the parental generation before selection. It is found that, the ratio of response to selection differential is equal to the heritability. Therefore, response to selection could be known by multiplying selection differential and the heritability. The response depends on the heritability of the character in the generation from which the parents are selected. The greater the heritability and selection differential, the greater will be the response to selection. Thus, response could be promoted by high genetic variance, low environmental variance and high selection intensity.

In the present study, selection was practised entirely on the basis of individual performance and body weight at 28-days of age in all groups (A, B and C) and in all generations, except in re-mated population of group A and B, in the second generation. As in the reciprocal recurrent selection, dams and sires were re-selected for re-mating to the member of their own group. Therefore, sires and dams were selected on the basis of cross-bred progeny, evaluated at 28-days of age. Dams were directly selected on the basis of higher mean litter weight and sires were selected on the basis of corresponding dams having higher mean litter weight. Selection differential and intensity of selection were also calculated in male and female separately.

TABLE 3.4

Showing the number of individuals and proportion selected at 28 days of age in group A,B and C, generationwise.

Group/ sex	Base population (Ist R.C.)		Remated population (selected dam & sire)		2nd R.C.	
	No.of individuals	Proportion selected. %	No. of individuals	Proportion selected. %	No. of individuals	Proportion selected.%
A						
Male	83	18.07	15(342)*	75.14	130	11.53
Female	76	78.94	60(407)*	67.07	169	35.50
B						
Male	94	15.95	15(407)*	83.29	148	10.13
Female	111	54.05	60(342)*	73.39	119	50.42
C						
Male	96	7.29	80	12.50	106	9.43
Female	101	27.72	91	43.95	100	40.00

* indicates number of offspring of respective parent.

R.C.= reciprocal crossing.

Parameter Estimation:

Estimates of phenotypic and genotypic parameters of economically important traits are of great help in animal breeding operations. Hence, some such estimates were obtained from the observations during this study.

The estimates fall into two broad groups:-

(a) Phenotypic parameters and

(b) Genotypic parameters.

(a) Phenotypic parameters :- On the phenotypic side, the following were estimated :-

(i) Mean, standard deviation, standard error and percentage of coefficient of variation of the trait according to the method suggested by Snedecor (1967).

(ii) Effect of sex on the body weight of mice at different stages of growth (21,28 and 42 days).

(iii) Estimation of selection differential and intensity of selection.

(b) Genotypic parameters:- The estimates of heretability on body weight of mice were obtained, at 21 days, 28 days and 42 days in both the reciprocal population and remated population alongwith selective random breeding groups.

Methods of estimating heretability :

Most of the economically important characters show a continuous variation which depends on a large number of genes which interact with one another and with the environment in a complex and intricate way. On the basic assumption that polygenes or blocks of polygenes, segregate and recombine in the same way as genes for qualitative traits, methods have been developed for the estimation of relative importance of heredity and environment in the variation of quantitative characters.

Heretability is usually defined in two ways, viz. heretability in broad sense and narrow sense (Lerner,1950). In broad sense, the heretability might include all the genotypic variance, which is due to additive, dominance or epistatic kind. But for the purpose of selection it is the amount of the additive genetic variance of a character, that is of particular significance. The additive genetic variance is the property which is found to be transmissible from generation to generation and hence h^2 in narrow sense is more accurate where the dominance and epistasis are generally not transmitted. The epistatic as well as dominance combinations are broken up in the course of reproduction, and resemble in a different pattern in the population of genotypes, in the next generation. Thus, it can be seen that a parent superior to the mean of its generation by virtue of its haploid gamete, contributes more towards the merit of the zygote than the parent superior by virtue of its genotype. Therefore, at least with respect to mass selection, our interest is in the heretability defined in narrow sense (i.e. the portion of the total variation which is due to additive genetic effect.

Depending on the method used, the actual numerical estimate of h^2 is usually between the broad and narrow concepts; it always includes a little of epistatic variance and sometimes a little of dominance variance. It may include all, part or none of the variance caused by the non-linear or joint effects of heredity and environment.

Phenotypic variation can be split up broadly into genetic, dominance, epistatic and environmental deviations as well as interaction of genetic and environmental factors. It can be broadly written as follows :-

P = G + E

where, P = the total phenotypic variance

G = the genetic variance

E = the environmental variance.

Genetic variance and the environmental variance can further be subdivided as :

(a) <u>Genetic variance</u> :

G = A + D + I

where, A = additive genetic variance

D = Dominance variance

I = variance due to epistatic or interaction.

(b) Environmental variance can be split up into two components - permanent and temporary.

E = Ep + Et

where, Ep= variance due to permanent environmental effect,

Et= variance due to temporary environmental effect.

Hence, P = A + D + I + Ep + Et.

Then variance of individual phenotypes in a population is :

$$6^2P = 6^2G + 6^2E$$

$$\text{or} \quad 6^2P = 6^2A + 6^2D + 6^2I + 6^2Ep + 6^2Et.$$

The precise definition of h^2 in broad sense concerns the fraction of the phenotypic variance which comes from all these sources.

$$h^2 = \frac{6^2G}{6^2P} = \frac{6^2A + 6^2D + 6^2I}{6^2A + 6^2D + 6^2I + 6^2Ep + 6^2Et}$$

and in narrow sense :

$$h^2 = \frac{6^2A}{6^2P} = \frac{6^2A}{6^2A + 6^2D + 6^2I + 6^2Ep + 6^2Et}$$

When there is no dominance or epistasis the heretability in broad and narrow sense have got the same value. Since h^2 is a ratio, its value may change with changes in either numerator or denominator. The value of h^2 ranges from 0 to 1.

Increased environmental variation as well as decrease in genetic variation (e.g. due to inbreeding), causes a decrease in the value of h^2. Obviously, the numerical value of heretability estimate depends not only on the variations in feeding and management of the animals but also on the errors in the measurements of the character.

Estimation of heretability of quantitative characters found in different ways depends on how closely phenotype corresponds to genotype.

Phenotypic resemblance may be measured directly, but genetic resemblance cannot be computed directly because genetic or hereditary portion of variations in quantitative character is not exactly known. So, genetic resemblance is obtained from coefficient of relationship.

In many sets of data, like the one used in the present study, heretability estimates can be computed more conveniently from variance components which can be derived from analysis of variance and covariance than by correlation directly, but the principle remains the same.

Various methods are available for estimating heritability (Lush,1948).

In the present study heritability was estimated by Intra-sire-regression of daughters on dams and sons on dams, because the weight of the mice is not limited to one sex only.

In this method, regression of daughters on dam and sons on dam were calculated separately for each set of dams mated to one sire. The regression coefficient of male was multiplied by the ratio of the phenotypic standard deviation of females to that of males, for the correction of inequality of variance in the two sexes (Falconer,1960).

The intra-sire regression of offspring on dam estimates half the heritability, as the progeny of one sire has a mean deviation from the population mean equal to half the breeding value of the sire and the progeny of one dam deviates from the mean of the sire groups by half the breeding value of the dam. Therefore, the within-sire covariance of offspring and dam is equal to half the additive variance of the population as a whole; and the within-sire regression of offspring on dam is equal to half the heritability.

The method of intra-sire regression of daughters on dam and sons on dam is found to be reliable to a great extent in the absence of maternal effects.

As discussed by Lush (1940),intra-sire regression can be explained as follows : The regression coefficient bxy is computed as hereunder. $bxy = \frac{Cov.xy}{6^2x}$ $bxy' = \frac{Cov.xy'}{6^2x}$

where, x,y and y' represents dam,daughters and sons respectively, and Cov.xy and 6^2x are estimated covariance and variance respectively.

Cov.xy estimates $\frac{1}{2}6^2G$ and 6^2x estimates 6^2P so that, $bxy = \frac{\frac{1}{2}6^2G}{6^2P}$, and as such $h^2 = 2$ bxy.

In the present study the number of dams was four times more than the number of sires. So intra-sire regression method offers a very useful way of estimating heritability.

Further, this method gives an unbiased estimate of heritability, irrespective of selection being practised. Heritability is not affected by the mating system in this case.

Analysis of variance was computed to estimate the heritability in the following way:-

Let there be 'n' sires and each sire has 'K' dam-daughter pairs. And 'x' denotes the value for the dam and 'y' for the daughters. Now, the analysis of variance and covariance in this case is given in table 3.5.

TABLE 3.5

Analysis of variance

Source of variation	d.f.	S.S.(x)	S.P.(xy)	S.S. (y)
Between sires	n-1	A	C	E
Within sire	n(K-1)	B	D	F
Total	nK-1	A+B	C+D	E+F

$$bxy = \frac{D}{B} = \frac{xy}{x^2}$$

$$h^2 = 2b$$

$$S.E.(h^2) = \sqrt{\frac{F - bD}{n(K-1)-1} \times \frac{1}{B}}$$

where,

D = corrected sum of product

B = corrected sum of squares (dam)

F = corrected sum of squares (daughter)

b = regression coefficient.

The analysis of variance for finding out the effects of age, generation and sexes was run as between and within analysis (Snedecor, 1967).

TABLE 3.6

Analysis of variance

Source of variation	d.f.	S.S.	M. S.	F.
Between generations	G-1	s_1	$\frac{s_1}{G-1} = M_1$	$\frac{M_1}{M_2}$
Within generation	N-G	s_2	$\frac{s_2}{N-G} = M_2$	
Total	N-1	s_1+s_2		

where,

N = total number of observations

G = number of generations.

C.D.Test :

When the value of F was significant, critical differences were calculated to find out the specific value of differences between the means of two treatment at a particular level of significance.

Critical differences were calculated on the basis of following equations :-

C.D. = Value of t at 5 % & 1% for n-1 degree of freedom x S.E. of the differences of mean.

And for different number of observations for different treatments, the S.E. of the differences of the mean was calculated as :

$$\text{S.E. of the differences of mean} = \sqrt{\text{M.S. error}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

where,

n_1 = number of observations on which first mean is based, and

n_2 = number of observations on which second mean is based (Pillai and Sinha, 1968).

CHAPTER - IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

In the present study, the body weight of males and females mice were studied separately. As the growth of males and females have been considered, potentially different manifestations of genotype, because of sex difference with respect to endocrine environment resulting in differences in means and variances of the trait.

The body weight of males and females mice were studied in three different populations, such as :

1. Base population,
2. Reciprocal population, and
3. Re-mated population (progeny of selected dam and sire in the group A & B).

The following studies on body weight have been made for all the three groups (A, B and C) in base population at different stages of growth (21, 28 and 42 days).

(i) Distribution of observations in each group,

(ii) Average with S.E. and C.V. of each group,

(iii) Effects of sex on body weight of mice, and

(iv) Comparison of averages between groups through test of significance.

GROUP 'A':

(i) Distribution of observations:-

In the male mice, the body weight ranged from 2.5 to 12.0, 3.5-18.5 and 12.0 - 26.0 gms. at 21,28 and 42-days respectively. The body weight were grouped at 1 gm. class-intervals. The highest number of observations were found between 6.0-7.0, 11.0-12.0 and 17.0 - 18.0 gms. at 21, 28 and 42 days respectively (table 4.1 and histogram in fig.1).

TABLE 4.1

Showing frequency and cummulative distribution of body weight of male mice of group A in base population.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre	Class	Fre.	Cu. fre.
2.0 - 3.0	4	4	3.0 - 4.0	1	1	12.0 - 13.0	3	3
3.0 - 4.0	2	6	4.0 - 5.0	5	6	13.0 - 14.0	6	9
4.0 - 5.0	10	16	5.0 - 6.0	2	8	14.0 - 15.0	7	16
5.0 - 6.0	18	34	6.0 - 7.0	2	10	15.0 - 16.0	9	25
6.0 - 7.0	18	52	7.0 - 8.0	10	20	16.0 - 17.0	10	35
7.0 - 8.0	10	62	8.0 - 9.0	6	26	17.0 - 18.0	13	48
8.0 - 9.0	11	73	9.0 -10.0	8	34	18.0 - 19.0	9	57
9.0 -10.0	4	77	10.0 -11.0	12	46	19.0 - 20.0	7	64
10.0 -11.0	2	79	11.0 -12.0	14	60	20.0 - 21.0	7	71
11.0 -12.0	4	83	12.0 -13.0	7	67	21.0 - 22.0	3	74
...		...	13.0 -14.0	3	70	22.0 - 23.0	2	76
...		...	14.0 -15.0	4	74	23.0 - 24.0	4	80
...		...	15.0 -16.0	3	77	24.0 - 25.0	1	81
...		...	16.0 -17.0	4	81	25.0 - 26.0	2	83
...		...	17.0 -18.0	1	82	...		...
...		...	18.0 -19.0	1	83	...		...

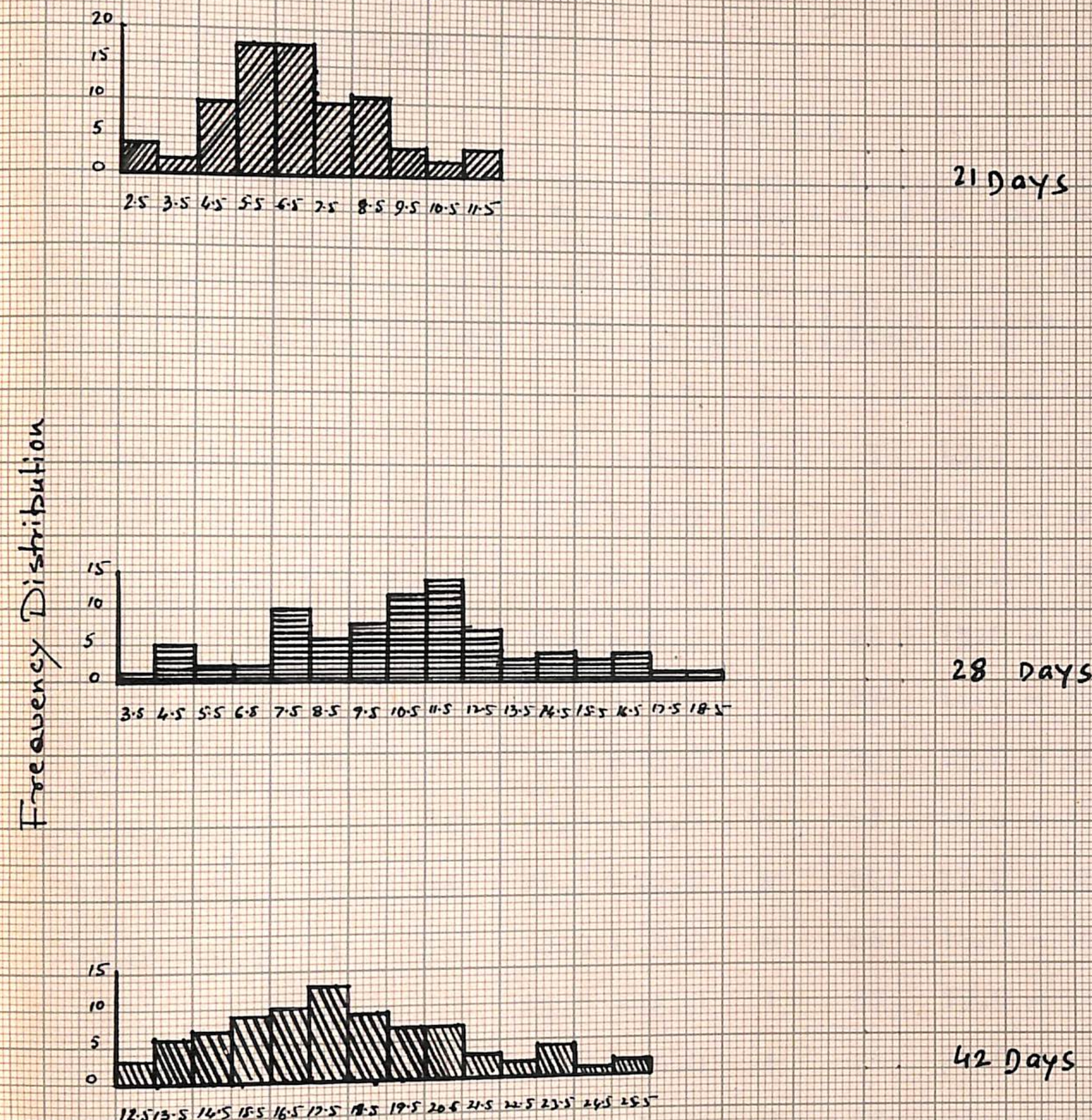
Fre. = frequency

Cu.fre. = cummulative frequency.

Fig — 1

Base Population – Group-A

Body weight of the Male Mice at Different stages of Growth



Body weight (in grams)

(1 small division = one)

In female mice, the body weight ranged from 3.0-12.0, 3.5-17.0, and 9.0-25.0 gms. at 21, 28 and 42 days respectively. The highest frequencies were observed in class 6.0-7.0,10.0-11.0 and 16.0-17.0 gms. at 21,28 and 42 days respectively (table 4.2 and histogram in fig.2).

TABLE 4.2

Showing frequency and cummulative distribution of body weight of female mice of group A in base population.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
2.0 - 3.0	2	2	3.0 - 4.0	1	1	9.0 - 10.0	3	3
3.0 - 4.0	1	3	4.0 - 5.0	2	3	10.0 - 11.0	2	5
4.0 - 5.0	17	20	5.0 - 6.0	2	5	11.0 - 12.0	2	7
5.0 - 6.0	13	33	6.0 - 7.0	8	13	12.0 - 13.0	1	8
6.0 - 7.0	20	53	7.0 - 8.0	9	22	13.0 - 14.0	1	9
7.0 - 8.0	9	62	8.0 - 9.0	7	29	14.0 - 15.0	8	17
8.0 - 9.0	9	71	9.0 -10.0	9	38	15.0 - 16.0	11	28
9.0 -10.0	3	74	10.0 -11.0	13	51	16.0 - 17.0	13	41
10.0 -11.0	1	75	11.0 -12.0	9	60	17.0 - 18.0	10	51
11.0 -12.0	1	76	12.0 -13.0	6	66	18.0 - 19.0	9	60
			13.0 -14.0	1	67	19.0 - 20.0	4	64
...	...		14.0 -15.0	4	71	20.0 - 21.0	6	70
...	...		15.0 -16.0	2	73	21.0 - 22.0	2	72
...	...		16.0 -17.0	3	76	22.0 - 23.0	1	73
...	...		...	...		23.0 - 24.0	1	74
...	...		...	...		24.0 - 25.0	2	76
...	...							

Fre. = frequency

Cu.fre. = cummulative frequency.

FIG - 2

Base Population - Group-A

Body Weight of the Female at Different stages of Growth

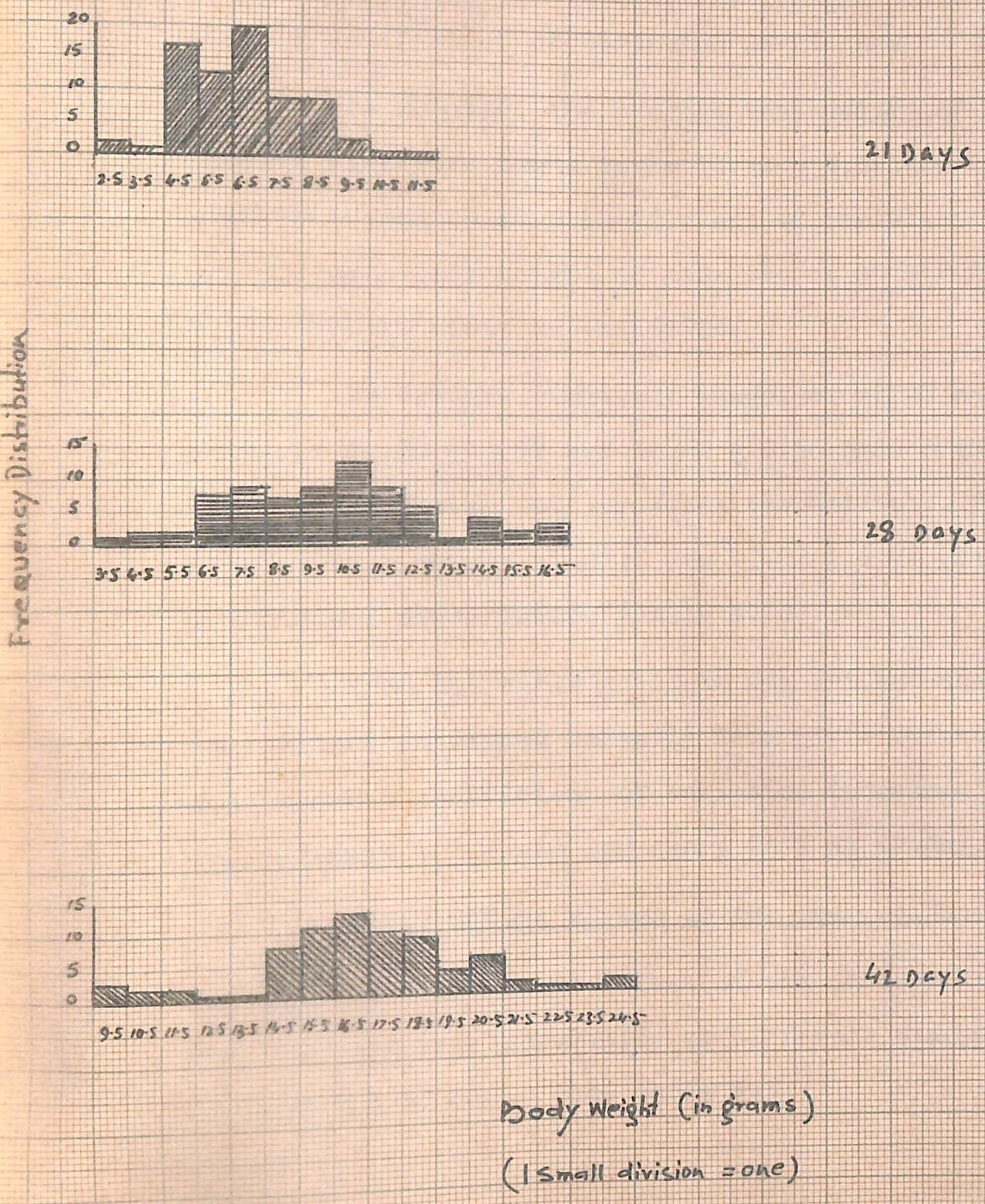
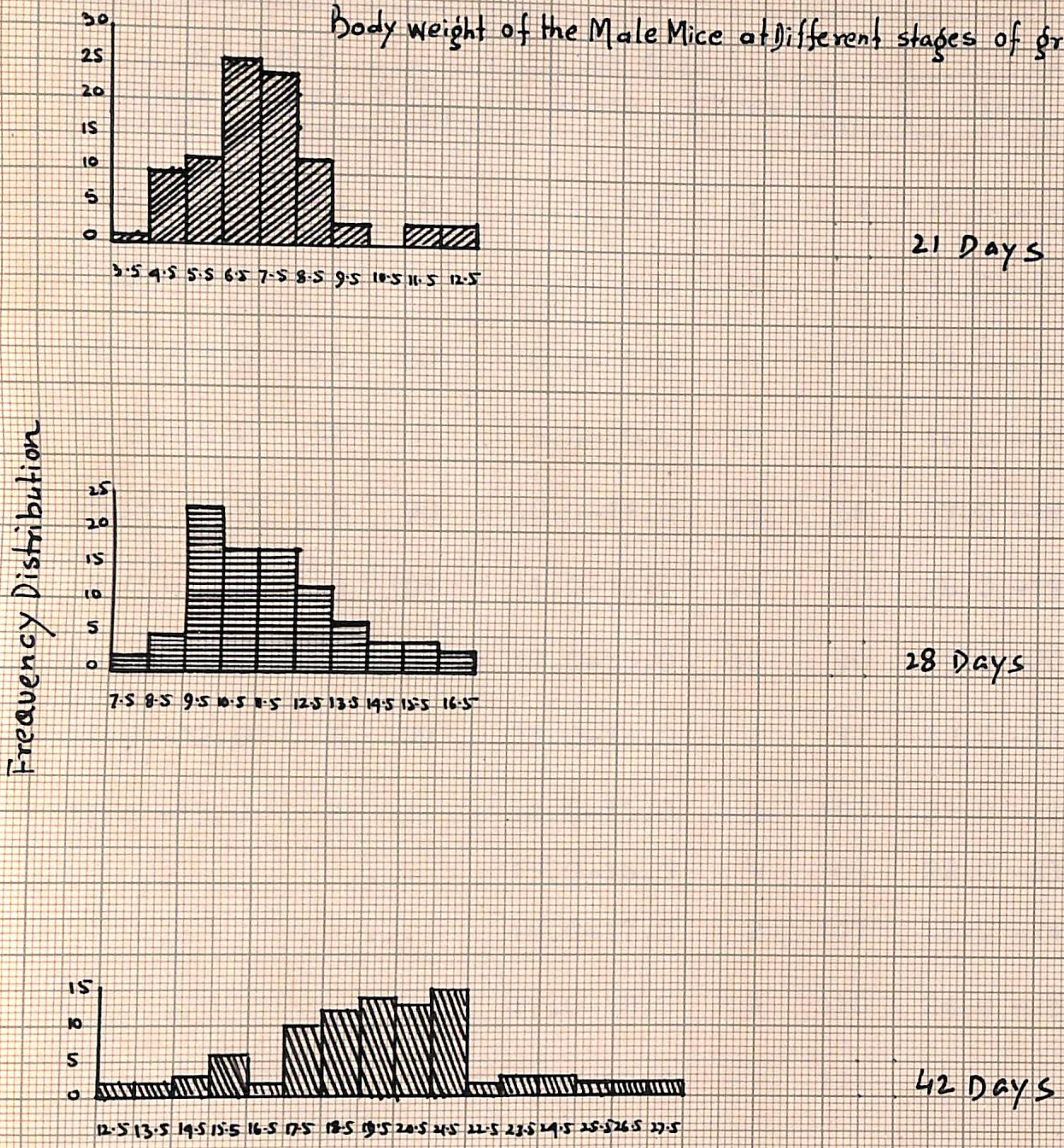


