# STUDIES ON CURLY COAT, GROWTH, MULTIPLE BIRTH AND COLOR OF YOUNG HORSES

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Leonard H. Blakeslee

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A THESIS

SUBMITTED TO THE GRADUATE SCHOOL

OF

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BY

LEONARD H. BLAKESLEE

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# INTRODUCTION

Many noteworthy contributions have been made to the genetic field since Mendel's law of inheritance was made known to the world. Mendel's work, and that of other eminent genetists, served not only as an incentive to workers, but also as a tool in animal and plant breeding. While much progress has been made, there still remains a vast and unexplored field for study in animal genetics and all of its related subjects. The obstacles encountered in livestock genetic investigations make progress difficult. A few of these obstacles are slow rate of increase, influence of environment, control of environment, lack of uniform methods of evaluating offspring, need for uniform records, and the economic standards involved. The outstanding obstacle in studying the genetics of the horse is its slow rate of increase which greatly delays the accumulation of the necessary information. Furthermore, horses are not considered mature until they are four years old, in spite of the fact that many reach mature weight earlier than this age. Fully cognizant of these facts, the writer felt when this study was initiated that an opportunity presented itself which could not be overlooked.

The horse herd owned by Michigan State College is unique in its origin and development, making it a desirable basis for the studies reported in the following pages.

This herd, composed of Belgian and Percheron draft horses, was developed largely from the offspring of two outstanding females. One, a Belgian called Pervenche 9030, is twenty years old. This mare, her daughter, and their offspring, make up most of the herd of Belgian mares maintained at Michigan State College. Pervenche was selected as a foal because of her very desirable type. After her purchase in 1922, she made an

outstanding show record which, supported by her record as a brood mare, justified her selection as a foundation animal. Nine of her female offspring or their descendants are now in the College herd. These nine mares are the get of Range Line Phoenix 12808, Preston Wolfe 14607, Success de Cognebeau 17015, and Ginger 18711.

The other mare, Coreen, a grey Percheron, was equally as famous. This mare was foaled in 1914 and was purchased by the College in 1923. Since coming into the College herd, she has completed an outstanding record, producing twenty foals during her twenty-five years. Of this number, sixteen were strong, living foals. One pair of twins and one single were aborted. The twentieth foal was dropped during her last year, but did not live. The present Percheron herd is composed largely of Coreen's female offspring or their descendants, twelve in number. These mares are the get of such sires as Treviso 144394, Sir Laet 190277, Oak Forest Echo 183540 and Mediator 209523. It is from these and several other mares, their foals and the herd stallions that the data reported in the following pages were obtained.

# PART I

## CURLY COAT OF HORSES

### Review of Literature

The occurrence of curly hair coat in domestic animals is very uncommon. This condition, however, is of economic importance especially in purebred animals, since it is abnormal and may detract from their value as breeders.

Rhoad (1934) reported a condition called "woolly hair" in swine which according to his description appears similar to the curly coat of horses. He states: "Six matings consisting of four outcrosses, one back-cross and one brother-sister mating indicate that woolly hair condition in swine is due to a single mendelian factor completely dominant over normal straight hair, the recessive condition."

Cole (1919) reported a defective hair and teeth condition in a herd of Wisconsin Holstein-Friesian cattle. He suggests that this defect might be attributed to a genetic cause rather than to factors of the environment or to faulty nutrition.

Craft and Blizzard (1934) describe in cattle a semi-hairless condition which is also curly in appearance. These workers state: "Experimental matings substantiate the suggestion that the semi-hairless condition is a hereditary recessive character."

### Occurrence of Curly Coat in Horses

On March 27, 1931, a male foal was dropped by a grey Percheron mare, Colene 191001, owned by Michigan State College. This foal was sired by Sir Laet 190277, but did not live. The foal seemed normal in all respects, but possessed a very curly type of hair coat over the en-

tire body. Little attention was given to this peculiar condition, except to write in the foaling records that the foal possessed a curly coat. The following year on April 7, 1932, Colene again in foal to Sir Laet, dropped another male foal with a curly hair coat. This colt, pictured on page 5 as a foal and on page 6 as a yearling developed into a good stallion, and was registered as Colonel Laet 207619. He was sold September 18, 1933, to a purebred Percheron breeder who still has him in use as a herd sire. As far as the writer can determine, no curly foals have been sired by this stallion. Two days after Colonel Laet was foaled, a curly-coated filly was dropped by Queen Eagle 202035. This filly, later registered as Queenet 208683, was also sired by Sir Laet. One year later, on April 9, 1933, a full-sister of Colene's, Coro 197515, dropped a colt with a curly coat. This colt was also sired by Sir Laet. The animals mated in pedigrees 1 to 4, pages 61 to 64, producing these curly-coated young, were related through several ancestors. Curly coat looks like a recessive brought out by inbreeding.