FIG — 3

Base Population — Group - B

Body weight of the Male Mice at Different stages of growth



Body weight (in grams)

(1 small division = one)

TABLE 4.4

Showing frequency and cummulative distribution of body weight of male mice of group 'B' in base population.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
3.0 - 4.0	1	1	7.0 - 8.0	2	2	11.0 - 12.0	1	1
4.0 - 5.0	10	11	8.0 - 9.0	5	7	12.0 - 13.0	1	2
5.0 - 6.0	12	23	9.0 -10.0	23	30	13.0 - 14.0	2	4
6.0 - 7.0	26	49	10.0 -11.0	17	47	14.0 - 15.0	3	7
7.0 - 8.0	24	73	11.0 -12.0	17	64	15.0 - 16.0	6	13
8.0 - 9.0	12	85	12.0 -13.0	12	76	16.0 - 17.0	2	15
9.0 -10.0	3	88	13.0 -14.0	7	83	17.0 - 18.0	10	25
10.0 -11.0	0	88	14.0 -15.0	4	87	18.0 - 19.0	12	37
11.0 -12.0	3	91	15.0 -16.0	4	91	19.0 - 20.0	14	51
12.0 -13.0	3	94	16.0 -17.0	3	94	20.0 - 21.0	13	64
...		...	...		...	21.0 - 22.0	15	79
...		...	...		...	22.0 - 23.0	2	81
...		...	...		...	23.0 - 24.0	3	84
...		...	...		...	24.0 - 25.0	3	87
...		...	...		...	25.0 - 26.0	2	89
...		...	...		...	26.0 - 27.0	2	91
...		...	...		...	27.0 - 28.0	2	93

Fre. = frequency

Cu. fre. = cummulative frequency.

TABLE 4.5

Showing frequency and cummulative distribution of female mice body weight of group B in base population.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
4.0 - 5.0	6	6	6.0- 7.0	1	1	13.0 -14.0	5	5
5.0 - 6.0	11	17	7.0- 8.0	3	4	14.0 -15.0	6	11
6.0 - 7.0	33	50	8.0- 9.0	7	11	15.0 -16.0	5	16
7.0 - 8.0	32	82	9.0-10.0	22	33	16.0 -17.0	12	28
8.0 - 9.0	16	98	10.0-11.0	23	56	17.0 -18.0	20	48
9.0 -10.0	3	101	11.0-12.0	24	80	18.0 -19.0	18	66
10.0 -11.0	4	105	12.0-13.0	10	90	19.0 -20.0	17	83
11.0 -12.0	4	109	13.0-14.0	7	97	20.0 -21.0	13	96
12.0 -13.0	2	111	14.0-15.0	3	100	21.0 -22.0	7	103
...		...	15.0-16.0	5	105	22.0 -23.0	4	107
...		...	16.0-17.0	2	107	23.0 -24.0	0	107
...		...	17.0-18.0	3	110	24.0 -25.0	3	110
...		...	18.0-19.0	1	111	...		...

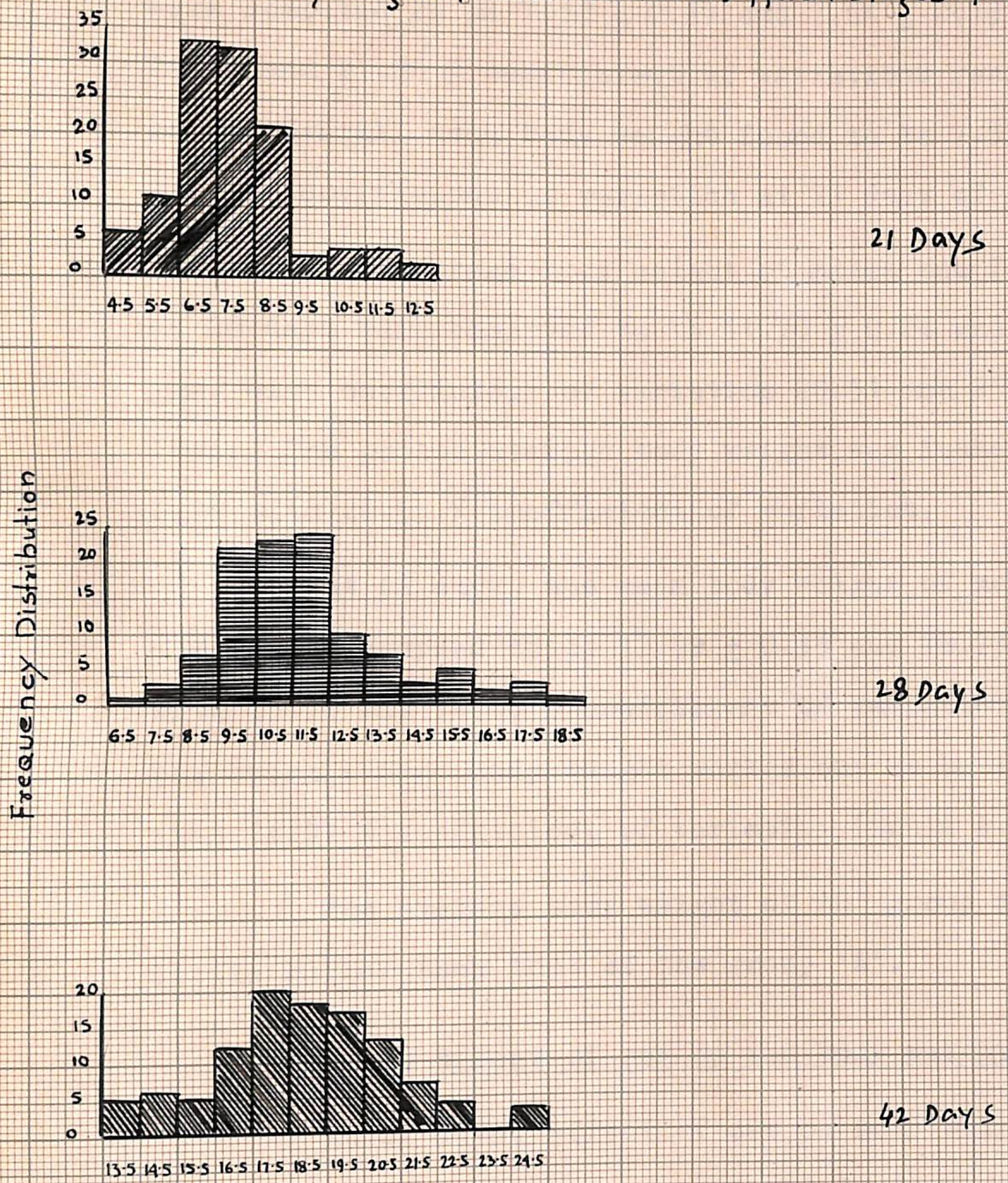
Fre. = frequency

Cu.fre. = cummulative frequency.

FIG- 4

Base Population - Group-B

Body weight of the Female Mice at Different stages of Growth



Body weight (in grams)

(1 small division = one)

(ii) Averages:-

The average body weight of males and females mice were computed to be 7.38 ± 0.59 and 7.64 ± 0.15 gms. with 24.66 and 21.85 % coefficient of variations respectively, whereas the overall mean body weight found to be 7.53 ± 0.12 with 23.11 % coefficient of variation at 21 days of age.

The average body weight of males and females mice at 28 days were observed to be 11.70 ± 0.24 and 11.66 ± 0.22 gms. with coefficient of variation 20.51 and 20.58 % respectively. The pooled average body weight was found to be 11.68 ± 0.16 with 20.55 % coefficient of variation.

At 42 days, the mean body weight of males and females mice were recorded to be 19.99 ± 0.33 and 18.73 ± 0.23 gms. with 16.30 and 12.86 % coefficient of variation respectively. The overall mean body weight worked out to be 19.31 ± 0.20 gms. with 14.97 % coefficient of variation (table 4.10).

The average body weight of 'B' group seemed to be little higher than that of the group 'A'.

(iii) Effect of sex on the body weight:-

At 42 days, effect of sex on body weight was found highly significant whereas at 21 and 28 days, no sex effect was recorded (table 4.6).

TABLE 4.6

Showing analysis of variance to see the effects of sex on body weight of group 'B' mice at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	3.45	1.13 NS	1	0.08	0.013 NS	1	79.78	9.91**
Within sex	203	3.03		203	5.79		201	8.05	
Total	204			204			202		

NS = non-significant

** = significant at 1 % level.

GROUP 'C':

TABLE 4.7

Showing frequency and cummulative distribution of male mice body weight of group C in base population.

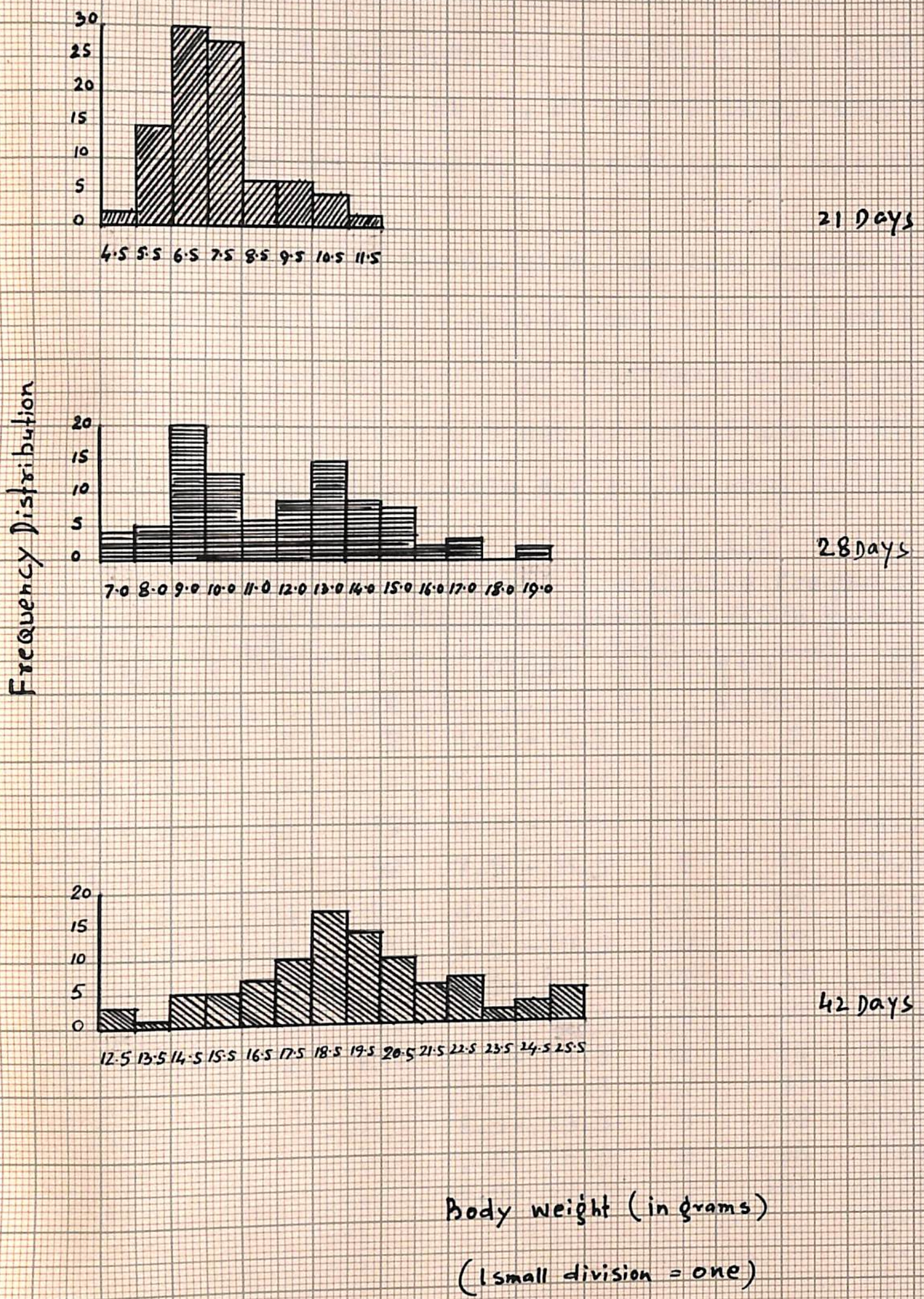
21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
4.0 - 5.0	2	2	6.5- 7.5	4	4	12.0-13.0	3	3
5.0 - 6.0	15	17	7.5- 8.5	5	9	13.0-14.0	1	4
6.0 - 7.0	30	47	8.5- 9.5	20	29	14.0-15.0	5	9
7.0 - 8.0	28	75	9.5-10.5	13	42	15.0-16.0	5	14
8.0 - 9.0	7	82	10.5-11.5	6	48	16.0-17.0	7	21
9.0 -10.0	7	89	11.5-12.5	9	57	17.0-18.0	10	31
10.0 -11.0	5	94	12.5-13.5	15	72	18.0-19.0	17	48
11.0 -12.0	2	96	13.5-14.5	9	81	19.0-20.0	14	62
...		...	14.5-15.5	8	89	20.0-21.0	10	72
...		...	15.5-16.5	2	91	21.0-22.0	6	78
...		...	16.5-17.5	3	94	22.0-23.0	7	85
...		...	17.5-18.5	0	94	23.0-24.0	2	87
...		...	18.5-19.5	2	96	24.0-25.0	3	90
...		...	...		...	25.0-26.0	5	95

Fre.= frequency; Cu.fre.= cummulative frequency.

FIG-5

Base Population - Group-C

Body weight of the Male Mice at Different stages of Growth



(i) Distribution of observations:-

From the table 4.7 above, it is revealed that the body weight of male mice ranges from 3.5-12.0, 6.0-19.5 and 12.5-26.0 gms. at 21, 28 and 42 days of age, respectively. The highest frequency was observed in the class 6.0 - 7.0, 8.5-9.5 and 18.0-19.0 at 21, 28 and 42 days, respectively. Histogram shows the frequency distribution of male mice body weight (fig.5).

In female mice, the body weight varied from 3.5-12.0, 5.5-17.5 and 11.0-26.5 gms. at 21, 28 and 42 days, respectively. The maximum number of observations were recorded in class 6.0-7.0, 11.5-12.5 and 20.5-21.5 gms. at 21, 28 and 42 days, respectively (table 4.8 ; histogram in fig.6).

TABLE 4.8

Showing frequency and cummulative frequency distribution of female mice body weight of group C in base population.

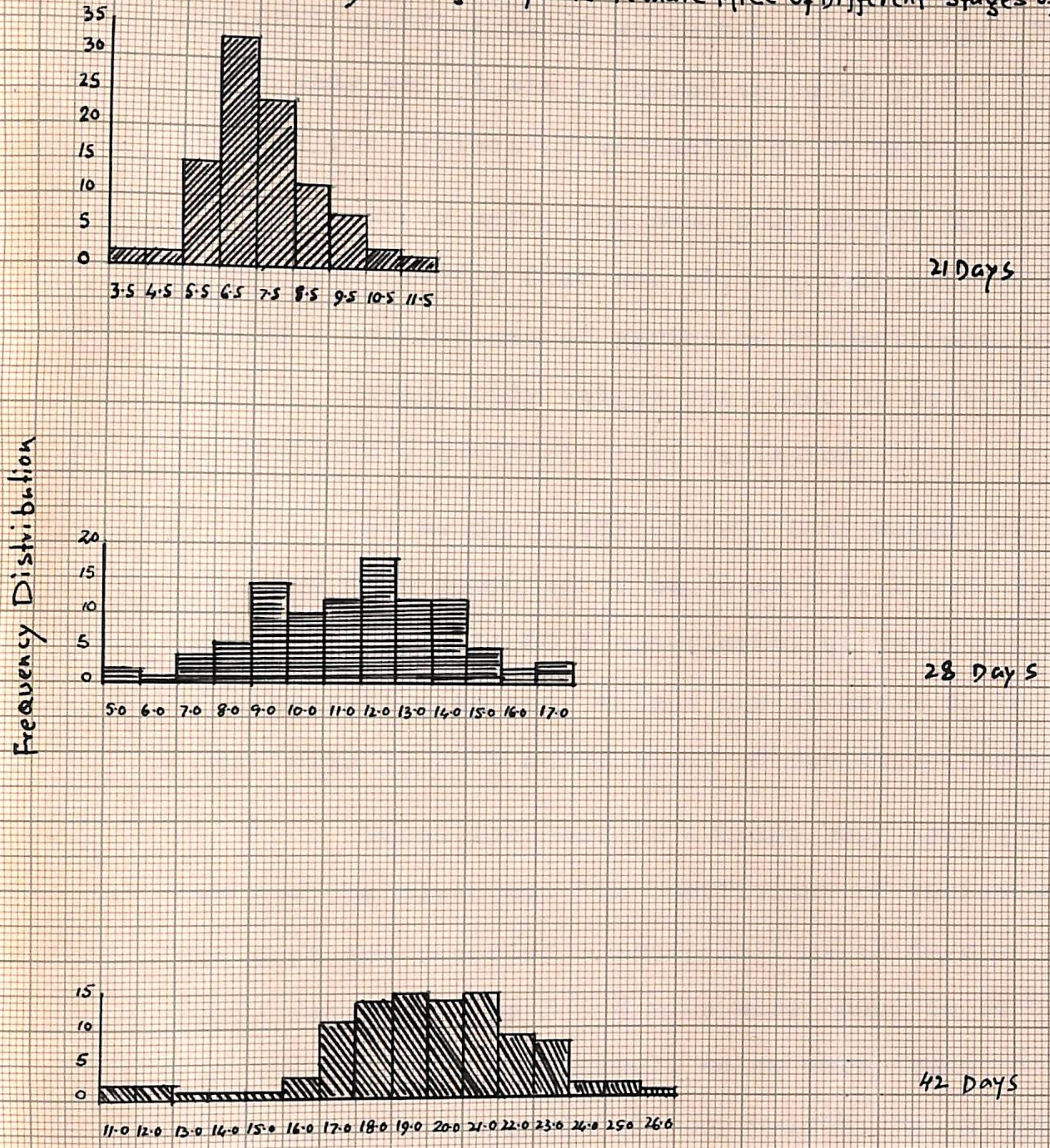
21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
3.0 - 4.0	2	2	4.5 - 5.5	2	2	10.5-11.5	2	2
4.0 - 5.0	2	4	5.5 - 6.5	1	3	11.5-12.5	2	4
5.0 - 6.0	15	19	6.5 - 7.5	4	7	12.5-13.5	1	5
6.0 - 7.0	33	52	7.5 - 8.5	6	13	13.5-14.5	1	6
7.0 - 8.0	24	76	8.5 - 9.5	14	27	14.5-15.5	1	7
8.0 - 9.0	12	88	9.5 -10.5	10	37	15.5-16.5	3	10
9.0 -10.0	8	96	10.5- 11.5	12	49	16.5-17.5	11	21
10.0 -11.0	3	99	11.5- 12.5	18	67	17.5-18.5	14	35
11.0 -12.0	2	101	12.5- 13.5	12	79	18.5-19.5	15	50
...		...	13.5- 14.5	12	91	19.5-20.5	14	64
...		...	14.5- 15.5	5	96	20.5-21.5	15	79
...		...	15.5- 16.5	2	98	21.5-22.5	9	88
...		...	16.5- 17.5	3	101	22.5-23.5	8	96
...		...	...		...	23.5-24.5	2	98
...		...	...		...	24.5-25.5	2	100
...		...	...		...	25.5-26.5	1	101
...		...						

Fre. = frequency; Cu.fre.= cummulative frequency.

Fig - 6

Base Population — Group - C

Body weight of the Female Mice of Different stages of Growth



Body weight (in grams)

(1 small division = one)

(ii) Averages:-

The average body weight of males and females mice were found to be 7.53 ± 0.15, 7.42 ± 0.14 gms. with 20.31 and 20.08 % coefficient of variation respectively. The overall mean body weight was recorded to be as 7.48 ± 0.10 gms. with 20.19% coefficient of variation at 21 days.

At 28 days, the mean body weight of males and females mice were 11.82 ± 0.28 and 11.59 ± 0.26 gms. with 23.43 % and 22.86 % coefficient of variation respectively, whereas the pooled average body weight was found to be 11.71 ± 0.19 gms. with 23.06 % coefficient of variation.

At 42 days, the average body weight of males and females were computed to be 19.44 ± 0.32 and 19.58 ± 0.28 gms. with 15.99 and 14.60 % coefficient of variation respectively. The overall mean body weight was observed to be 19.52 ± 0.21 gms. with 15.27 % coefficient of variation (table 4.10).

Rapid increase in average body weight was observed as the age advanced. The coefficient of variation increased at 28 days and recorded a sharp fall at 42 days of age. As regards body weight, group B & C mice were found to be better than that of the group A. In general, males were found to be superior to females in respects of body weight, but in the group C at 42 days, body weight of females mice was observed to be a bit higher than that of males.

(iii) Effects of sex on body weight:-

The effects of sex on body weight of mice at

21, 28 and 42 days were observed non-significant (table 4.9).

TABLE 4.9

Showing the analysis of variance of sex effects on body weight of mice under group C in base population.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	0.65	0.28[NS]	1	2.58	0.35[NS]	1	0.91	0.10[NS]
Within sex	195	2.29		195	7.35		194	8.93	
Total	196			196			195		

NS = non-significant.

(iv) Comparison of averages between groups:-

In case of male mice, group difference at 28 days and 42 days body weight were found to be significant, whereas no group difference at 21 days was observed (table 4.11).

Critical difference test shows significant at 21 days between A & C groups, whereas between groups A & B and B & C non-significant group difference was observed. Group A differed significantly from both the groups B & C as regards body weight at 28 days and 42 days. No significant difference in the body weight was found between groups B and C at 21, 28 and 42 days respectively(table 4.12).

TABLE 4.10

Showing average body weight of mice with S.E. and C.V. in base population at different stages of growth, groupwise (gms.).

Group/ sex	Different stages of growth								
	21 days			28 days			42 days		
	No. of obs.	Average ± S.E.	C.V.%	No. of obs.	Average ± S.E.	C.V.%	No. of obs.	Average ± S.E.	C.V.%
'A'									
Male	83	6.91 ± 0.22	29.37	83	10.78 ± 0.36	30.42	83	18.00 ± 0.37	18.83
Female	76	6.63 ± 0.65	27.14	76	10.19 ± 0.34	29.24	76	17.09 ± 0.37	19.32
Overall	159	6.77 ± 0.15	28.36	159	10.50 ± 0.25	29.90	159	17.57 ± 0.26	19.19
'B'									
Male	94	7.38 ± 0.59	24.66	94	11.70 ± 0.24	20.51	93	19.99 ± 0.33	16.30
Female	111	7.64 ± 0.15	21.85	111	11.66 ± 0.22	20.58	110	18.73 ± 0.23	12.86
Overall	205	7.53 ± 0.12	23.11	205	11.68 ± 0.16	20.55	203	19.31 ± 0.20	14.97
'C'									
Male	96	7.53 ± 0.15	20.31	96	11.82 ± 0.28	23.43	95	19.44 ± 0.32	15.99
Female	101	7.42 ± 0.14	20.08	101	11.59 ± 0.26	22.86	101	19.58 ± 0.28	14.60
Overall	197	7.48 ± 0.10	20.19	197	11.71 ± 0.19	23.06	196	19.52 ± 0.21	15.27

TABLE 4.11

Showing analysis of variance of body weight difference of male mice between groups at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between groups	2	9.17	2.84NS	2	28.20	3.53*	2	91.42	8.61**
Within group	270	3.22		270	7.97		268	10.61	
Total	272			272			270		

* = significant at 5 % level

** = significant at 1 % level

NS = non-significant.

TABLE 4.12

Critical difference showing body weight difference of male mice between groups.

Between Group	21 days			28 days			42 days		
	M.D.	C.D. value 5%	1%	M.D.	C.D. value 5 %	1%	M.D.	C.D. value 5%	1%
A Vs. B	0.47NS	0.52	0.69	0.92*	0.82	1.08	1.99**	0.96	1.26
A Vs. C	0.62*	0.50	0.66	1.04*	0.82	1.08	1.44**	0.94	1.23
B Vs. C	0.15NS	0.50	0.66	0.12NS	0.78	1.03	0.55NS	0.92	1.21

* = significant at 5 % level,

** = significant at 1 % level,

NS = non-significant,

M.D.= mean difference.

In female mice, difference of body weight between groups was observed to be highly significant at all stages (21, 28 and 42 days, vide table 4.13).

Critical difference test revealed that the body weight of female mice between groups were highly significant at all stages, except for group B & C at 21 days and 28 days, where group effect was non-significant (Table 4.14).

TABLE 4.13

Analysis of variance showing body weight difference of female mice between groups at different stages.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between groups	2	24.45	8.98^{**}	2	58.24	8.27^{**}	2	137.08	17.09^{**}
Within group	285	2.72		285	7.04		284	8.02	
Total	287			287			286		

TABLE 4.14

Critical difference showing body weight difference of female mice between groups at different stages.

Between group	21 days			28 days			42 days		
	M.D.	C.D. value 5%	1%	M.D.	C.D. value 5%	1%	M.D.	C. D. value 5%	1%
A Vs. B	1.01^{**}	0.47	0.61	1.47^{**}	0.76	1.00	1.65^{**}	0.82	1.08
A Vs. C	0.79^{**}	0.49	0.64	1.40^{**}	0.78	1.03	2.50^{**}	0.84	1.10
B Vs. C	0.22^{NS}	0.43	0.56	0.07^{NS}	0.70	0.92	0.85^{*}	0.76	1.00

* = significant at 5 % level,

** = significant at 1 % level,

NS = non-significant,

M.D.= mean difference.

As shown under table 4.10, the difference of average body weight between groups - A, B and C, indicates clearly that the average body weight of groups C and B is superior to that of group A, and on analysis it was found that the group C differs significantly from group A mice as regards body weight at all stages of growth (21, 28 and 42 days). The growth of group A mice was found to be lower as compared to that of group B and C. The reason may be that the sires of group A were from outside stock, which might have a inferior germ plasm as compared to those of the existing stock.

The coefficient of variation in group A mice was found higher than that of groups B and C. The coefficient of variation for groups A, B and C was found to be more at 21, 28 and 42 days of age, as compared to that reported by Hansson and Lindkvist (1962) at these periods.

The average body weight of the present observation at 21 days was more or less similar to that of small sized mice of Lewis and Warwick (1953), but the average body weight of their medium and large sized mice at 21 days was higher than the present findings.

Hansson and Lindkvist (1962) reported, average body weight of mice at 21 days, 28 days and 42 days was 10.58, 15.88 and 20.63 gms., which was higher than the present observations of the body weight of mice at different stages of growth.

In reciprocal population, the following studies have been made on body weight of mice under groups A and B, and that in group C, at different stages of growth (21, 28 and 42 days):

(i) Distribution of observations in each group,

(ii) Average with S.E. and C.V. for each group,

(iii) Effect of sex on body weight of mice in each group,

(iv) Heritability with S.E. of body weight in each group, and

(v) Comparison of averages between group.

GROUP 'A':

(i) Distribution of observations:-

In male mice at 21, 28 and 42 days, the body weight ranged from 5.0-13.0, 7.5-17.0 and 12.0-27.0 gms., respectively. The body weight were grouped at 1 gm. class intervals. The highest frequency of observations were found in the class 6.5-7.5, 11.0-12.0 and 18.0-19.0 gms. at 21, 28 and 42 days, respectively(vide table 4.15 and histogram in fig.8).

In female mice, the body weight varied from 4.5-12.0, 7.5-17.0 and 13.0-27.0 gms. at 21, 28 and 42 days, respectively The maximum number of observations were noted between the class 6.0-7.0, 9.0-10.0 and 18.5-19.5 gms., respectively at 21, 28 and 42 days of age(table 4.16 and histogram in fig.9).

(ii) Averages:-

The body weight of males and females averaged 7.90±0.0[illegible] 7.63±0.08 gms. with 16.45 and 16.90% coefficient of variation

TABLE 4.15

Showing frequency and cummulative distribution of male mice body weight of group A in reciprocal population at 21,28 & 42 days of age.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
4.5 - 5.5	7	7	7.0- 8.0	4	4	14.0-15.0	6	6
5.5 - 6.5	21	28	8.0- 9.0	11	15	15.0-16.0	6	12
6.5 - 7.5	66	94	9.0-10.0	25	40	16.0-17.0	17	29
7.5 - 8.5	57	151	10.0-11.0	39	79	17.0-18.0	19	48
8.5 - 9.5	37	188	11.0-12.0	51	130	18.0-19.0	27	75
9.5 -10.5	5	193	12.0-13.0	22	152	19.0-20.0	23	98
10.5 -11.5	4	197	13.0-14.0	29	181	20.0-21.0	22	120
11.5 -12.5	1	198	14.0-15.0	7	188	21.0-22.0	24	144
12.5 -13.5	2	200	15.0-16.0	10	198	22.0-23.0	25	169
...	...		16.0-17.0	2	200	23.0-24.0	15	184
...	...		...	...		24.0-25.0	6	190
...	...		...	...		25.0-26.0	3	193
...	...		...	...		26.0-27.0	3	196

TABLE 4.16

Showing frequency and cummulative distribution of female mice body weight of group A in reciprocal population at 21,28 & 42 days of age.

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.
4.0- 5.0	2	2	7.0- 8.0	2	2	12.5-13.5	2	2
5.0- 6.0	28	30	8.0- 9.0	17	19	13.5-14.5	5	7
6.0- 7.0	61	91	9.0-10.0	57	76	14.5-15.5	4	11
7.0- 8.0	60	151	10.0-11.0	32	108	15.5-16.5	7	18
8.0- 9.0	33	184	11.0-12.0	38	146	16.5-17.5	21	39
9.0-10.0	15	199	12.0-13.0	31	177	17.5-18.5	30	69
10.0-11.0	7	206	13.0-14.0	14	191	18.5-19.5	31	100
11.0-12.0	1	207	14.0-15.0	4	195	19.5-20.5	30	130
...	...		15.0-16.0	8	203	20.5-21.5	25	155
...	...		16.0-17.0	4	207	21.5-22.5	20	175
...	...		...	...		22.5-23.5	14	189
...	...		...	...		23.5-24.5	4	193
...	...		...	...		24.5-25.5	7	200
...	...		...	...		25.5-26.5	3	203
...	...		...	...		26.5-27.5	1	204
...	...							

Fre. = frequency, Cu.fre.= cummulative frequency.

FIG— 8

Reciprocal Population— Group-A

Body weight of the Male Mice at Different stages of Growth

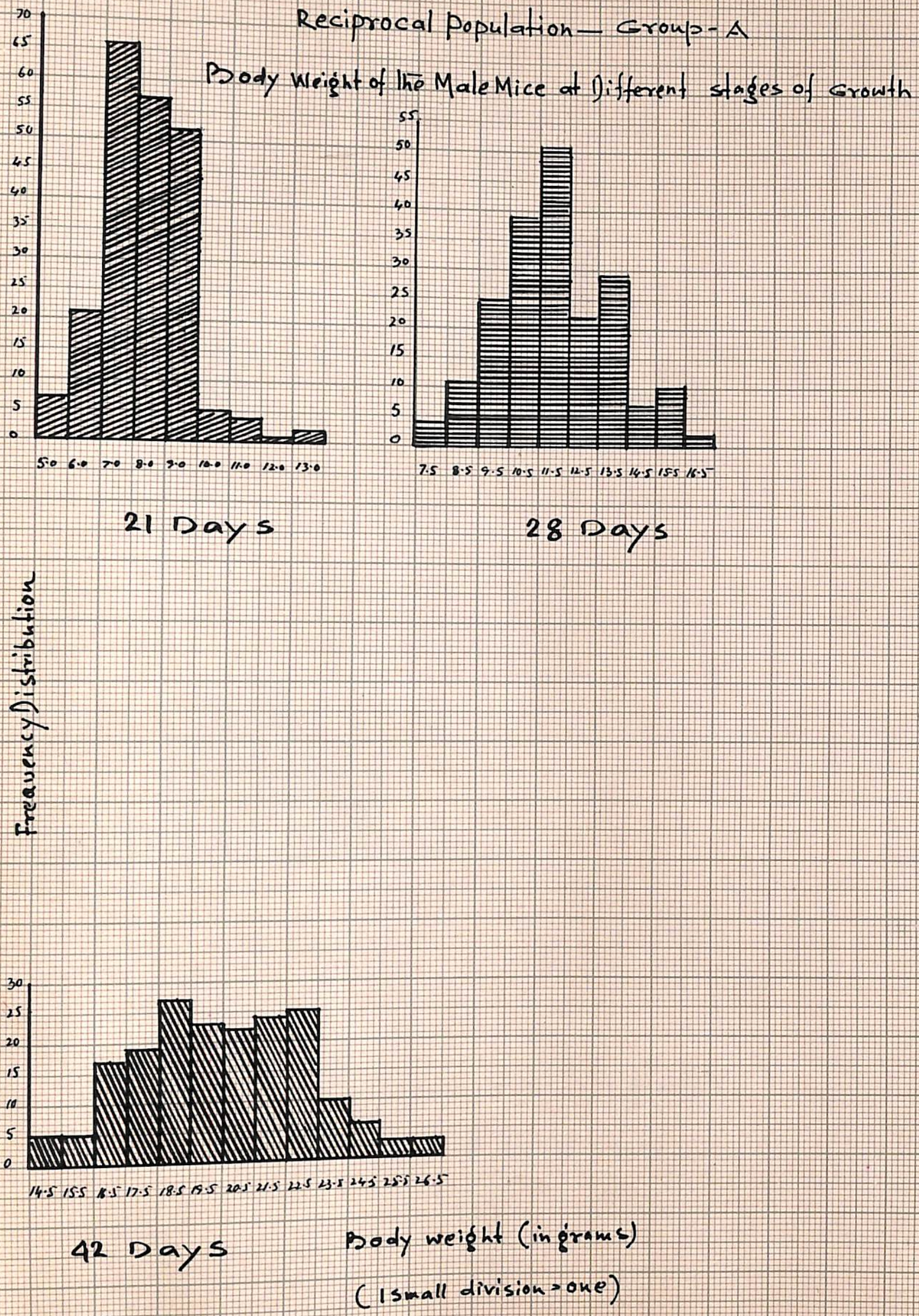
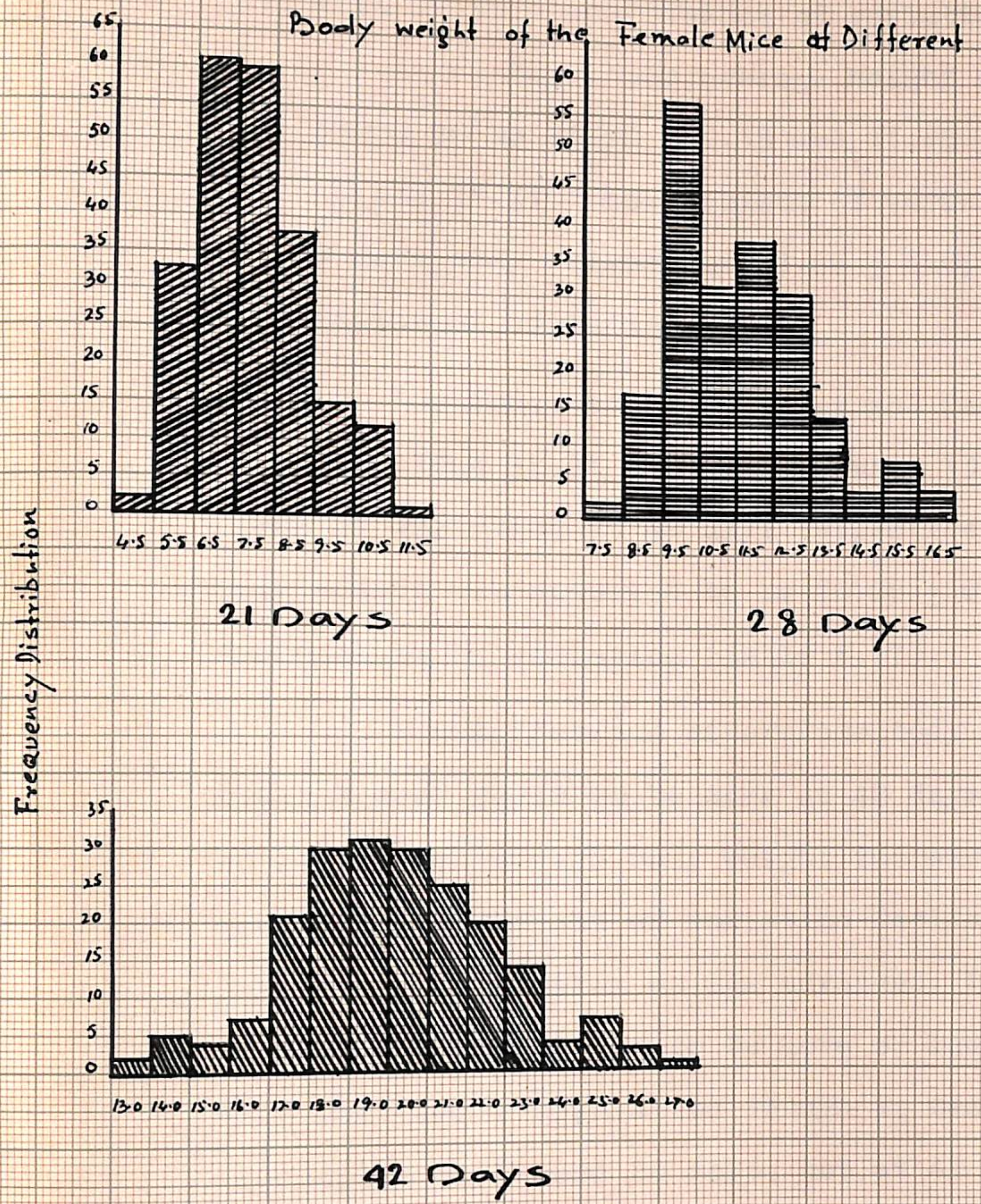


Fig – 9

Reciprocal Population – Group- A

Body weight of the Female Mice at Different stages of Growth



Body weight (in grams)

(1 small division = one)

at 21 days, respectively. The overall average was 7.76 ± 0.06 gms. with 16.75 % coefficient of variation.

At 28 days, the average weight of males and females were found to be 11.90 ± 0.13 and 11.43 ± 0.13 gms. with 15.12 % and 16.71 % coefficient of variation respectively. The pooled mean body weight was 11.66 ± 0.09 gms. with 16.29 % coefficient of variation.

The body weight of males and females mice averaged 20.38 ± 0.19,& 19.81 ± 0.18 gms. with 13.44 and 13.37 % coefficient of variation at 42 days respectively. The overall average body weight was computed to be 20.09 ± 0.13 gms. with 13.44 % coefficient of variation (table 4.17).

The difference of average body weight of males and females were found to be more at 42 days than that of 21 and 28 days. The average body weight increased rapidly with the age. The coefficient of variation declined gradually in both the males and females as age advanced. The coefficient of variation was observed to be more or less similar in both the male and female population though it was a little bit higher in females at 21 and 28 days, but at 42 days the same was slightly higher in males than in females.

The average body weight of mice in reciprocal population was observed to be higher than the body weight of mice in base population.

(iii) <u>Effect of sex on body weight:-</u>

Significant effect of sex on body weight of mice in reciprocal population was observed at all stages (table 4.18).

TABLE 4.17

Showing average body weight with S.E. and C.V. of male and female mice in Reciprocal population at different stages of growth, groupwise.

Group/ sex	Different stages of growth								
	21 days			28 days			42 days		
	No. of obs.	Average ± S.E.	C.V.%	No. of obs.	Average ± S.E.	C.V.%	No. of obs.	Average ± S.E.	C.V. %
'A'									
Male	200	7.90 ± 0.09	16.45	200	11.90 ± 0.13	15.12	196	20.38 ± 0.19	13.44
Female	207	7.63 ± 0.08	16.90	207	11.43 ± 0.13	16.71	204	19.81 ± 0.18	13.37
Overall	407	7.76 ± 0.06	16.75	407	11.66 ± 0.09	16.29	400	20.09 ± 0.13	13.44
'B'									
Male	172	8.04 ± 0.14	22.38	172	12.46 ± 0.17	18.61	169	21.44 ± 0.24	14.92
Female	170	7.98 ± 0.15	25.93	170	12.04 ± 0.18	20.18	169	20.07 ± 0.23	15.39
Overall	342	8.01 ± 0.10	24.34	342	12.25 ± 0.12	19.43	338	20.76 ± 0.17	15.46
'C'									
Male	80	8.91 ± 0.25	25.36	80	13.34 ± 0.32	21.73	76	22.75 ± 0.30	11.69
Female	91	8.82 ± 0.25	27.66	91	12.42 ± 0.30	23.67	90	20.71 ± 0.35	16.36
Overall	171	8.87 ± 0.18	26.49	171	12.85 ± 0.22	22.88	166	21.65 ± 0.25	14.92

TABLE 4.18

Analysis of variance showing sex effect on mice body weight at different stages of growth of group A in Reciprocal populn.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	7.39	4.39*	1	22.26	6.22*	1	32.07	4.41*
Within sex	405	1.68		405	3.58		398	7.26	
Total	406			406			399		

* = significant at 5 % level.