Since 1933, four other curly foals, one male and three females, have been dropped, all bred similar to the first four as shown in pedigree numbers 5, 6, 7, and 8, pages 65 to 68. In pedigree numbers 6 and 7, we find a slight difference in the ancestry of the curly foal; that is, No. 6, curly filly is out of a mare whose dam was by Treviso, but the curly filly is sired by Sir Laet. The curly filly represented in pedigree No. 7 is sired by a son of Sir Laet and out of a granddaughter of Treviso. No. 8 filly is out of a daughter of Treviso and by a son of Sir Laet. These two pedigrees and the fact that no other curly-coated individuals are known, give more proof that the Sir Laet-Treviso cross is responsible for the appearance of this genetic anomaly. If we accept this as true, then from what common ancestor (if any) and

in what manner is this curly coat inherited?

In an effort to answer the foregoing questions, the writer obtained data on all available mares which were sired by Treviso or sons of Treviso and bred back to Sir Laet. This survey, when summarized, involved 28 mares. Sixteen of these mares, sired by Treviso, dropped 42 foals to the service of Sir Laet. (Table 1, page ). Of these 42 foals, 5 were curly-coated and 37 smooth-coated. Assuming that Treviso is heterozygous for the recessive curly factor, then 50 per cent of his daughters would be heterozygous for the same factor. The other 50 per cent would be homozygous for smooth hair coat. Mating Sir Laet, also heterozygous for curly, to these daughters of Treviso should result in one-eighth of the 42 offspring being homozygous curly, one-half heterozygous curly, and three-eights, homozygous smooth haired. On this basis, the expected ratio would be 36.75 smooth-coated foals and 5.25 curly-coated foals, while the actual ratio was 37 to 5 or .25 less curly foals than would be expected to make a perfect ratio.

A close examination of the pedigrees on pages 61 to 68 reveals that there are two common ancestors in the pedigree of Sir Laet and Treviso. One is Dragon 52155, which was the sire of Treviso and also the sire of Sir Laet's dam, Rozelle 123963. The other is Couceorous 94852 which was the dam of Treviso and also the dam of Sir Laet's sire, Laet 133886. Correspondence with caretakers and owners of these individuals revealed that Rozelle, the dam of Sir Laet, possessed a slightly curly coat. Her fore-top, mane and tail were always especially curly. This information convinces the writer that the curly coat factor is inherited through the common ancestor Dragon. Couceorous, the other common ancestor, apparently is not a carrier of the curly factor since her son,


**Figure 1.**

**Colonel Laet, a curly colt as a foal.**

**(See pedigree No. 2)**

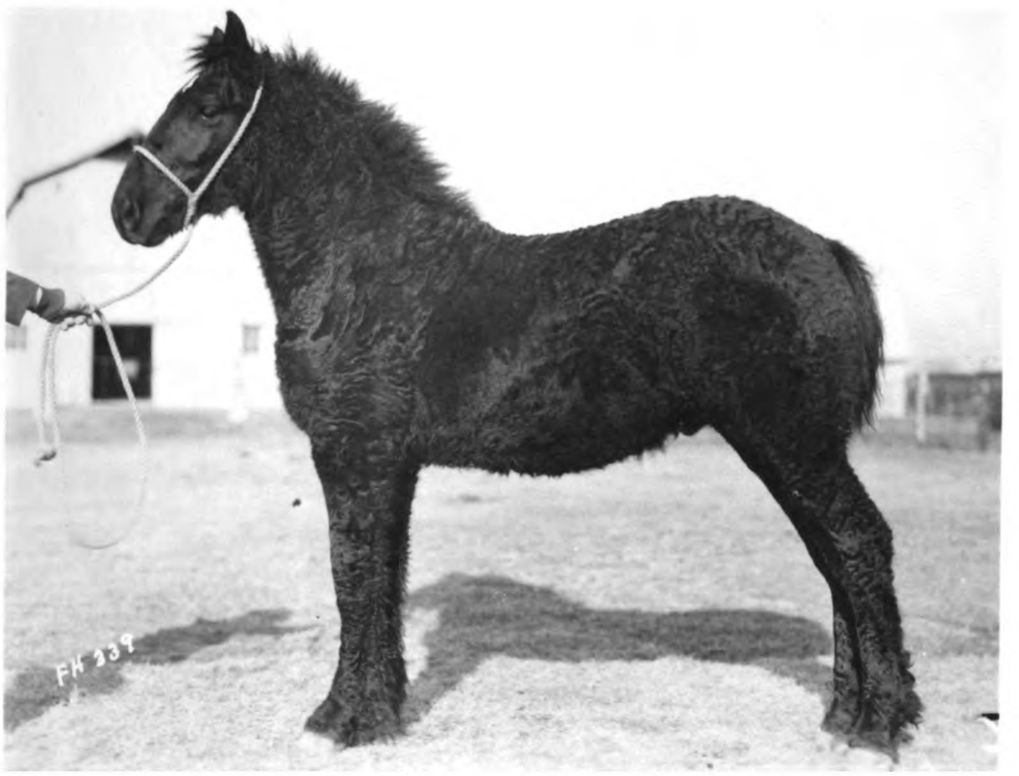



**Figure 2.**

**Colonel Laet as a yearling.**

Laet, was mated five or more times to Rozelle and no curly colts have been dropped as far as the writer can determine.

There remains at least one method to further study the inheritance of curly coats. The writer plans one or several matings of Colonel Laet and Queenet, two of the eight curly-coated individuals. This mating or other similar matings should produce only curly-coated young if the trait is a recessive.

Table 1.

CURLY AND SMOOTH FOALS OF SIMILAR BREEDING

| Mares by Treviso | Foals by Sir Laet |
|---|---|
| Colene 191001 | (2 curly males<br>(3 normal foals (2 males, 1 female) |
| Colo 194276 | 3 normal males |
| Coro 197515 | (3 normal males<br>(1 curly male |
| Treva 203692 | (1 normal female<br>(1 normal male |
| Maroline 196806 | 4 normal females |
| *Claudette | 1 curly female |
| Marge | 1 curly male |
| Clauro 191003 | **1 curly filly |
| Allia 196831 | 2 normal foals |
| Maroline 196806 | 4 normal males |
| Fashion 182195 | 2 normal foals |
| Ota 199928 | 1 normal foal |
| Doritea 199930 | (1 normal male<br>(2 normal females |
| *Lady Koncarcleviso | **1 curly female |
| Trevaret 195875 | 1 normal male |
| Leina 200584 | 4 normal foals |
| Leola | (4 normal females<br>(1 normal male |
| Queen Eagle | 1 curly female |

*These mares are of Treviso breeding, but not by Treviso.

**These foals are by a son of Sir Laet.

# PART II

## GROWTH STUDIES IN FOALS

### Introduction and Review of Literature

All genetic studies with mammals and especially with domestic animals or farm livestock are ultimately concerned with growth and development. Growth is usually expressed in terms of pounds. At the same time that the animal is increasing in weight, there is an increase in certain body measurements. "What is the relation of these increases in weights and measurements and can any one measurement be used to estimate weights?" This is a question often asked. Lush, Trowbridge, Culbertson and many other investigators report that there is a great increase in heart girth of feeding steers during the fattening period. They concluded that the chest girth is the most generally useful single measurement among those which increase rapidly with fattening.

Ragsdale, Brody and their associates (1937) of Missouri arrived at the same conclusion with dairy cows and established a table to estimate weights from heart girth measurements.

A similar table for dairy cows was also prepared by Kendrick and Parker (1936). Bradford Knapp, Jr. (1937) published a table for estimating the weight of beef and dual-purpose cattle from heart-girth measurements.

Trowbridge and Chittenden (1932) reported that horses from birth to five years of age increased 900 per cent in weight or an average of 1,354 pounds, while the chest circumference increased 128 per cent or 45 inches during the same length of time. The greatest percentage of increase in any body measurement according to this report was width of hips, which increased 182 per cent, but involved an increase

of only 16.4 inches.

Hudson (1934) reports that young horses fed on different planes of nutrition develop at a different rate in weight and body measurements.

Phillips, Krantz and Lambert (1938) in a study of 17 different measurements of horses report that the coefficient of variation showing the inaccuracy of measurements was from .75 to 5.09. The coefficient of variation for circumference of chest measurement was 1.54.