(iv) Heritability estimates of mice body weight of group A in Reciprocal population:

The heritability coefficient of male mice body weight was estimated by Intra-Sire Regression of son on dam. The analysis of variance and covariance based on 199 pairs of dam,& son at 21 and 28 days of age and 195 dam-son pairs at 42 days of age, belonging to 15 sires, are presented in table 4.19.

The heritability coefficient estimation was observed to be 0.20 ± 0.14, -0.16 and -0.60 at 21, 28 and 42 days, respectively(table 4.19). The heritability estimate of the body weight of male mice was found to be negative, except at 21 days of age.

At 21 days, 20 % heritability was obtained,which was similar to that reported by Singh(1967). The negative value of heritability may be taken as zero, which may be due to the sampling error including environmental factors.The S.E.of the negative value has not been worked out.

TABLE 4.19

Showing analysis of variance and covariance for estimating heritability of male mice body weight of group 'A' in Reciprocal population at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S. P. (Sxiyi)
Between sires	14	135.96	-3.57	14	212.44	-34.69	14	1554.19	623.46
Within sire	185	282.95	29.52	185	766.16	-64.03	181	698.26	-224.08
Total	199	418.91	25.52	199	978.60	-98.75	195	2252.45	399.38
b =		0.10			-0.08			-0.32	
cf =		0.10			1.06			0.96	
C(b) =		0.10			-0.08			-0.30	
h^2 =		0.20 ± 0.14			-0.16			-0.60	

cf = correction factor

C(b) = corrected b

TABLE 4.20

Showing analysis of variance and covariance for estimating heritability of the female mice body weight of group A in Reciprocal population at different stages.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	14	89.76	-16.35	14	321.68	-29.78	14	295.75	27.98
Within sire	192	315.52	-35.34	192	836.07	-191.54	189	774.01	-173.82
Total	206	405.28	-51.66	206	1157.75	-221.32	203	1069.76	-145.84
b =		-0.11			-0.23			-0.22	
h^2 =		-0.22			-0.46			-0.44	

In the table 4.20 above, the heritability coefficient of female mice body weight was estimated to be -0.22, -0.46 and -0.44 at 21, 28 and 42 days, respectively. The heritability coefficient was estimated by Intra-Sire-Regression of daughter on dam.

GROUP 'B':

(i) Distribution of observations:-

In male mice, the body weight ranged from 4.0-14.0, 7.0-21.0 and 12.5-31.0 gms. at 21, 28 and 42 days of age, respectively. The frequency of body weight grouped into class intervals of 1 gm. revealed that the maximum number of observations fell in the class 6.0-7.0, 11.5-12.5 and 23.0-24.0 gms. at 21, 28 and 42 days respectively (table 4.21 and histogram in fig.10).

In female mice, the body weight varied from 3.5-15.0, 7.5-20.0 and 12.0-29.5 gms. at 21, 28 and 42 days, respectively. There was one mice weighing 9.5 gms. which was included in the class 12.0-13.0 gms. The highest frequency were observed in the class 6.0-7.0, 11.0-12.0 and 20.0-21.0 gms. at 21, 28 and 42 days respectively (table 4.22 and histogram in fig.11.).

(ii) Averages:-

The mean body weight of males and females of reciprocal population of group 'B' was found to be 8.04 ± 0.14 and 7.98 ± 0.15 gms. with 22.38 and 25.92 % coefficient of variation respectively at 21 days of age. The overall average body weight was computed to be 8.01±0.10 gms.with 24.34 % C.V.

TABLE 4.21

Showing frequency and cummulative distribution of male mice body weight of group B in Reciprocal population at all stages.

21 days			28 days			42 days		
Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.	Class	Fre.	Cu. fre.
3.0 - 4.0	3	3	6.5 - 7.5	2	2	12.0-13.0	2	2
4.0 - 5.0	4	7	7.5 - 8.5	1	3	13.0-14.0	1	3
5.0 - 6.0	21	28	8.5 - 9.5	16	19	14.0-15.0	3	6
6.0 - 7.0	40	68	9.5 -10.5	13	32	15.0-16.0	1	7
7.0 - 8.0	34	102	10.5 -11.5	29	61	16.0-17.0	7	14
8.0 - 9.0	28	130	11.5 -12.5	41	102	17.0-18.0	14	28
9.0 -10.0	24	154	12.5 -13.5	27	129	18.0-19.0	20	48
10.0-11.0	12	166	13.5 -14.5	21	150	19.0-20.0	15	63
11.0-12.0	3	169	14.5- 15.5	12	162	20.0-21.0	18	81
12.0-13.0	0	169	15.5 -16.5	2	164	21.0-22.0	18	99
13.0-14.0	3	172	16.5 -17.5	4	168	22.0-23.0	18	117
...		...	17.5 -18.5	0	168	23.0-24.0	25	142
...		...	18.5 -19.5	0	168	24.0-25.0	10	152
...		...	19.5 -20.5	1	169	25.0-26.0	6	158
...		...	20.5 -21.5	3	172	26.0-27.0	6	164
...		...	...		...	27.0-28.0	3	167
...		...	...		...	28.0-29.0	1	168
...		...	...		...	29.0-30.0	0	168
...		...	...		...	30.0-31.0	1	169

Fre. = frequency,

CU.fre= cummulative frequency.

FIG – 10

Reciprocal Population – Group-B

Body weight of the Male Mice of Different stages of Growth

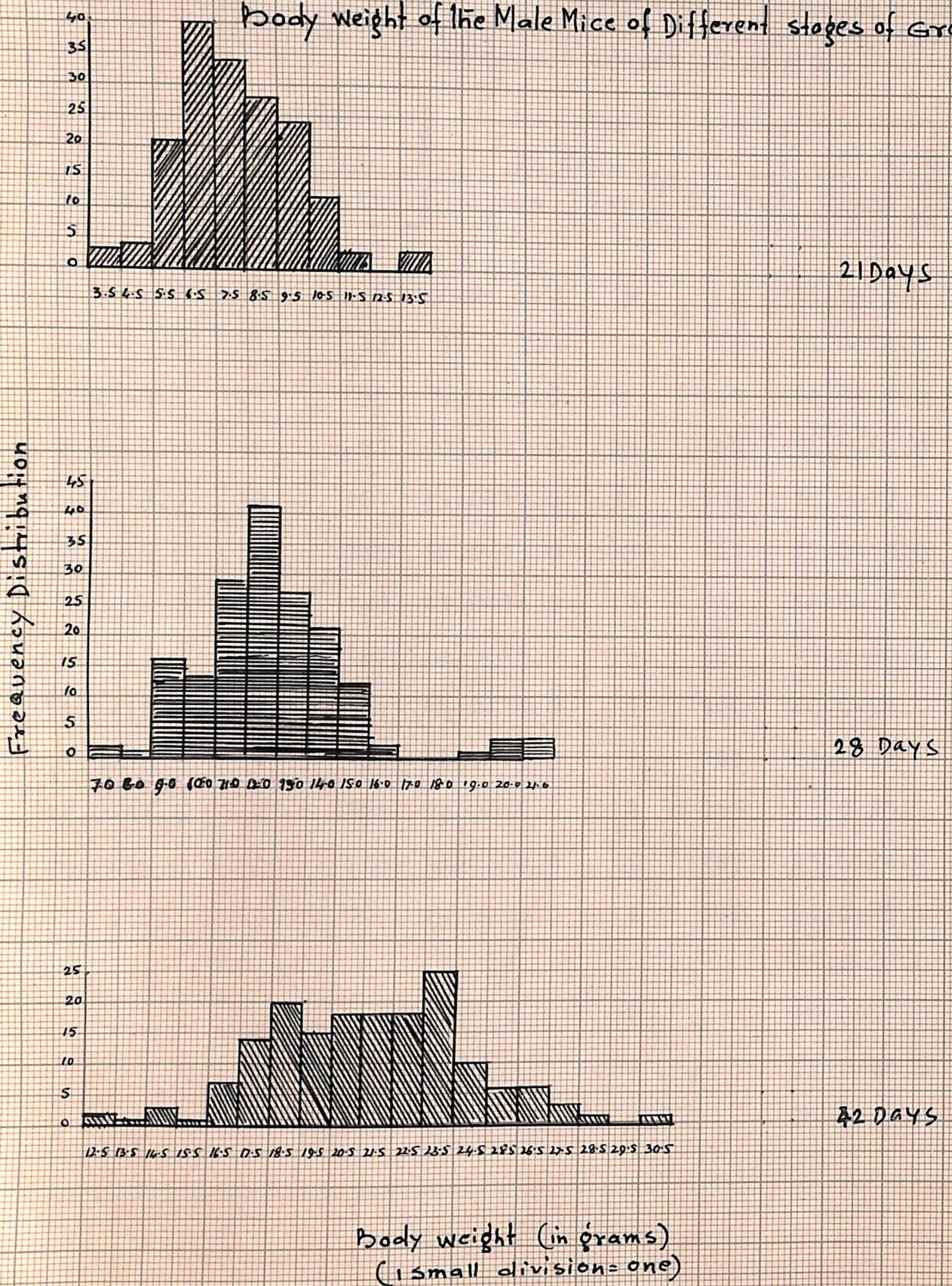


TABLE 4.22

Showing frequency and cummulative distribution of female mice body weight of group 'B' in Reciprocal population at different stages of growth.

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre	Class	Fre.	Cu.fre.
3.0- 4.0	4	4	7.0- 8.0	5	5	12.0-13.0	2	2
4.0- 5.0	8	12	8.0- 9.0	11	16	13.0-14.0	3	5
5.0- 6.0	23	35	9.0-10.0	25	41	14.0-15.0	4	9
6.0- 7.0	36	71	10.0-11.0	28	69	15.0-16.0	8	17
7.0- 8.0	30	101	11.0-12.0	35	104	16.0-17.0	12	29
8.0- 9.0	32	133	12.0-13.0	23	127	17.0-18.0	24	53
9.0-10.0	15	148	13.0-14.0	17	144	18.0-19.0	15	68
10.0-11.0	14	162	14.0-15.0	15	159	19.0-20.0	23	91
11.0-12.0	2	164	15.0-16.0	3	162	20.0-21.0	24	115
12.0-13.0	2	166	16.0-17.0	1	163	21.0-22.0	16	131
13.0-14.0	2	168	17.0-18.0	0	163	22.0-23.0	17	148
14.0-15.0	2	170	18.0-19.0	4	167	23.0-24.0	8	156
...		...	19.0-20.0	3	170	24.0-25.0	6	162
...		...	...		...	25.0-26.0	3	165
...		...	...		...	26.0-27.0	1	166
...		...	...		...	27.0-28.0	1	167
...		...	...		...	28.0-29.0	2	169

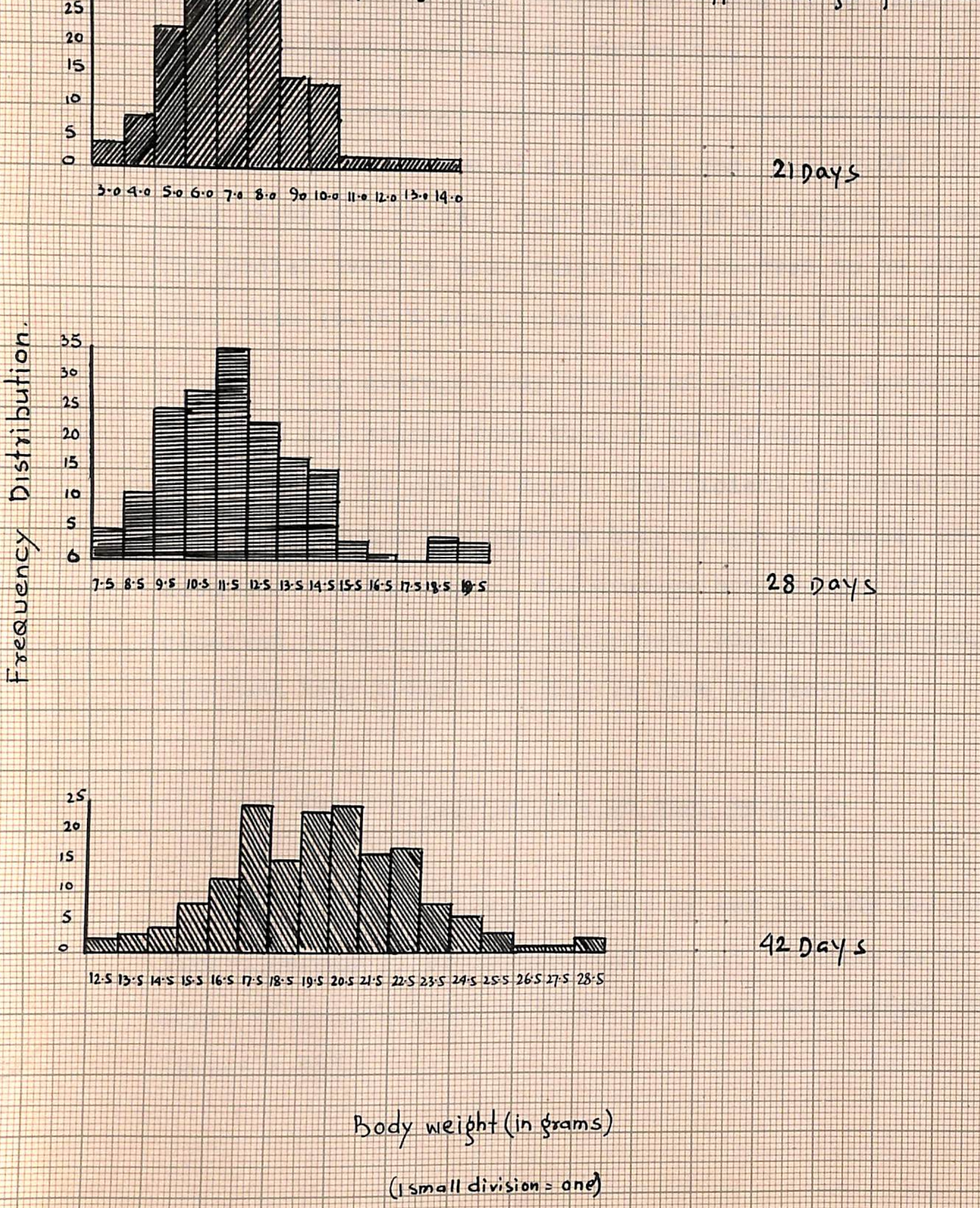
Fre. = frequency

Cu.fre.= cummulative frequency.

FIG- 11

Reciprocal Population- Group-B

Body weight of the Female Mice at Different stages of Growth



At 28 days, the average body weight of males and females were observed to be 12.46 $\pm$ 0.17 and 12.04 $\pm$ 0.18 gms. with 18.61 and 20.19 % coefficient of variation respectively, and pooled average body weight was found to be 12.25 $\pm$ 0.12 gms. with 19.43 % coefficient of variation,

The average body weight of males and females at 42 days were found to be 21.44 $\pm$ 0.24 gms. and 20.07 $\pm$ 0.23 gms. with 14.92 and 15.39 % coefficient of variation, respectively. The pooled average body weight was observed to be 20.76 $\pm$ 0.17 gms. with 15.46 % coefficient of variation (table 4.17).

The average body weight of group 'B' was found to be a little bit higher than that of the group 'A' at all stages of growth (21, 28 and 42 days). Coefficient of variation decreased gradually and the average body weight increased as the age advanced. On the whole, the average body weight of mice was observed to be higher in reciprocal population as compared to the mean body weight of mice in base population.

(iii) Effect of sex on body weight:-

At 42 days, the effects of sex on body weight of mice were observed to be highly significant, whereas at 21 and 28 days, non-significant effects of sex on body weight were found (table 4.23).

TABLE 4.23

Analysis of variance showing effects of sex on mice body weight at different stages of growth (21, 28 and 42 days) of group 'B' in reciprocal population.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	0.28	0.07^{NS}	1	15.15	2.67^{NS}	1	158.55	15.98^{**}
Within sex	340	3.84		340	5.66		336	9.92	
Total	341			341			337		

** = significant at 1 % level,
NS = non-significant.

(iv) Heritability estimates of mice body weight of group 'B' in reciprocal population:-

Heritability of male mice body weight was calculated by Intra-Sire-Regression of son on dam. Correction factor was used according to Clayton et al.(1957). The estimated heritability coefficient was -0.14, 0.30$\pm$ 0.18 and 0.010$\pm$ 0.36 at 21, 28 and 42 days of age (table 4.24).

The heritability estimate was found positive at 28 and 42 days, but at 21 days it was observed to be negative, which may be considered as zero. The h^2 at 42 days was slightly lower than that reported by Eisen and Legates (1966). The h^2 at 28 days was slightly higher to that reported by Rahnefeld et al.(1963) at 42 days. Reference regarding h^2 at 28 days could not be traced in literature and only few references were found regarding other stages of growth for comparison with the

TABLE 4.24

Showing analysis of variance and covariance for estimating heritability of the male mice body weight of group 'B' in reciprocal population at 21,28 & 42 days of age.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	14	16.69	-11.08	14	122.98	88.86	14	285.06	-87.72
Within sire	157	247.55	-22.53	157	460.32	62.85	154	435.96	2.96
Total	171	264.24	-33.61	171	583.30	151.71	168	721.02	-84.76
b =		-0.09			0.14			0.0068	
cf =		0.89			1.05			0.76	
C(b)=		0.08			0.15			0.005	
h^2 =		-0.16			0.30±0.18			0.010± 0.36	

cf = correction factor,
C(b)= corrected b.

present findings.

In female mice, heritability coefficient was estimated by the method of Intra-Sire-Regression of daughter on dam. The estimated heritability coefficient was observed to be 0.28 ± 0.21, 0.68 ± 0.16 and 0.12 ± 0.34 respectively, at 21, 28 and 42 days of age(table 4.25).

The higher percentage of heritability coefficient was found at 28 days as compared to 21 and 42 days.

The heritability coefficient at 21 days was slightly higher than that obtained by Eisen and Legates (1966) and more or less similar to that reported by Singh (1967). The heritability coefficient at 42 days was found to be a little bit lower than that reported by Rahnefeld et al. (1963) and Singh (1967), but as compared to the values of Eisen and Legates (1966), the present estimate was higher. Falconer (1953) reported heritability estimate of mice for body weight to be 20 % and 50 % at 42 days in upward and downward selection, respectively. The present findings are more or less similar to those of Falconer upward selection estimate and lower as compared to downward selection value.

However, the heritability estimates of group 'B', mice was observed to be better as compared to group 'A' mice. It seems that the portion of additive genes which are transmitted from generation to generation, as regards body weight, was more in group 'B' mice than that of group 'A'.

TABLE 4.25

Showing analysis of variance and covariance for estimating heritability of female mice body weight of group 'B' in reciprocal population at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	14	124.24	-5.59	14	206.54	-56.03	14	330.96	17.11
Within sire	155	300.32	43.28	155	588.64	201.48	155	437.54	26.14
Total	169	424.56	37.69	169	795.18	145.45	169	768.50	43.25
b =		0.14			0.34			0.06	
h^2 =		0.28 ± 0.21			0.68 ± 0.16			0.12 ± 0.34	

GROUP 'C':

(i) Distribution of observations:-

In male mice, the body weight ranged from 4.5-13.0, 7.0-20.5 and 13.0-29.0 gms.at 21,28 and 42 days of age, respectively. The frequency of body weight were grouped into class intervals of 1 gm. which show maximum frequency in the class 9.0-10.0, 13.5-14.5 and 21.0-22.0 gms.,respectively (vide table 4.26 and histogram in fig.12).

TABLE 4.26

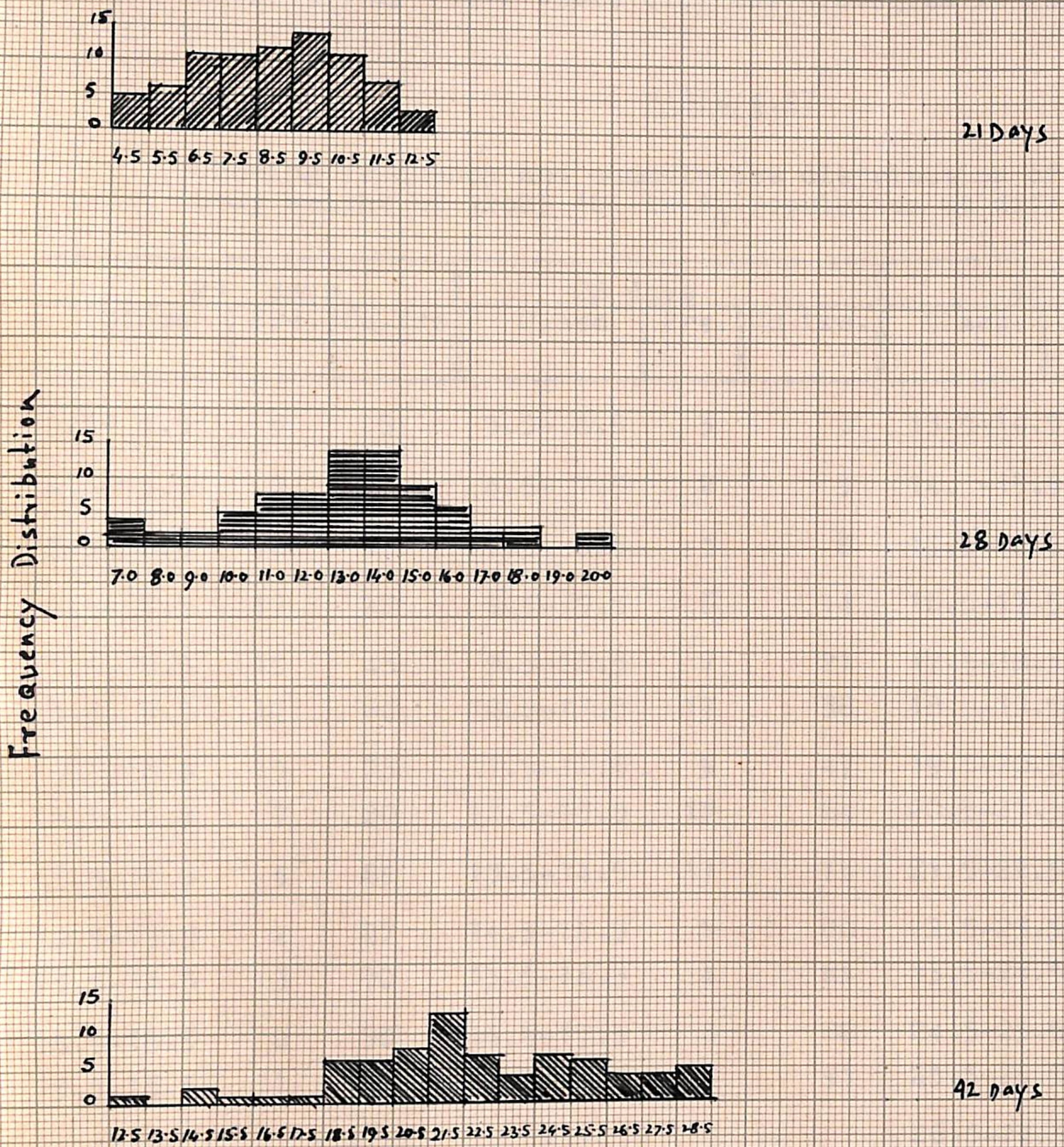
Showing frequency and cummulative distribution of male mice body weight of group 'C' in F_1 population at different stages.

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre	Class	Fre.	Cu.fre.
4.0- 5.0	5	5	6.5- 7.5	4	4	12.0-13.0	1	1
5.0- 6.0	6	11	7.5- 8.5	2	6	13.0-14.0	0	1
6.0- 7.0	11	22	8.5- 9.5	2	8	14.0-15.0	2	3
7.0- 8.0	11	33	9.5-10.5	5	13	15.0-16.0	1	4
8.0- 9.0	12	45	10.5-11.5	8	21	16.0-17.0	1	5
9.0-10.0	14	59	11.5-12.5	8	29	17.0-18.0	1	6
10.0-11.0	11	70	12.5-13.5	14	43	18.0-19.0	6	12
11.0-12.0	7	77	13.5-14.5	14	57	19.0-20.0	6	18
12.0-13.0	3	80	14.5-15.5	9	66	20.0-21.0	8	26
...		...	15.5-16.5	6	72	21.0-22.0	13	39
...		...	16.5-17.5	3	75	22.0-23.0	7	46
...		...	17.5-18.5	3	78	23.0-24.0	4	50
...		...	18.5-19.5	0	78	24.0-25.0	7	57
...		...	19.5-20.5	2	80	25.0-26.0	6	63
...		...		...	...	26.0-27.0	4	67
...		...		...	...	27.0-28.0	4	71
...		...		...	...	28.0-29.0	5	76
...		...						

FIG - 12

F1 - Population - Group - C

Body weight of the Male Mice at Different stages of Growth



Body weight (in grams)

(1 small division = one)

In female mice, the body weight varied from 4.0-16.5, 6.0-18.5 and 13.5-31.5 gms. at 21,28 and 42 days of age,respectively. The highest observations was found under the group 8.5-9.5, 12.5-13.5 and 19.5-20.5 gms. at 21, 28 and 42 days of age respectively (vide table 4.27 and histogram in fig.13).

TABLE 4.27

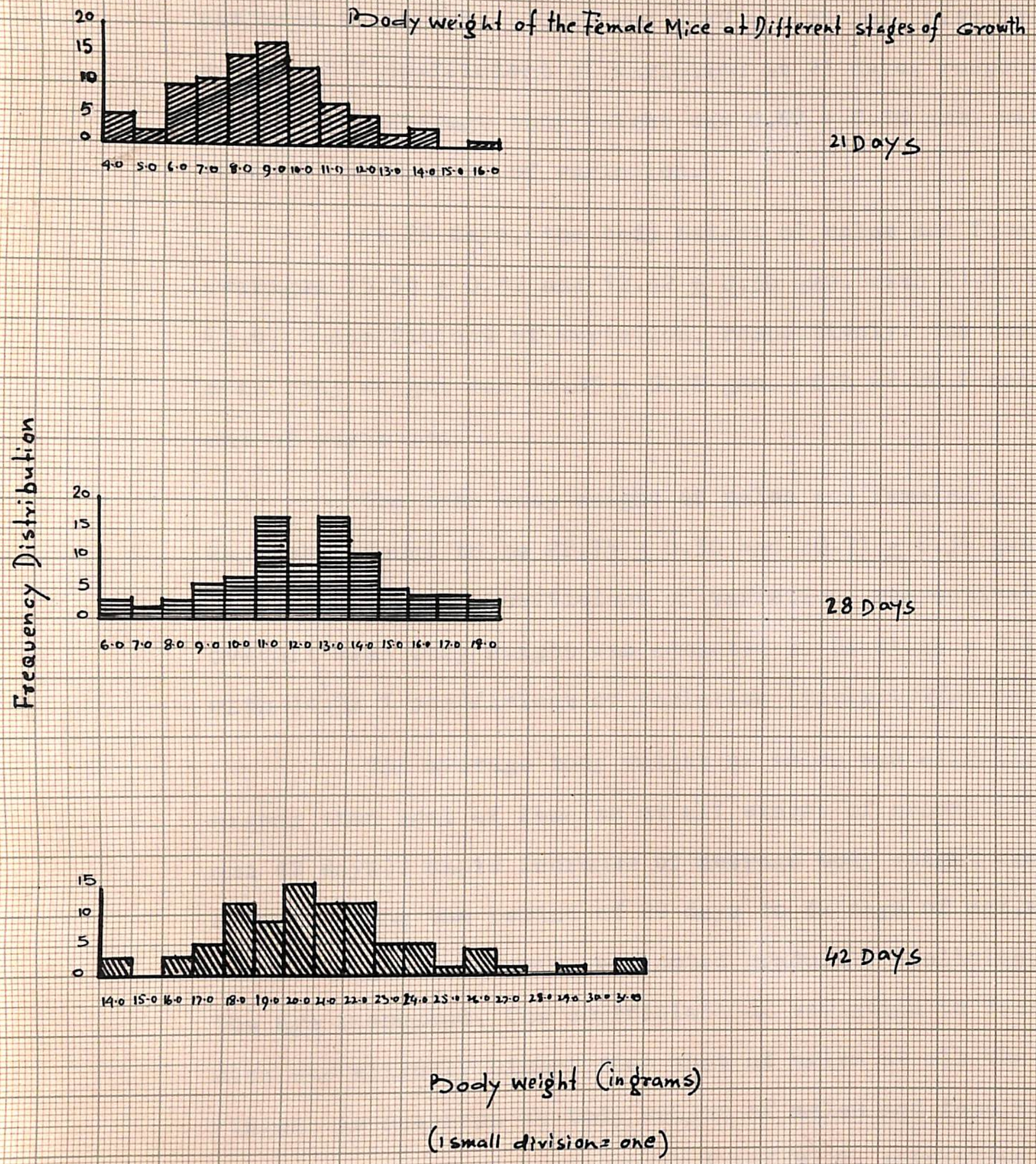
Showing frequency and cummulative distribution of female mice body weight of group 'C' in F_1 population at different stages.

21 days			28 days			42 days		
Class	Fre.	Cu.fre	Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.
3.5- 4.5	5	5	5.5- 6.5	3	3	13.5-14.5	3	3
4.5- 5.5	2	7	6.5- 7.5	2	5	14.5-15.5	0	3
5.5- 6.5	10	17	7.5- 8.5	3	8	15.5-16.5	3	6
6.5- 7.5	11	28	8.5- 9.5	6	14	16.5-17.5	5	11
7.5- 8.5	15	43	9.5-10.5	7	21	17.5-18.5	12	23
8.5- 9.5	17	60	10.5-11.5	17	38	18.5-19.5	9	32
9.5-10.5	13	73	11.5-12.5	9	47	19.5-20.5	15	47
10.5-11.5	7	80	12.5-13.5	17	64	20.5-21.5	12	59
11.5-12.5	5	85	13.5-14.5	11	75	21.5-22.5	12	71
12.5-13.5	2	87	14.5-15.5	5	80	22.5-23.5	5	76
13.5-14.5	3	90	15.5-16.5	4	84	23.5-24.5	5	81
14.5-15.5	0	90	16.5-17.5	4	88	24.5-25.5	1	82
15.5-16.5	1	91	17.5-18.5	3	91	25.5-26.5	4	86
...	...		...	...		26.5-27.5	1	87
...	...		...	...		27.5-28.5	0	87
...	...		...	...		28.5-29.5	1	88
...	...		...	...		29.5-30.5	0	88
...	...		...	...		30.5-31.5	2	90

Fre. = frequency; Cu.fre.= cummulative frequency.

FIG — 13

F-1 Population — Group-C



(ii) Average:-

The average body weight of males and females were computed to be 8.91 ± 0.25 and 8.82 ± 0.25 gms. with 25.36 and 27.66 % coefficient of variation at 21 days, respectively. The overall average body weight was 8.87 ± 0.18 gms. with 26.49 % coefficient of variation.

At 28 days, the body weight of males and females averaged 13.34 ± 0.32 and 12.42 ± 0.30 gms. with 21.73 and 23.67 % coefficient of variation, respectively. The pooled mean body weight was 12.85 ± 0.22 gms. with 22.88 % coefficient of variation.

The mean body weight of males and females at 42 days were found to be 22.75 ± 0.30 and 20.71 ± 0.35 gms. with 11.69 and 16.36 % coefficient of variation, respectively.The overall mean body weight was computed to be 21.65 ± 0.25 gms. with 14.92 % coefficient of variation (table 4.17at page 60).

The average body weight of males was slightly higher than that of females at all stages of growth (21,28 and 42 days). Rapid increase of average body weight was observed during the period of 28 days to 42 days of age,whereas coefficient of variation was noted gradually declining, as the age increased. The coefficient of variation in female mice was slightly higher than that of males at all the three stages. As compared to body weight of males and females in reciprocal population of groups A and B, F_1 population of group C was slightly superior.

The mean body weight of groups A, B and C at 21 days was found slightly higher that to that of small sized mice and lower than that of medium sized mice of Lewis and Warwick (1953). The average body weight of mice at 42 days was lower than that reported by Falconer and King (1953). As compared to Hansson and Lindkvist (1962), the average body weight of mice at all three stages of growth, was found lower.

The coefficient of variation was observed to be higher as compared to that of Hansson and Lindkvist (1962) at all the three stages of growth.

(iii) Effect of sex on body weight:-

At 28 and 42 days the effect of sex on body weight of mice was observed significant, whereas at 21 days, it was found non-significant (table 4.28).

TABLE 4.28

Analysis of variance showing effect of sex on mice body weight at different stages of growth of group C in first generation (F_1)

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	0.29	0.05[NS]	1	36.08	4.22*	1	172.40	18.14**
Within sex	169	5.57		169	8.53		164	9.50	
Total	170			170			165		

* = significant at 5 % level.
** = significant at 1 % level.
NS = non-significant.

(iv) Heritability estimates of mice body weight of group 'C' in first generation (F_1):-

In male mice, heritability coefficient was computed to be -0.46, 0.36 ± 0.30 and -0.09 at 21, 28 and 42 days of age, respectively (Table 4.29).

The heritability coefficient at 28 days was more or less similar to that of Falconer (1960) at 6 weeks of age. Negative heritability, which was observed at 21 and 42 days, might be due to sampling error and environmental factors. Hansson and Lindkvist (1962) reported that environment has significant effect on body weight development in mice, even when the feeding, temperature and managements are kept constant.

In female mice, the estimated heritability coefficient on body weight of mice was -0.66, -0.52 and -0.18 at 21, 28 and 42 days, respectively (table 4.30). The negative heritability may be taken as zero, which may be due to the reasons stated earlier.

(v) Comparison of averages between groups:-

In case of male mice, highly significant group differences were observed as regards body weight at all stages of growth (21, 28, and 42 days vide the table 4.31).

Critical difference at 21 days was observed to be highly significant between groups A and C, and B and C, whereas the same for groups A & B was found non-significant.

TABLE 4.29

Showing analysis of variance and covariance for estimating heritability of male mice body weight of group 'C' in first generation at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	6	37.72	-30.36	6	44.61	301.77	6	64.90	-13.34
Within sire	73	162.33	-34.91	73	240.38	43.35	69	314.85	-16.28
Total	79	200.05	-65.27	79	284.99	345.12	75	379.75	-29.62
b =		-0.21			0.18			-0.052	
cf =		1.08			1.01			0.90	
C(b) =		-0.23			0.18			-0.047	
h^2 =		-0.46			0.36 ± 0.30			-0.09	

cf = correction factor.

C(b) = corrected b.

TABLE 4.30

Showing analysis of variance and covariance for estimating heritability of female mice body weight of group'C' in first generation at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	6	23.64	-48.23	6	37.28	18.31	6	64.16	33.55
Within sire	84	155.39	-51.22	84	164.13	-42.57	83	299.59	-26.94
Total	90	179.03	-99.45	90	201.41	-24.26	89	363.75	6.61
b =		-0.33			-0.26			-0.09	
h^2 =		-0.66			-0.52			-0.18	

At 28 and 42 days, the mean differences were highly significant in all possible combinations except between groups A and B at 28 days for which the difference was simply significant (table 4.32).

TABLE 4.31

Analysis of variance showing difference of male mice body weight between groups in Reciprocal population at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between groups	2	30.46	10.33**	2	54.59	10.72**	2	162.80	19.13**
Within group	449	2.95		449	5.09		438	8.51	
Total	451			451			440		

TABLE 4.32

Critical difference showing body weight difference of male mice between groups.

Between groups	21 days			28 days			42 days		
	M.D.	C.D. value at 5 %	1%	M.D.	C.D. value at 5%	1%	M.D.	C.D. value at 5%	1%
A Vs.B	0.14NS	0.33	0.43	0.56*	0.49	0.64	1.06**	0.58	0.77
A Vs.C	1.01**	0.43	0.56	1.44**	0.62	0.82	2.37**	0.70	0.92
B Vs.C	0.87**	0.45	0.59	0.88**	0.58	0.77	1.31**	0.78	1.03

* = significant at 1 % level,

** = significant at 5 % level

NS = non-significant,

MD = mean difference.

In female mice, body weight difference between groups was found highly significant at 21 and 28 days, whereas at 42 days, group difference was found non-significant (table 4.33).

TABLE 4.33

Analysis of variance showing body weight difference of female mice between groups A & B in Reciprocal population and group C in F_1 population at 21, 28 & 42 days.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between groups	2	45.46	13.14**	2	36.10	6.62**	2	25.01	2.83NS
Within group	465	3.46		465	5.45		460	8.82	
Total	467			467			462		

Critical difference test revealed non-significant difference between groups A and B at 21 days and B & C at 28 and 42 days, and highly significant difference between A & C at 21 and 28 days. Non-significant difference was observed between A and B at the stage of 42 days (table 4.34).

TABLE 4.34.

Critical difference showing body weight difference of female mice between groups.

Between groups	21 days			28 days			42 days		
	M.D.	C.D. value at 5%	1%	M.D.	C.D. value at 5%	1%	M.D.	C.D. value at 5%	1%
A Vs.B	0.35NS	0.37	0.48	0.61*	0.47	0.61	0.26NS	0.58	0.77
A Vs.C	1.19**	0.45	0.59	0.99**	0.56	0.74	0.90*	0.72	0.95
B Vs.C	0.84**	0.47	0.61	0.38NS	0.58	0.77	0.64NS	0.74	0.97

* = significant at 5% level, ** = significant at 1 % level, NS = non-significant, M.D.= mean difference.

Remated population:- The following studies have been made on the body weight of mice in re-mated population (progeny of the selected dams and sires) of groups A and B and that of group C (selective random breeding) at different stages of growth (21, 28 and 42 days):

i. Distribution of observations in each group,

ii. Average with S.E. and C.V. for each group,

iii. Effects of sex on body weight of mice in each group,

iv. Heritability with S.E. of body weight in each group, and

v. Comparison of averages between groups.

GROUP 'A':

(i) Distribution of observations:-

In male mice, the body weight ranged from 4.5-14.0, 8.5-22.0 and 17.0-29.0 gms. at 21, 28 and 42 days, respectively. The body weight were grouped at 1 gm. class intervals. The highest frequency of observation was observed in the class 8.0 - 9.0, 14.0-15.0 and 19.0-20.0 gms. at 21, 28 and 42 days respectively, (table 4.35 and histogram in fig.15).

In female mice, the body weight varied from 4.5-12.0, 8.0-19.0 and 14.0-24.5 gms. at 21,28 and 42 days respectively. The maximum number of frequency was observed in the class 8.0-9.0, 14.0-15.0 and 19.5-20.5 gms. at 21,28 and 42 days respectively, (table 4.36 and histogram in fig.16).

TABLE 4.35

Showing frequency and cummulative distribution of male mice body weight of group A in re-mated population at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre	Class	Fre.	Cu.fre.
4.0- 5.0	3	3	8.0- 9.0	1	1	16.0-17.0	1	1
5.0- 6.0	4	7	9.0-10.0	1	2	17.0-18.0	7	8
6.0- 7.0	13	20	10.0-11.0	5	7	18.0-19.0	8	16
7.0- 8.0	32	52	11.0-12.0	5	12	19.0-20.0	24	40
8.0- 9.0	39	91	12.0-13.0	14	26	20.0-21.0	21	61
9.0-10.0	27	118	13.0-14.0	25	51	21.0-22.0	21	82
10.0-11.0	7	125	14.0-15.0	30	81	22.0-23.0	15	97
11.0-12.0	3	128	15.0-16.0	22	103	23.0-24.0	13	110
12.0-13.0	0	128	16.0-17.0	15	118	24.0-25.0	8	118
13.0-14.0	2	130	17.0-18.0	6	124	25.0-26.0	7	125
...		...	18.0-19.0	3	127	26.0-27.0	4	129
...		...	19.0-20.0	1	128	27.0-28.0	0	129
...		...	20.0-21.0	0	128	28.0-29.0	1	130
...		...	21.0-22.0	2	130	...	...	

TABLE 4.36

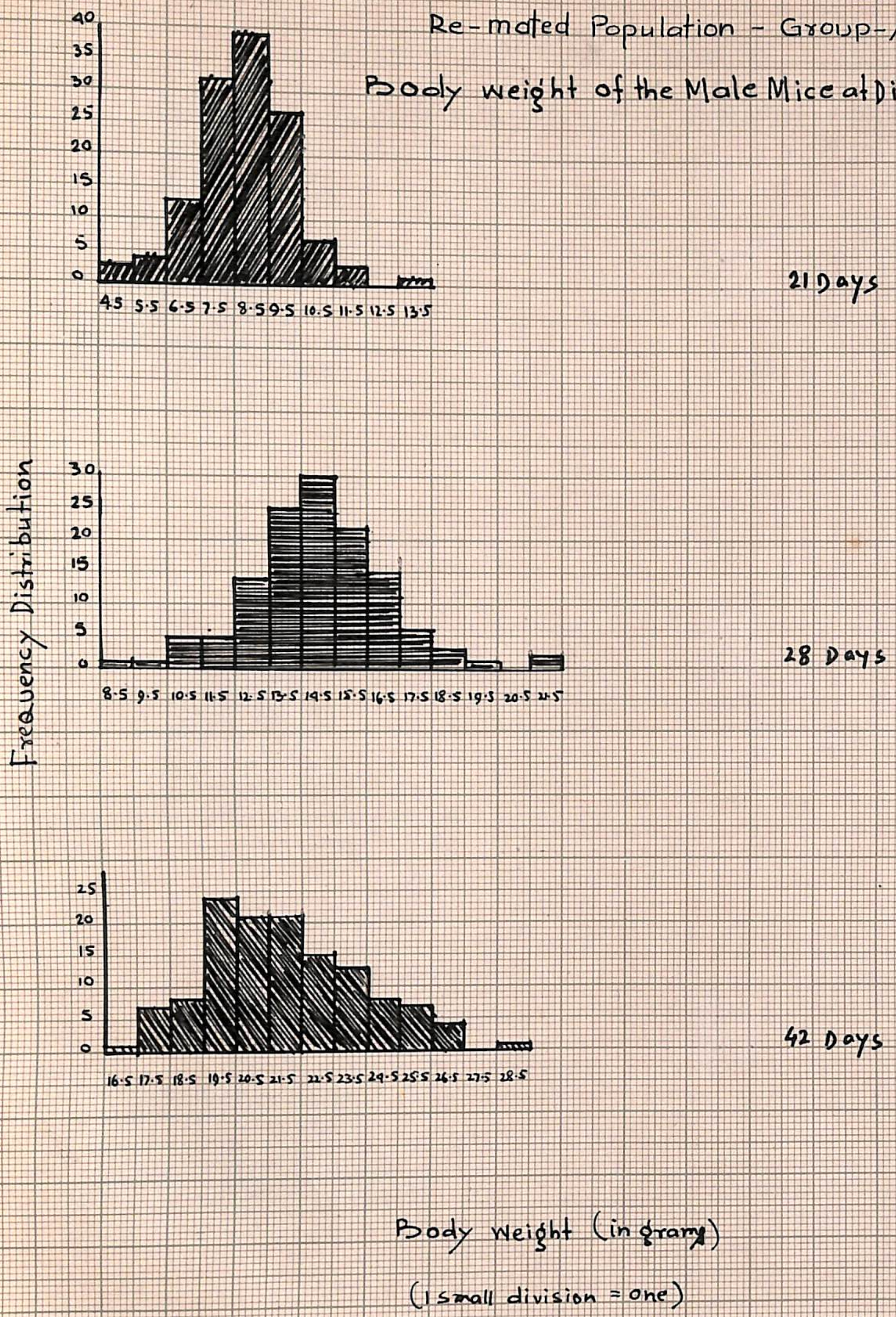
Showing frequency and cummulative distribution of female mice body weight of group A,in re-mated population at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.Fre.	Class	Fre.	Cu.fre.
4.0- 5.0	3	3	7.0- 8.0	1	1	13.5-14.5	3	3
5.0- 6.0	17	20	8.0- 9.0	4	5	14.5-15.5	9	12
6.0- 7.0	26	46	9.0-10.0	6	11	15.5-16.5	17	29
7.0- 8.0	43	89	10.0-11.0	18	29	16.5-17.5	19	48
8.0- 9.0	45	134	11.0-12.0	25	54	17.5-18.5	19	67
9.0-10.0	26	160	12.0-13.0	31	85	18.5-19.5	25	92
10.0-11.0	8	168	13.0-14.0	27	112	19.5-20.5	26	118
11.0-12.0	1	169	14.0-15.0	34	146	20.5-21.5	21	139
...	...		15.0-16.0	12	158	21.5-22.5	17	156
...	...		16.0-17.0	8	166	22.5-23.5	7	163
...	...		17.0-18.0	2	168	23.5-24.5	5	168
...	...		18.0-19.0	1	169	...		...