Other coefficients of variation due to inaccuracy of measurements and variation between recorders were:

| | |
|---|---|
| Height at withers..... | .75 |
| Depth of chest..... | 1.15 |
| Height at floor of chest.. | 1.58 |
| Width of chest..... | 3.32 |
| Circumference at last rib..... | 2.03 |
| Angle of shoulder..... | 5.09 |
| Width of fore cannon..... | 1.75 |
| Depth of hock..... | 1.75 |

These workers concluded that body measurements in horses were more accurate than scores or visual attempts to compare horses, since the inaccuracy coefficient of scores studied varied from 9.21 to 19.06.

Johnson (1939) prepared a formula which involved two body measurements for the purpose of estimating weights of horses. The formula was: Heart girth x Heart girth x Length $\div$ 300 $-$ 50 = Weight.

As pointed out by Knapp (1937) with beef cattle, and Kendrick, Parker (1936) and Ragsdale (1934) with dairy cattle, the accuracy of their tables prepared for estimating weights depends upon the fatness of the animal as well as type, breed, etc.

Such tables for estimating weights, however, serve several

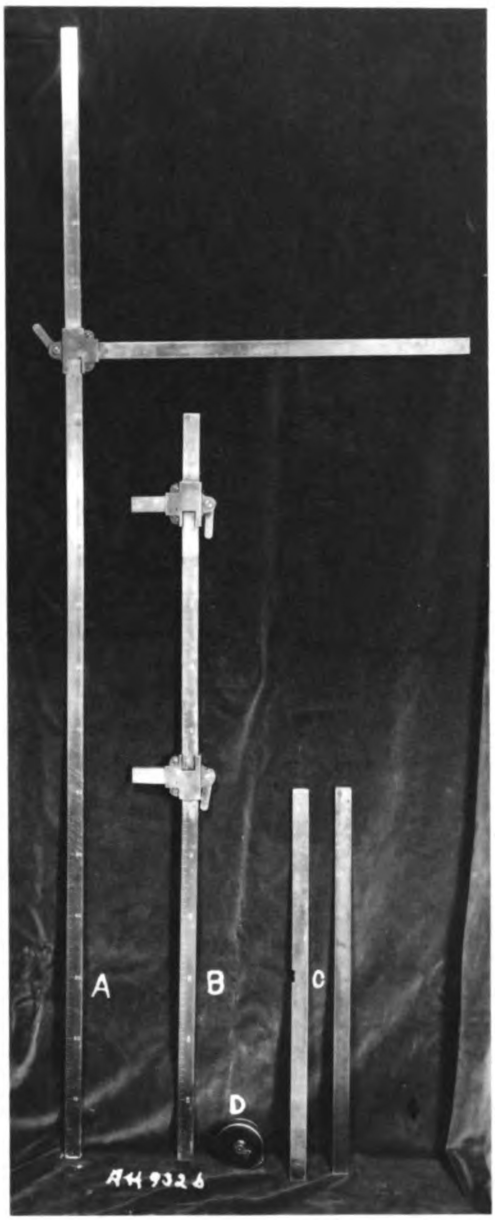



Figure 3.

Metric Measuring Instruments
Standard Equipment Obtained from Bureau of Animal Industry, United States Department of Agriculture:

(A) Bronze rule used for height measurements
(B) Calipers for width measurements
(C) Arms used to replace short caliper arms for width measurements on mature animal
(D) Centimeter tape.

very valuable purposes. Livestock producers and dealers use such tables for estimating weights when scales are not convenient. To be useful, such a method of weight estimation must be determined from some measurement or measurements easy to obtain with simple equipment.

Such tables may likewise be used as a standard for comparing all animals of a breed of the same age. If used for this purpose, animals judged as representative may be used to establish the standard or table.

## Problem and Method of Procedure

At the outset of this project the writer had in mind possible solutions of the following questions:

1. How does a young foal grow while maturing?
2. Can the weights of foals and mature horses be determined by some one body measurement?
3. Is there a direct relation or correlation between increase in weight and increase in certain body measurements?
4. Do the different breeds and sexes develop at different rates?