FIG— 15

Re-mated Population - Group-A

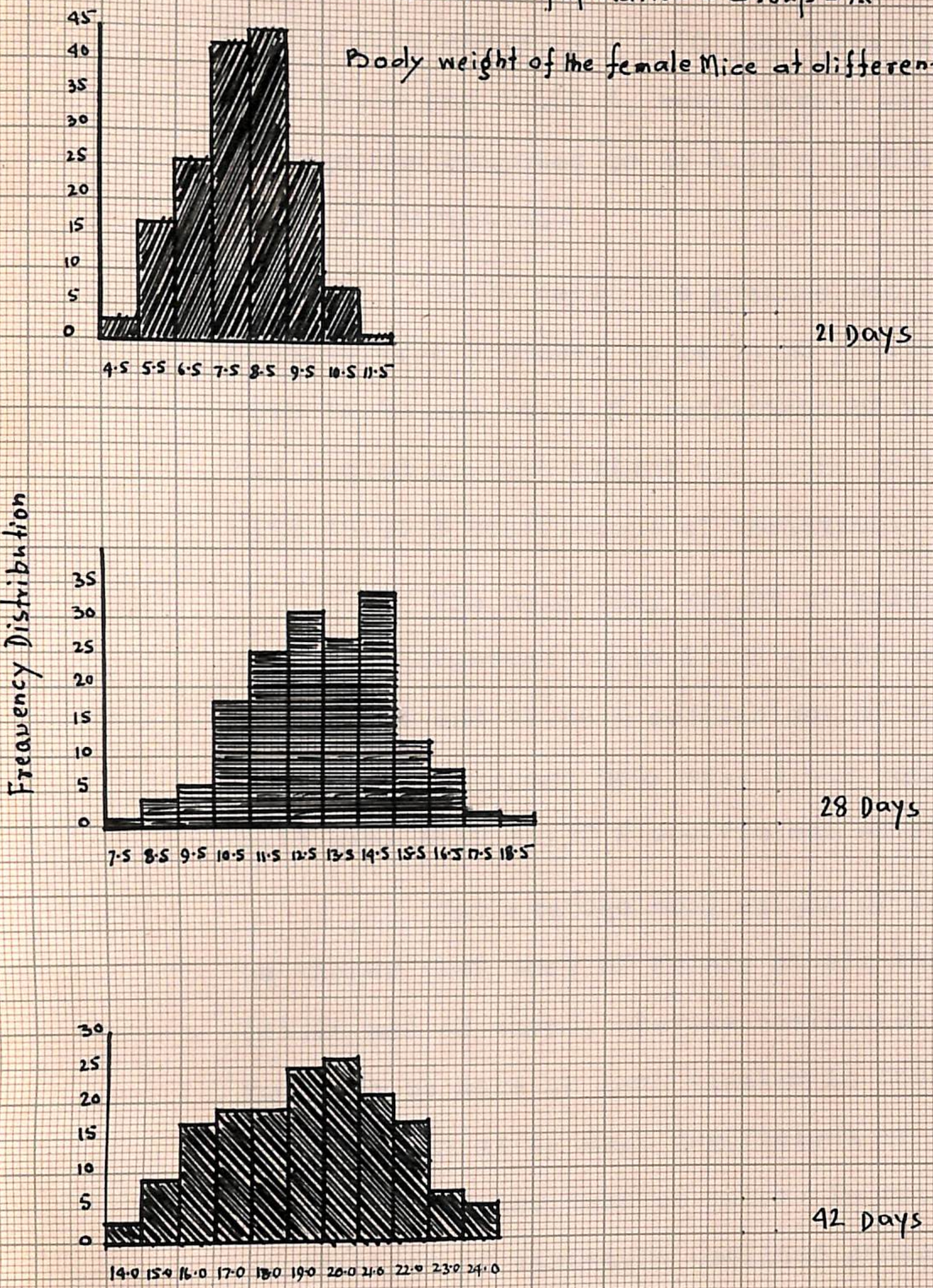
Body weight of the Male Mice at Different stages of Growth



FIG— 16

Re-mated population - Group - A

Body weight of the female Mice at different stages of Growth.



Body weight (in grams)

(1 small division = one)

(ii) Averages:-

The body weight of males and females averaged 8.65 ± 0.13 and 8.13 ± 0.10 gms. with coefficient of variation 17.34 and 17.09 %, respectively at 21 days. The overall average was computed to be 8.36 ± 0.08 with 17.73 % coefficient of variation.

At 28 days, the average body weight of males and females were computed to be 14.88 ± 0.18 and 13.34 ± 0.15 gms with 14.11 and 14.91 % coefficient of variation, respectively. The pooled average weight was found to be 14.01 ± 0.12 gms. with 15.56 % coefficient of variation.

The mean body weight of males and females at 42 days were observed to be 21.86 ± 0.20 and 19.20 ± 0.18 gms. with 10.88 and 12.34 % coefficient of variation, respectively. The overall average body weight was computed to be 20.37 ± 0.15 gms. with 13.30 % coefficient of variation (table 4.37).

The average body weight of male was observed to be higher than that of female at all three stages of growth (21,28 and 42 days), whereas coefficient of variation was found to be more or less similar in both the sexes at 21 and 28 days, but at 42 days coefficient of variation was slightly higher in females than in males. In both the sexes, the coefficient of variation declined gradually and the average body weight increased rapidly as the age advanced.

The average body weight of mice of group A at 21 days was higher than that of small sized mice and lower than medium and large sized mice of Lewis and Warwick(1953).

TABLE 4.37

Showing average body weight with S.E. and C.V. of male and female mice in Remated population (progeny of selected dam and sire) at different stages, groupwise(gms)

Group/ sex	Different stages of growth								
	21 days			28 days			42 days		
	No.of obs.	Average ± S.E.	C.V.%	No.of obs.	Average ± S.E.	C.V.%	No.of obs.	Average ± S.E.	C.V.%
'A'									
Male	130	8.65 ± 0.13	17.34	130	14.88 ± 0.18	14.11	130	21.86 ± 0.20	10.88
Female	169	8.13 ± 0.10	17.09	169	13.34 ± 0.15	14.91	168	19.20 ± 0.18	12.34
Overall	299	8.36 ± 0.08	17.73	299	14.01 ± 0.12	15.56	298	20.37 ± 0.15	13.30
'B'									
Male	148	8.15 ± 0.15	22.69	148	13.81 ± 0.24	20.07	148	20.05 ± 0.27	16.85
Female	120	8.15 ± 0.17	23.19	119	13.47 ± 0.24	20.11	118	19.58 ± 0.25	14.19
Overall	268	8.15 ± 0.11	22.82	267	13.66 ± 0.17	20.64	266	19.84 ± 0.19	15.78
'C'									
Male	108	7.66 ± 0.21	28.59	106	12.68 ± 0.34	27.76	106	20.26 ± 0.22	11.35
Female	101	7.09 ± 0.14	20.87	100	11.60 ± 0.23	20.09	99	19.59 ± 0.23	11.89
Overall	209	7.39 ± 0.13	25.71	206	12.16 ± 0.21	25.08	205	19.93 ± 0.19	13.70

At 28 and 42 days of age, the mean body weight of male and female was slightly lower than that reported by Hansson and Lindkvist (1962). The coefficient of variation was found slightly higher at all three different stages of growth as compared to Hansson and Lindkvist (1962) at these stages.

(iii) Effect of sex on body weight:-

Highly significant effects of sex on body weight of mice was found at all three stages of growth (21, 28 and 42 days, vide table 4.38).

TABLE 4.38

Analysis of variance showing effect of sex on mice body weight of group A in re-mated population at at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	M. S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	20.45	9.60**	1	175.45	42.07**	1	517.41	91.41**
Within sex	297	2.13		297	4.17		296	5.66	
Total	298			298			297		

** = significant at 1 % level.

(iv) Heritability of male mice body weight of group A in Re-mated population:-

The heritability coefficient was estimated to be

TABLE 4.39

Showing analysis of variance and covariance for estimating heritability of the male mice body weight of group A in re-mated population at different stages.

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S. P. (Sxiyi)	d.f.	S. S.dam (Sxi^2)	S. P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S. P. (Sxiyi)
Between sires	9	43.01	5.58	9	188.54	30.77	9	101.49	45.32
Within sire	120	131.43	-45.20	120	431.54	-122.78	120	308.24	126.43
Total	129	174.44	-39.62	129	620.08	- 92.01	129	409.73	171.75
b =		-0.34			-0.28			0.41	
cf =		0.67			0.95			0.99	
C(b) =		0.23			0.27			0.40	
h^2 =		-0.46			-0.54			0.80 ± 0.24	

cf = correction factor ; C (b) = corrected b.

TABLE 4.40

Showing analysis of variance and covariance for estimating heritability of the female mice body weight, of group A in re-mated population at different stages.

Source of variation	21 days			28 days			42 days		
	d.f.	S. S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S. S. dam (Sxi^2)	S. P. (Sxiyi)	d.f.	S. S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	9	100.49	-11.25	9	249.11	-7.39	9	166.31	-73.59
Within sire	159	235.84	-114.22	159	760.58	-42.56	158	749.71	-280.26
Total	168	336.33	-125.47	168	1009.69	-49.95	167	916.02	-353.59
b =		-0.48			-0.05			-0.37	
h^2 =		-0.96			-0.10			-0.74	

-0.46, -0.54 and 0.80 ± 0.24 at 21, 28 and 42 days of age (table 4.39 at page 86). The heritability coefficient, obtained at 42 days of age, was higher than that estimated by Falconer (1953), Rahnefeld <u>et al</u>.(1963), Eisen and Legates (1966) and Singh (1967). The heritability at 21 and 28 days was observed negative which may be taken as zero.

The heritability coefficient of female mice body weight was found to be -0.96, -0.10 and -0.74 at 21,28 and 42 days of age respectively (table 4.40, at page 87). The negative heritability may be considered due to sampling error or environmental fluctuation.

<u>GROUP 'B':</u>

(i) <u>Distribution of observations:-</u>

At 21, 28 and 42 days, the body weight of male mice ranged from 4.0-13.0, 6.5-21.5 and 11.0-30.0 gms. respectively. The body weight was grouped at 1 gm. class intervals. The maximum frequency was observed in the class 7.0-8.0, 14.5-15.5 and 19.0-20.0 gms. at 21, 28 and 42 days respectively(table 4.41 and histogram in fig.17).

In female mice, the body weight varied from 4.0-13.0, 5.5-19.0 and 13.0-25.0 gms. at 21,28 and 42 days, respectively. The highest frequency was found in the class 8.0-9.0, 12.0-13.0 and 19.0-20.0 gms. at 21,28 and 42 days respectively(table 4.42 and histogram in fig.18).

TABLE 4.41

Showing frequency and cummulative distribution of male mice body weight of group B, in re-mated population at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.
3.0- 4.0	1	1	5.5- 6.5	2	2	11.0-12.0	1	1
4.0- 5.0	7	8	6.5- 7.5	1	3	12.0-13.0	2	3
5.0- 6.0	15	23	7.5- 8.5	1	4	13.0-14.0	3	6
6.0- 7.0	28	51	8.5- 9.5	5	9	14.0-15.0	8	14
7.0- 8.0	37	88	9.5-10.5	11	20	15.0-16.0	6	20
8.0- 9.0	25	113	10.5-11.5	12	32	16.0-17.0	15	35
9.0-10.0	20	133	11.5-12.5	20	52	17.0-18.0	14	49
10.0-11.0	5	138	12.5-13.5	23	75	18.0-19.0	10	59
11.0-12.0	5	143	13.5-14.5	13	88	19.0-20.0	22	81
12.0-13.0	5	148	14.5-15.5	29	117	20.0-21.0	19	100
...	...		15.5-16.5	7	124	21.0-22.0	13	113
...	...		16.5-17.5	6	130	22.0-23.0	12	125
...	...		17.5-18.5	6	136	23.0-24.0	7	132
...	...		18.5-19.5	9	145	24.0-25.0	10	142
...	...		19.5-20.5	2	147	25.0-26.0	2	144
...	...		20.5-21.5	1	148	26.0-27.0	0	144
...	...		...	...		27.0-28.0	2	146
...	...		...	...		28.0-29.0	1	147
...	...		...	...		29.0-30.0	1	148
...	...							

Fre.=frequency

Cu.fre.= Cummulative frequency.

FIG – 17

Re-mated Population – Group-D

Body weight of the Male Mice at Different stages of Growth

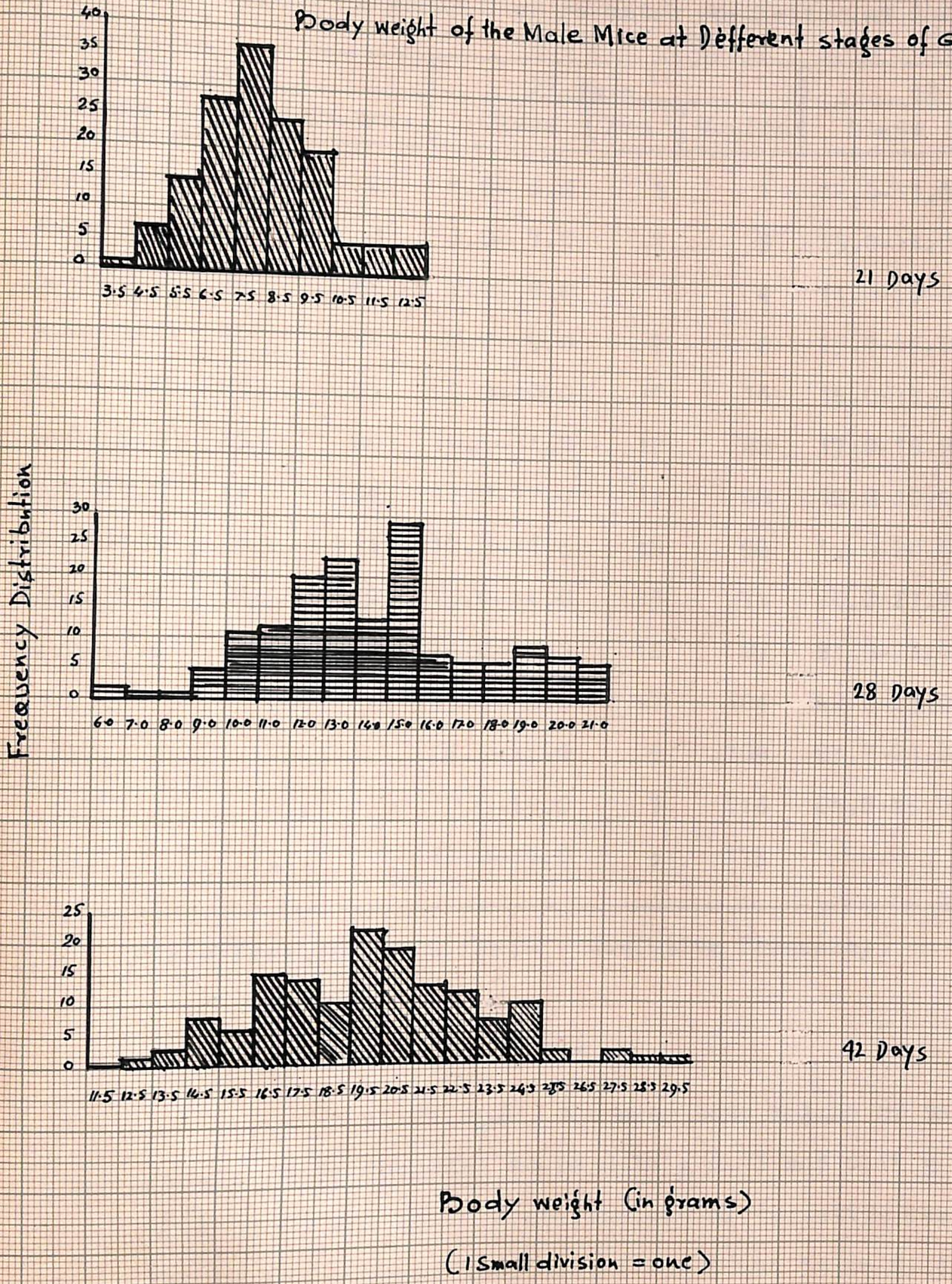


TABLE 4.42

Showing frequency and cummulative distribution of female mice body weight in group B of re-mated population at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.	Class	Fre.	Cu. fre.
3.0- 4.0	2	2	5.0- 6.0	1	1	12.0-13.0	1	1
4.0- 5.0	6	8	6.0- 7.0	2	3	13.0-14.0	2	3
5.0- 6.0	14	22	7.0- 8.0	1	4	14.0-15.0	4	7
6.0- 7.0	20	42	8.0- 9.0	2	6	15.0-16.0	10	17
7.0- 8.0	23	65	9.0-10.0	10	16	16.0-17.0	8	25
8.0- 9.0	25	90	10.0-11.0	12	28	17.0-18.0	19	44
9.0-10.0	14	104	11.0-12.0	12	40	18.0-19.0	10	54
10.0-11.0	7	111	12.0-13.0	18	58	19.0-20.0	19	73
11.0-12.0	8	119	13.0-14.0	13	71	20.0-21.0	15	88
12.0-13.0	1	120	14.0-15.0	16	87	21.0-22.0	12	100
...		...	15.0-16.0	17	104	22.0-23.0	7	107
...		...	16.0-17.0	5	109	23.0-24.0	8	115
...		...	17.0-18.0	7	116	24.0-25.0	3	118
...		...	18.0-19.0	3	119	...	...	

Fre.= frequency; Cu.fre.= cummulative frequency.

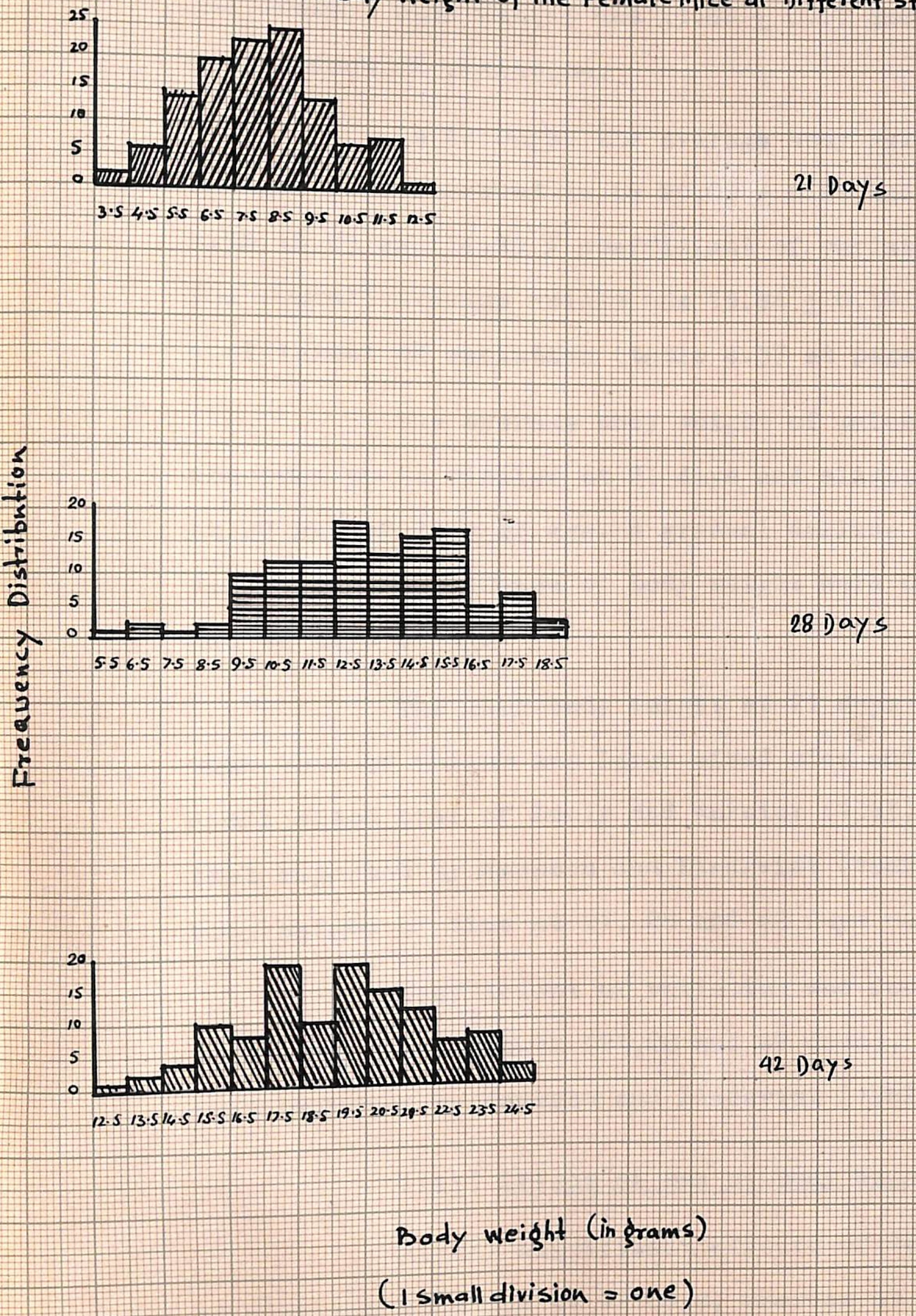
(ii) Averages:-

At 21 days, the mean body weight of the males and females were computed to be 8.15 ± 0.15 and 8.15 ± 0.17 gms. with 22.69 and 23.19 % coefficient of variation respectively. The pooled average body weight was found to be 8.15 ± 0.11 gms. with 22.82 % coefficient of variation.

FIG — 18

Re-mated Population - Group-B

Body weight of the Female Mice at Different stages of Growth



The average body weight of the males and females at 28 days were found to be 13.81 ± 0.24 and 13.47 ± 0.24 gms. with 20.07 and 20.11 % coefficient of variation respectively. The overall mean weight was 13.66 ± 0.17 gms. with 20.64 % coefficient of variation.

At 42 days, the average body weight of males and females were observed to be 20.05 ± 0.27 and 19.58 ± 0.25 gms. with 16.85 and 14.19 % coefficient of variation respectively. The overall average weight was 19.84 ± 0.19 gms. with 15.78 % coefficient of variation (table 4.37 at page 84).

The average body weight of males and females was observed to be similar at 21 days and slightly higher in males at 28 and 42 days of age. A gradual decline of coefficient of variation and increase of body weight were observed at 21, 28 and 42 days of age.

The mean body weight at 21 days was slightly lower than that of medium and large sized mice and higher to that of small sized ones of Lewis and Warwick (1953). As compared to that reported by Hansson and Lindkvist (1962), the average body weight of mice at 21, 28 and 42 days was slightly lower.

Coefficient of variation was found higher at all three stages of growth (21,28 and 42 days), as compared to that reported by Hansson and Lindkvist (1962).

(iii) Effect of sex on body weight:-

Highly significant effects of sex on body weight of mice was observed at 42 days, whereas at 21 and 28 days, it was found non-significant (table 4.43).

As "Between S.S." comes to zero, no analysis of variance table for 21 days weight has been presented.

TABLE 4.43

Analysis of variance showing effects of sex on body weight of mice in group B of re-mated population at different stages of growth.

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	-	-	-	1	7.26	0.91 NS	1	375.96	44.54 **
Within sex	-	-	-	265	7.97		264	8.44	
Total				266			265		

** = significant at 1 % level.

NS = non-significant.

(iv) Heritability estimates of mice body weight in group 'B' of re-mated population:-

In male mice, heritability coefficient of body weight were estimated to be 0.12 ± 0.18, -0.068 and 0.162±0.40 at 21, 28 and 42 days respectively,(table 4.44).

The heritability coefficient was found positive at 21, and 42 days and negative at 28 days. The heritability coefficient at 21 days was slightly higher to that reported by Eisen and Legates (1966) and lower as compared to S'lines of Singh (1967). At 42 days, the heritability coefficient was slightly lower to that reported by Rahnefeld et al.(1963),

TABLE 4.44

Showing analysis of variance and covariance for estimating heritability of male mice body weight in group B of re-mated population at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)
Between sires	9	122.67	26.89	9	86.30	22.86	9	214.69	100.78
Within sire	138	244.45	14.03	138	480.27	-18.17	138	288.00	28.01
Total	147	367.12	40.92	147	566.57	4.69	147	502.69	128.79
b =		0.06			-0.037			0.097	
cf =		1.02			0.93			0.84	
C(b)=		0.06			-0.034			0.080	
h^2 =		0.12 ± 0.18			-0.068			0.16 ± 0.40	

cf = correction factor ; C(b) = corrected b.

TABLE 4.45

Showing analysis of variance and covariance for estimating heritability of female mice body weight in group B of re-mated population at different staged of growth

Source of variation	21 days			28 days			42 days		
	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)
Between sires	9	78.98	-27.11	9	60.74	5.14	9	220.04	9.38
Within sire	110	218.52	48.82	109	404.23	134.08	108	276.53	-101.17
Total	119	297.50	21.71	118	464.97	139.22	117	496.57	-91.79
b =		0.22			0.33			-0.36	
h^2 =		0.44 ± 0.22			0.66 ± 0.18			-0.72	

Falconer (1953) and found higher as compared to Eisen and Legates (1966).

In female mice, the heritability coefficient was computed to be 0.44 ± 0.22, 0.66 ± 0.18 and -0.72 at 21,28 and 42 days respectively (table 4.45).

The heritability coefficient at 21 and 28 days was observed positive,and negative at 42 days of age. The heritability coefficient estimated at 21 and 28 days was observed higher as compared to Eisen and Legates (1966) and Singh (1967).

GROUP 'C':

(i) Distribution of observations:-

In male mice, the body weight ranged from 4.0-14.0, 6.0-22.5 and 14.0-29.0 gms. at 21, 28 and 42 days respectively. The body weight was grouped into the class intervals of 1 gm., showing the maximum frequency in the class 6.0-7.0 12.5-13.5 and 20.0-21.0 gms. at 21, 28 and 42 days respectively (table 4.46 and histogram in fig. 19).

In female mice, the body weight varied from 4.0-11.5, 6.0-17.0 and 15.0-24.5 gms. at 21,28 and 42 days, respectively. The highest frequency of body weight was noted in the class 6.5-7.5, 12.0-13.0 and 17.5-18.5 gms. at 21, 28 and 42 days respectively,(table 4.47 and histogram in fig.20).

TABLE 4.46

Showing frequency and cummulative distribution of male mice body weight in group C of second generation (F_2) at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre
3.0- 4.0	2	2	5.5- 6.5	3	3	13.0-14.0	2	2
4.0-5.0	10	12	6.5- 7.5	4	7	14.0-15.0	2	4
5.0- 6.0	17	29	7.5- 8.5	3	10	15.0-16.0	5	9
6.0- 7.0	26	55	8.5- 9.5	7	17	16.0-17.0	9	18
7.0- 8.0	24	79	9.5-10.5	14	31	17.0-18.0	14	32
8.0- 9.0	9	88	10.5-11.5	12	43	18.0-19.0	12	44
9.0-10.0	6	94	11.5-12.5	11	54	19.0-20.0	13	57
10.0-11.0	3	97	12.5-13.5	17	71	20.0-21.0	14	71
11.0-12.0	5	102	13.5-14.5	9	80	21.0-22.0	11	82
12.0-13.0	3	105	14.5-15.5	10	90	22.0-23.0	10	92
13.0-14.0	3	108	15.5-16.5	3	93	23.0-24.0	6	98
...		...	16.5-17.5	1	94	24.0-25.0	2	100
...		...	17.5-18.5	2	96	25.0-26.0	2	102
...		...	18.5-19.5	2	98	26.0-27.0	1	103
...		...	19.5-20.5	6	104	27.0-28.0	2	105
...		...	20.5-21.5	1	105	28.0-29.0	1	106
...		...	21.5-22.5	1	106	...		...

Fre. = frequency,

Cu.fre.=cummulative frequency.

Fig — 19

F2 Population — Group - C

Body weight of the Male Mice at Different stages of Growth

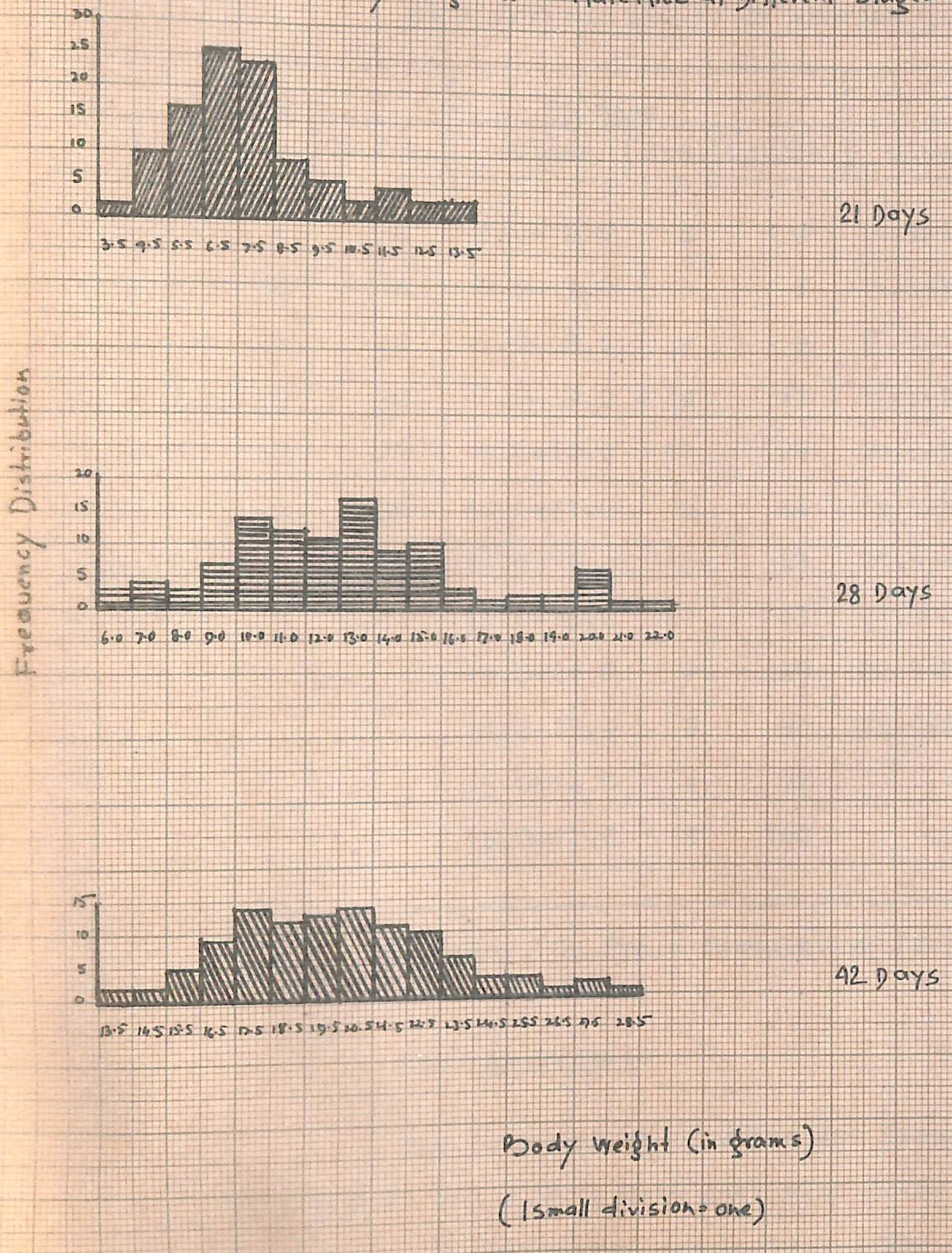


Fig - 20

F_2 Population — Group-C

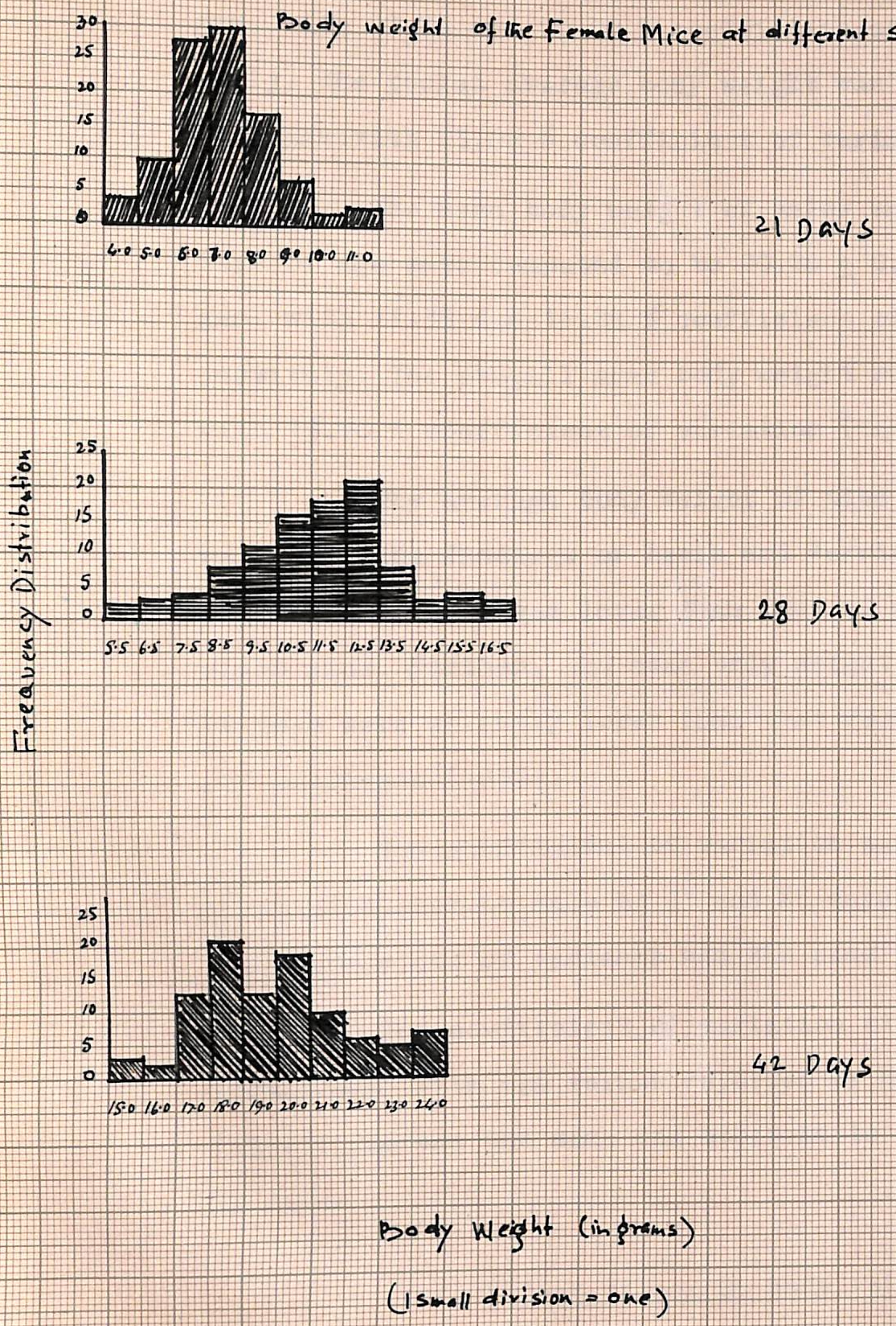


TABLE 4.47

Showing frequency and cummulative distribution of female mice body weight in group C of second generation (F_2) at different stages of growth

21 days			28 days			42 days		
Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.	Class	Fre.	Cu.fre.
3.5- 4.5	4	4	5.0- 6.0	2	2	14.5-15.5	3	3
4.5- 5.5	10	14	6.0- 7.0	3	5	15.5-16.5	2	5
5.5- 6.5	28	42	7.0- 8.0	4	9	16.5-17.5	13	18
6.5- 7.5	30	72	8.0- 9.0	8	17	17.5-18.5	21	39
7.5- 8.5	17	89	9.0-10.0	11	28	18.5-19.5	13	52
8.5- 9.5	7	96	10.0-11.0	16	44	19.5-20.5	19	71
9.5-10.5	2	98	11.0-12.0	18	62	20.5-21.5	10	81
10.5-11.5	3	111	12.0-13.0	21	83	21.5-22.5	6	87
...		...	13.0-14.0	7	90	22.5-23.5	5	92
...		...	14.0-15.0	3	93	23.5-24.5	7	99
...		...	15.0-16.0	4	97	...	...	
...		...	16.0-17.0	3	100	...	...	

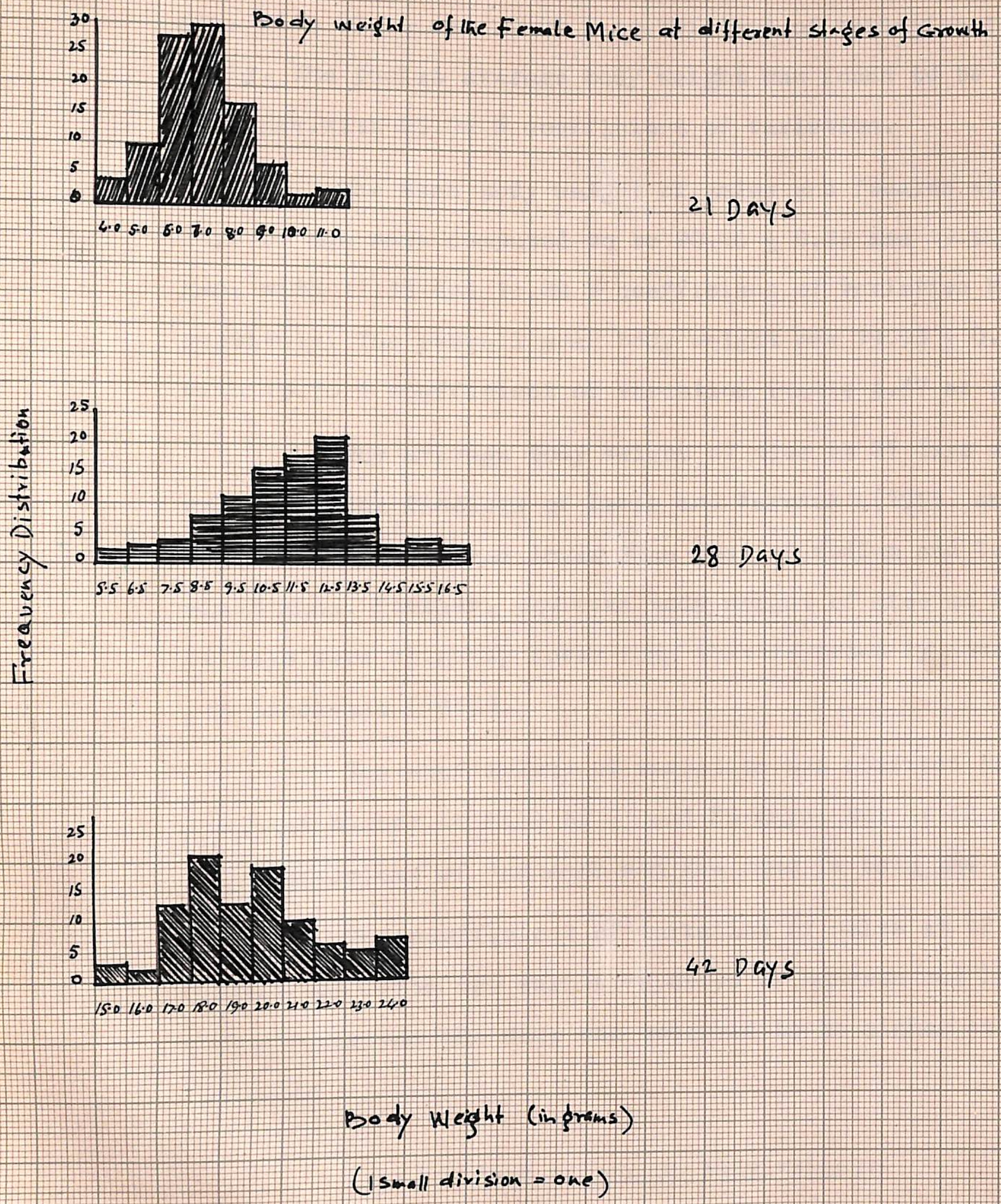
Fre.= frequency, Cu.fre.= cummulative frequency.

(ii) Averages:-

The body weight of males and females averaged 7.66 ± 0.21 and 7.09 ± 0.14 gms. with 28.59 and 20.87 % coefficient of variation respectively. The overall mean value was 7.39 ± 0.13 gms.with 25.71% coefficient of variation.

FIG - 20

F_2 Population — Group-C



At 28 days, the average body weight of males and females were observed to be 12.68 ± 0.34 and 11.60 ± 0.23 gms. with 27.76 and 20.09 % coefficient of variation respectively. The pooled average body weight was found to be 12.16± 0.21 gms.with 25.08 % coefficient of variation.

The mean body weight of males and females at 42 days of age were computed to be 20.26 ± 0.22 and 19.59±0.23 gms. with 11.35 and 11.89 % coefficient of variation respectively. The overall mean body weight was 19.93 ± 0.19 gms with 13.70 % coefficient of variation (table 4.37 at p.84).

The average body weight of mice at 21 days agrees well with the findings of Lewis and Warwick's(1953) small sized mice and it was lower than that of medium and large sized mice. Further, the mean body weight of mice at 21,28 42 days were slightly lower than that reported by Hansson and Lindkvist (1962).

The coefficient of variation was observed to be slightly higher in male at 21 and 28 days, but at 42 days, the coefficient of variance was the same in both the sexes.

The coefficient of variation of males at 42 days agrees well with the values reported by Hansson and Lindkvist (1962), whereas the same was observed to be higher at 21 and 28 days.

(iii) <u>Effect of sex on body weight</u>:-

Significant effects of sex on body weight of mice were observed at 21 and 28 days of age, but at 42 days, the same were found non-significant (table 4.48).

TABLE 4.48

Analysis of variance showing effect of sex on mice body weight in group C of second generation (F_2) at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between sexes	1	16.55	4.68*	1	59.90	6.58*	1	23.22	3.14NS
Within sex	207	3.54		204	9.10		203	7.40	
Total	208			205			204		

* = significant at 5 % level.
NS= non-significant.

(iv) Heritability estimates of mice body weight in group C of second generation (F_2):-

The heritability coefficient was estimated by Intra-Sire-Regression of son on dam and daughter on dam. The analysis of variance and covariance of male mice based on 108 pair of dam and son at 21 days and 106 pair at 28 and 42 days.

The heritability estimates of male mice computed to be 0.128 ± 0.18, -0.12 and -0.24 at 21, 28 and 42 days respectively (table 4.49).

Heritability at 21 days was found to be higher to that reported by Eisen and Legates (1966) and slightly lower as compared to that of Singh (1967). The heritability

TABLE 4.49

Showing analysis of variance and covariance for estimating heritability of the male mice body weight in group C of second generation at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	S.S.dam	S.P.	d.f.	S.S.dam	S.P.	d.f.	S.S. dam	S. P.
Between sires	9	98.17	34.59	9	105.54	76.78	9	342.68	-3.74
Within sire	98	314.91	29.98	96	358.60	-35.10	96	912.33	-107.15
Total	107	413.09	64.57	105	464.14	41.68	105	1255.01	-110.89
b =		0.095			-0.098			-0.12	
cf =		0.67			0.66			1.01	
C (b)=		0.064			-0.06			-0.12	
h^2 =		0.128 ± 0.18			-0.12			-0.24	

cf = correction factor,

C(b)= corrected b.

at 28 and 42 days was observed negative, which may be taken as zero. The reason of estimating negative heritability coefficient might be due to sampling variation and environmental fluctuations.

In female mice, the heritability coefficient was calculated to be 0.198 ± 0.14, -0.114 and -0.048 at 21,28 and 42 days, respectively (table 4.50).

The heritability coefficient at 21 days was observed to be more or less similar to that of S'lines mice of Singh (1967) and it was found higher to that of Eisen and Legates (1966).

(v) <u>Comparison of averages between groups</u>:-

In male mice, highly significant differences of body weight between groups A, B and C were observed at all three stages of growth (21,28 and 42 days) - table 4.51.

Critical difference test showed highly significant differences in body weight between groups A and C at all three stages of growth. Group A and B differed significantly at 21 days and the differences were observed to be highly significant at 28 and 42 days. Group B and C also differed significantly at 21 days and highly significant differences were noted at 28 days; but at 42 days the differences were observed to be non-significant (table 4.52).

TABLE 4.50

Showing analysis of variance and covariance for estimating heritability of the female mice body weight in group C of second generation at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S.dam (Sxi^2)	S.P. (Sxiyi)	d.f.	S.S. dam (Sxi^2)	S.P. (Sxiyi)
Between sires	9	140.43	-7.93	9	134.65	881.82	9	357.69	10.14
Within sire	91	282.02	28.02	90	295.58	-16.85	89	869.49	-20.96
Total	100	422.45	20.09	99	430.23	864.97	98	1227.18	-10.82
b =		0.099			-0.057			-0.024	
h^2 =		0.198±0.14			-0.114			-0.048	

TABLE 4.51

Analysis of variance showing difference of male mice body weight between groups of re-mated population, including group'C' at different stages of growth

Source of variation	21 days d.f.	21 days M.S.	21 days F.	28 days d.f.	28 days M.S.	28 days F.	42 days d.f	42 days M.S.	42 days F.
Between groups	2	29.62	8.64**	2	142.23	17.28**	2	129.67	14.59**
Within group	383	3.43		381	8.23		381	8.89	
Total	385			383			383		

TABLE 4.52

Critical difference test showing differences of body weight of male mice between groups at different stages of growth

Between groups	21 days M.D.	21 days C.D. value at 5%	21 days C.D. value at 1%	28 days M.D.	28 days C.D. Value at 5%	28 days C.D. Value at 1%	42 days M.D.	42 days C.D. value at 5%	42 days C.D. value at 1%
A Vs. B	0.50*	0.43	0.56	1.07**	0.66	0.87	1.81**	0.68	0.90
A Vs. C	0.99**	0.52	0.69	2.20**	0.72	0.95	1.60**	0.76	1.00
B Vs. C	0.49*	0.45	0.59	1.13**	0.70	0.92	0.21NS	0.72	0.95

* = significant at 5 % level,

** = significant at 1 % level,

NS = non-significant.

In female mice, highly significant differences in body weight were observed at 21 and 28 days, whereas at 42 days the same were found non-significant (table 4.53).

TABLE 4.53

Analysis of variance showing difference of female mice body weight between groups of re-mated population, including group 'C' at different stages of growth

Source of variation	21 days			28 days			42 days		
	d.f.	M.S.	F.	d.f.	M.S.	F.	d.f.	M.S.	F.
Between groups	2	40.96	16.00**	2	120.13	22.29**	2	6.64	1.07 NS
Within group	387	2.56		385	5.39		382	6.23	
Total	389			387			384		

** = significant at 1 % level

NS = non-significant.

Critical difference test showed non-significant differences between groups of A and B at 21, 28 and 42 days, and highly significant differences were found between groups A and C, and B & C at 21 and 28 days, whereas at 42 days, these combinations were found non-significant (table 4.54).

TABLE 4.54

Critical difference test showing differences of body weight of female mice between groups at different stages of growth

Between groups	21 days			28 days			42 days		
	M.D.	C.D. value at 5%	1%	M.D.	C.D. value at 5%	1%	M.D.	C.D. value at 5%	1%
A Vs.B	0.02 NS	0.37	0.48	0.13 NS	0.52	0.69	0.38 NS	0.49	0.64
A Vs.C	1.04 **	0.39	0.51	1.74 **	0.56	0.74	0.39 NS	0.60	0.79
B Vs.C	1.06 **	0.41	0.54	1.87 **	0.60	0.79	0.01 NS	0.66	0.87

** = significant at 1 % level,
NS = non-significant,
M.D.= mean difference.

Analysis between generations were not made as the comparison of populations under two different environments might lead to unreliable results. Therefore, analysis between groups of the respective generation were made.

Any change in the populations kept under the same environment might be due to the change in genetic structure of the population.

In the present study, the improvement made in the R.R.S. population of groupsA and B was probably due to the improved method of breeding and selection, and not due to the environmental advantages. It was observed that R.R.S. population superseded the selective random breeding population, as regards the expression of body weight (table 4.37).

However, in the F_1 population of the selective random breeding, remarkable improvement in body weight, as compared to that in the R.R.S. population, was noticed (table 4.17), but in the F_2 population of selective random breeding, the results were found just reverse (table 4.37).

Irregular fluctuation in live-weight was observed in selective random breeding population, whereas in R.R.S. population, gradual increase generationwise of mean body weight was noticed as compared to that of the selective random breeding population.

The results of the present study tends to show clearly the definite superiority of R.R.S. system over that of the selective random breeding. It is expected that with increasing cycles of R.R.S. mating, better body weight in mice could be obtained.

SELECTION:

In the present study, selection was practised in males and females at 28 days of age, in all the three groups (A, B and C) and in all successive generations (Base population, selection of sires and dams within population, and selection in the population of the progenies produced by these selected sires and dams.

The selection differential of males was computed to be 5.05, 4.13 and 4.60 gms. and for females, it was found 1.01, 1.59 and 2.69 gms. respectively for groups A, B and C in base population.

The intensity of selection was calculated by the method reported by Falconer (1960). The selection differential has been divided by the phenotypic standard deviation of the population, which measures the intensity of selection.

The intensity of selection for males and females mice were measured to be 1.53, 1.72 and 1.66 for males, and 0.33, 0.66 and 1.01 for females of groups A, B and C respectively in base population (table 4.55).

The selection differential and intensity of selection were observed to be higher in males than those of females, because selection differential and intensity of selection depend upon the proportion of the individuals selected for breeding purposes.

For reciprocal recurrent selection, the dams and sires were selected within each population on the basis of their cross bred progeny mean weight at 28 days. The highest and lowest cross bred mean weight were 16.2 and 9.1 gms.,and 19.8 and 9.8 gms. respectively for both the groups A and B. Dams that had above 10.5 gms. and 11.0 gms. mean progeny weight of groups A and B were selected and the corresponding sires of opposite group were also selected simultaneously in both the groups. Details of selection procedure have been described under the chapter "Description of breeding experiment".

Selection differential and intensity of selection in population (R.R.S.) of groups A and B were measured in the following manner.

The average body weight of all the progeny belonging to 60 dams were deducted from the average body weight of the progeny of 40 selected dams.

The selection differential of sires were also computed in the same way, as was measured in case of dams. The mean body weight of all the progeny belonging to 15 sires were substracted from the average body weight of the progeny of 10 selected sires.

The selection differential of sires and dams of group A was found to be 0.12 and 0.90 and intensity of selection was 0.05 and 0.47 respectively. And for group B, selection differential was obtained to be 2.04 and 0.82 for sire and dam and intensity of selection was 0.34 and 1.30 for sires and dams respectively.

In group 'C' of first generation (F_1) selection differential and intensity of selection were measured in the same way as in the base population of group C.

The selection differential of males and females were found to be 4.81 and 2.49 gms. respectively, and selection intensity was observed to be 1.30 and 0.84 for male and female respectively (table 4.55).

In the 2nd cycle of R.R.S. within population, selection was made among the progenies produced by the selected dams and sires as stated earlier in group A and B, and also in group 'C'(selective random mating); selection differential and intensity of selection were also calculated as follows:

Selection differential for males was found to be 3.62, 5.19 and 7.52 gms. for groups A, B and C respectively & I.S. was observed to be 1.72, 1.78 & 2.13 for Groups A, B & C.

In female mice, the selection differential was computed to be 2.07, 2.06 and 2.16 gms. and intensity of selection was 1.04, 0.76 and 0.92 respectively for groups A, B and C (table 4.55).

TABLE 4.55

Showing generationwise average body weight of mice at 28 days, selection differential and intensity of selection in different groups of mating

Group/sex	Base population			Re-mated population			2nd reciprocal populn.		
	Av. body wt.	S.D.	I.S.	Av. body wt.	S.D.	I.S.	Av. body wt.	S.D.	I.S.
'A'									
Male	10.78	5.05	1.53	12.25	0.12	0.05	14.88	3.62	1.72
Female	10.19	1.01	0.33	11.66	0.90	0.47	13.34	2.07	1.04
'B'									
Male	11.70	4.13	1.72	11.66	2.04	1.07	13.81	5.19	1.78
Female	11.66	1.59	0.66	12.25	0.82	0.34	13.47	2.06	0.76
'C'*									
Male	11.82	4.60	1.66	13.34	4.81	1.30	12.68	7.52	2.13
Female	11.59	2.69	1.01	12.42	2.49	0.84	13.76	2.16	0.92

S.D. = selection differential,

I.S. = intensity of selection,

* = selective random breeding.

LITTER SIZE AT BIRTH:

Litter size at birth were also observed in the following different populations:-

Foundation stock:-

The average litter size at birth were recorded to be 8.00 ±0.49, 8.33±0.44 and 8.34± 0.53 with 28.75, 27.97 and 27.21 % coefficient of variation in groups A, B and C, respectively (table 4.56).

The average litter size was observed to be more or less similar in all the groups, A, B and C, but group B and C showed slightly higher litter size than that of group A.

The average litter size at birth agreed well with the results obtained by Dadlani and Prabhu (1962) and with that of second parity of pure and reciprocally mated population of Shibata (1966).

Base population:-

In groups A, B and C of the base population (Ist reciprocal cross), the average litter size were 8.26 ± 0.17, 8.17 ± 0.34 and 7.70±0.48 with 16.46, 31.21 and 32.33 % coefficient of variation, respectively (table 4.56).

Litter size in group A was observed to be higher to that of group 'C', and the same was found similar in the groups'A'and'B!

The average litter size in groups A and B were observed slightly higher, whereas in group C, the litter size was lower as compared to that of the foundation stock.

Litter size at birth in both the groups A and B were found similar to 2nd group of Shibata (1966) and 3rd parity of Dadlani and Prabhu (1962), and Hansson and Lindkvists' (1962) 2nd generation of first group.

The average litter size of group C was similar to that noted by Hansson and Lindkvist (1962) in second generation of group 2nd, and second parity of Dadlani and Prabhu (1962).

Re-mated population:-

In re-mated population (selected dams and sires), the average litter size were observed to be 9.95±0.34, 9.57±0.36 and 7.36±0.41 with 25.43, 22.77 and 33.55 % coefficient of variation in groups A,B and C respectively (table 4.56).

The average litter size in groups A and B were observed to be higher to that of group C. The litter size increased in groups A and B over the base population and foundation stock, but in group C, the litter size decreased as compared to base population and foundation stock.

The litter size of group A and B at birth was found higher to that reported by Dadlani and Prabhu (1962), Hanssan and Lindkvist (1962) and Shibata (1966), but compared to the findings of Wilson and Edwards (1963), the present results were lower.

The litter size of group C was similar to that second generation of 2nd group of Hansson and Lindkvist(1962) and second parity of Dadlani and Prabhu (1962).

Second Reciprocal crossing:-

In groups A, B and C of second reciprocal crossing, the average litter size were 7.37±0.42, 7.96 ± 0.37 and 6.03± 0.42 with 43.96, 34.04 and 41.46 % coefficient of variation, respectively (table 4.56).

The average litter size in both the groups A and B were observed more or less similar, whereas in group C it was lower as compared to groups A and B.

The litter size of groups A and B agreed well with that reported by Dadlani and Prabhu (1962), Shibata (1966), and higher than that noted by Venge (1960), Hiraiwa and Hamajima (1960), and Shibata (1967).

The average litter size of group C was observed similar to that of 3rd, 4th and 5th generation in second group of Hansson and Lindkvist (1962) and higher than that stated by Venge (1960), Hiraiwa and Hamajima (1960) and lower than that reported by Shibata (1966).

The higher litter size of the present study might probably be due to the fact that the experimental stock be a mixed one.

Most pronounced decrease in litter size of group C was observed in 2nd generation, which might be due to the difference in the mating system and environmental fluctuation. And the improvement in litter size of groups A and B as

TABLE 4.56

Showing average litter size with S.E. and C.V. percent of groups A,B & C in all the successive generations

Group	Foundation stock			Base population(R.C)			*Re-mated population			2nd Reciprocal cross		
	No. of L	Litter size ± S.E.	C.V. %	No. of L	Litter size ± S.E.	C.V. %	No. of L	Litter size ± S.E.	C.V. %	No. of L	Litter size ± S.E.	C.V. %
A	22	8.00±0.49	28.75	57	8.26±0.17	16.46	38	9.95±0.34	25.43	58	7.37±0.42	43.96
B	27	8.33±0.44	27.97	56	8.17±0.34	31.21	35	9.57±0.36	22.77	54	7.96±0.37	34.04
**C	26	8.34±0.53	27.21	27	7.70±0.48	32.33	36	7.36±0.41	33.55	31	6.03±0.42	41.46

L = litters
R.C. = reciprocal cross
* = selected dams and sires within group
** = selective random breeding.

compared to that of group C, might be due the results of selection and breeding methods.

FERTILITY:

Fertility is reflected the litter size at birth. Fertility percentages were observed and recorded groupwise in all the different populations (table 4.57).

Fertility percentage in groups B and C was found to be higher than that in group A of the foundation stock, and in F_1 population of group C the fertility percentage was higher as compared to those of groups A and B of Reciprocal cross.

In re-mated population, higher fertility percentage in group A as compared to groups B and C, was observed and in second reciprocal crossing, the fertility percentage was noted to be higher in groups A and B as compared to group C.

However, it was observed that fertility percentage increased in group A, but decreased in groups B and C, as compared to the foundation stock. The fertility percentage decreased more pronouncely in group C than that of group B.

TABLE 4.57

Showing fertility percent of groups A,B, & C in all the successive generations

Group	Foundation stock	Base population(Ist R.C.)	Re-mated population	2nd Reciprocal cross
A	78.5	95.0	95.0	96.66
B	96.4	93.3	87.5	88.33
C	92.8	96.4	90.0	77.50

R.C. = Reciprocal cross.

TABLE 4.58

Showing sex ratio of groups A,B & C in all the successive generations at 21, 28 and 42 days

Population/ group	21 days			28 days			42 days		
	Male	Female	Ratio	Male	Female	Ratio	Male	Female	Ratio
Base Population:									
A	83	76	100: 91.57	83	76	100: 91.57	83	76	100: 91.57
B	94	111	100:118.09	94	111	100:118.09	93	110	100:118.28
C	96	101	100:105.21	96	101	100:105.21	95	101	100:106.32
Overall	273	288	100:105.49	273	288	100:105.49	271	287	100:105.90
Reciprocal Population									
A	200	207	100:103.50	200	207	100:103.50	196	204	100:104.08
B	172	170	100: 98.84	172	170	100: 98.84	169	169	100:100.00
C	80	91	100:113.75	80	91	100:113.75	76	90	100:118.42
Overall	452	468	100:103.54	452	468	100:103.54	441	463	100:104.99
Re-mated Population									
A	130	169	100:130.00	130	169	100:130.00	130	168	100:129.23
B	148	120	100: 81.08	148	119	100: 80.41	148	118	100: 79.73
C	108	101	100: 93.52	106	100	100: 94.34	106	99	100: 93.40
Overall	386	390	100:101.04	384	388	100:101.04	384	384	100:100.00
TOTAL	1111	1146	100:103.15	1109	1144	100:103.16	1096	1134	100:103.47

SEX RATIO:

Sex-ratio in all the groups of successive generations at different stages of growth were observed.

In group A,more males were observed, but in groups B and C, number of females were higher in Base population.

In Reciprocal population, number of females were more than males in all the groups of A,B and C.

In group 'A' of Re-mated population (Progeny of the selected dams and sires), females were found to be higher in number, whereas in groups B and C, males were observed to be more numerous.

However, the total sex-ratio was observed to be 100:103.15, 100:103.16 and 100:103.47 for males and females at 21, 28 and 42 days respectively (Table 4.58).

CHAPTER - V

S U M M A R Y

S U M M A R Y

In the present study, body weight of mice has been investigated in group 'A' and 'B' of Reciprocal Recurrent selection (R.R.S.) and in group 'C' of Selective Random breeding (S.R.B.) populations, generationwise.

Foundation stocks were divided into three groups - A, B and C. Groups A and B were used as R.R.S. population and group 'C' as S.R.B. population.

Selection was practised on the body weight of mice at 28 days of age in both the R.R.S. and S.R.B. populations.

Liveweight at 21, 28 and 42 days, was also recorded and effects of sex on body weight of mice was worked out at these periods in both the R.R.S. and S.R.B. populations.

Comparison of average body weight of mice between groups was made generationwise.

Heritability coefficient of body weight (for both male and female mice) was estimated by the Intra-Sire-Regression of son on dam and daughter on dam.

Average litter size at birth and fertility percentage were also recorded.

Following results have been obtained in groups A and B of R.R.S. and in group C of S.R.B.

1. Base Population:-

The average body weight of male mice was observed to be 6.91 ± 0.22, 10.78 ± 0.36 and 18.00 ± 0.37 gms. and for

females, the same was 6.63 ± 0.65, 10.19 ± 0.34 and 17.09 ± 0.37 gms. at 21, 28 and 42 days respectively in group A. The effects of sex on body weight was found non-significant at 21, 28 and 42 days.

In group 'B', the mean body weight of male mice was computed to be 7.38 ± 0.59, 11.70 ± 0.24 and 19.99 ± 0.33 gms. whereas for females, it was found to be 7.64 ± 0.15, 11.66 ± 0.22 and 18.73 ± 0.23 gms. at 21,28 and 42 days respectively. The effects of sex on body weight were observed to be non-significant at 21 and 28 days, but at 42 days it was found to be highly significant.

In group 'C', at 21, 28 and 42 days, the average body weight of male was noted to be 7.53 ± 0.15, 11.82 ± 0.28 gms. and 19.44 ± 0.32 gms. and in case of females, the same was found to be 7.42 ± 0.14, 11.59 ± 0.26 and 19.58 ± 0.28 gms. The effects of sex on body weight were observed to be non-significant at all the three stages of growth.

Group differences of male mice body weight were found non-significant at 21 days, significant at 28 days and highly significant at 42 days. In female mice group differences of body weight were observed to be highly significant at 21, 28 and 42 days.

2. Reciprocal Population:-

In group 'A', the mean body weight of males were found to be 7.90 ± 0.09, 11.90 ± 0.13 and 20.38 ± 0.19 gms., whereas in females, it was 7.63 ± 0.08, 11.43 ± 0.13 and

19.81 ± 0.18 gms. at 21, 28 and 42 days respectively. The effects of sex on body weight were found to be significant at all the three stages of growth.

The heritability coefficient of males was computed to be 0.20 ± 0.14, -0.16 and -0.60, and for females the values were -0.22,-0.46 and -0.44 at 21,28 and 42 days respectively.

In group 'B', at 21, 28 and 42 days, the average body weight of males was noted to be 8.04±0.14, 12.46 ± 0.17 and 21.44 ± 0.24 gms.,and for females, the same was observed to be 7.98±0.15, 12.04±0.18 and 20.07±0.23 gms. respectively. The effects of sex on body weight were found non-significant at 21 and 28 days and highly significant at 42 days.

The heritability coefficient of males was estimated to be -0.16, 0.30 ± 0.18 and 0.01 ± 0.36, whereas in females the same was 0.28 ± 0.21, 0.68 ± 0.16 and 0.12 ± 0.34 at 21, 28 and 42 days respectively.

In group 'C' of F_1 population, the mean body weight of males was obtained to be 8.91 ± 0.25, 13.34 ± 0.32 and 22.75 ± 0.30 gms., and in case of females, the same was 8.82 ± 0.25, 12.42 ± 0.30 and 20.71 ± 0.35 gms. at 21, 28 and 42 days respectively. The sex effects on body weight were observed to be non-significant at 21 days, whereas it was found significant at 28 days and highly significant at 42 days.

The heritability coefficient was found to be -0.46, 0.36 ± 0.30 and -0.09 for males, and in case of females the values were observed to be -0.66, -0.52 and -0.18 at 21, 28 and 42 days respectively.

Group differences in body weight of male mice were observed highly significant at all the three stages, whereas in females, the body weight differences between groups were found highly significant at 21 and 28 days and non-significant at 42 days.

3. Re-mated Population (Progeny of selected dams and sires:-

In group 'A', the average body weight of males was noted to be 8.65 ± 0.13, 14.88 ± 0.18 and 21.86 ± 0.20 gms., and for females the same was found to be 8.13 ± 0.10, 13.34 ± 0.15 and 19.20 ± 0.18 gms. at 21,28 and 42 days respectively. The effects of sex on body weight were observed highly significant at all three stages of growth.

The heritability coefficient of male mice body weight was computed to be -0.46, -0.54 and 0.80 ± 0.24 and for females, the values were -0.96, -0.10 and -0.74 at 21, 28 and 42 days, respectively.

In group 'B', the mean body weight of males at 21, 28 and 42 days was computed to be 8.15 ± 0.15, 13.81 ± 0.24 and 20.05 ± 0.27 gms., and in case of females, it was observed to be 8.15 ± 0.17, 13.47 ± 0.24 and 19.58 ± 0.25 gms. respectively. The effects of sex on body weight were found non-significant at 21 and 28 days, and highly significant at 42 days.

The heritability coefficient of body weight in male mice was found to be 0.12 ± 0.18, -0.07 and 0.16 ± 0.40, whereas in females the values were observed to be 0.44 ± 0.22, 0.66 $\pm$ 0.18 and -0.72 at 21, 28 and 42 days respectively.

In group 'C' of F_2 population, the average body weight of males was found to be 7.66 $\pm$ 0.21, 12.68 $\pm$ 0.34 and 20.26 $\pm$ 0.22 gms., whereas in case of females the same was observed to be 7.09 $\pm$ 0.14, 11.60 $\pm$ 0.23 and 19.59 $\pm$ 0.23 gms. at 21, 28 and 42 days respectively. The effect of sex on body weight turned out to be non-significant at 42 days and significant at 21 and 28 days.

The heritability coefficient of male mice body weight was estimated to be 0.128 $\pm$ 0.18, -0.12, -0.24 and in females the value was noted to be 0.198 $\pm$ 0.14, -0.114 and -0.048 at 21, 28 and 42 days respectively.

Group differences in male mice body weight between groups were noticed highly significant at all the three stages, whereas in females, the differences were observed non-significant at 42 days and highly significant at 21 and 28 days.

The gradual increase of the body weight of males and females in both the groups A and B of R.R.S. population was observed in the successive generations, as compared to base population, which might be due to the improved method of breeding and selection, although the environment was not quite uniform from generation to generation.

In F_1 population of group 'C', the average body weight increased remarkably as compared to base population, but in F_2, the average body weight decreased as compared to that of F_1 and base population. An irregular increase and decrease of body weight was observed, which might be due to the environmental factors and breeding method itself.

From the results obtained during this study, it appears that the R.R.S. procedure has proved its superiority over the S.R.B., even under the fluctuating environments from generation to generation.

CHAPTER - VI

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