To obtain some definite information on these questions, the writer started in the spring of 1936 to obtain data on College foals. Weights and measurements were taken at birth and each month thereafter as long as possible. At the beginning of this project, 20 body and limb measurements were taken. After some study, it was decided to eliminate all but the following 8 measurements, illustrated in Figure 4:

| | |
|---|---|
| Hip width | Height at withers |
| Body depth | Height at rump |
| Heart girth | Chest floor to ground |
| Shoulder width | Body length |

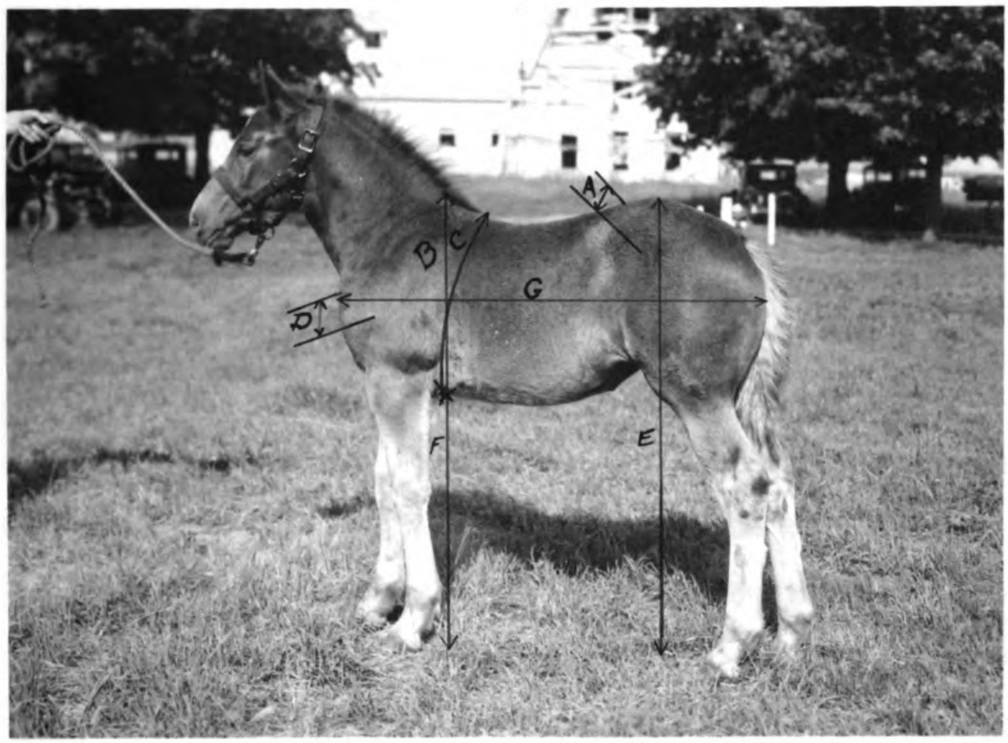



Figure 4.

Measurements Recorded

A. Hip width.

B. Body depth.

C. Heart girth.

D. Shoulder width.

B + F. Height at withers.

E. Height at rump.

F. Chest floor to ground.

G. Body length.

All measurements were taken with the individuals standing as squarely on all four feet as possible on a level floor. Weights were secured on standard tested platform or wagon scales. Hip width was determined as indicated in Figure 4 with special calipers shown in Figure 3, placed at the points of the tuber coxae. Body depth was also secured with calipers from the withers or highest point of the spinous processes of the thoracic vertebrae to the floor of the chest along a line perpendicular to the floor. With one end of the caliper on the floor, height at withers and chest floor to ground were obtained at the same time as shown in Figure 4. Heart girth was measured with a steel tape by drawing the tape firmly around the smallest circumference of the body just posterior to the forelegs. Shoulder width was taken with either short arm or long arm calipers and as shown at (D) of Figure 4. The width was secured with the calipers placed firmly at the points of the shoulder or at the lateral tuberosity of the humerus. Height at the rump was recorded with one arm of the caliper only placed firmly against the highest point in the sacral region of the backbone. The standard of the graduated caliper was held perpendicular to the floor. Body length was recorded with the long arm calipers. One arm was placed firmly against the breast of the horse, just anterior to the proximal extremity of the humerus, while the other was placed at the point of the buttock, just posterior to the tuber ischii.

Measurements and their corresponding weights were recorded on foals dropped in 1936, 1937 and 1938. Foaling weights were also secured in 1939. Foaling data for 1936, 1937, 1938, and 1939 are presented on pages 56 to 60.

LIES

| Range of age (days) | 0-266 | 267 | 295-320 | 325-349 | 351-378 |
|---|---|---|---|---|---|
| Average age when measured | | | days | 338 days | 366 days |
| Hip Width (cm.) | | | 3 | 49.52 | 50.16 |
| Body Depth (cm.) | | | | 65.5 | 66.18 |
| Heart Girth (cm.) | | | | 172 | 173. |
| Shoulder Width (cm. | | | | | 43.29 |
| Height at Withers ( | | | | 1 | 148.48 |
| Height at Rump (cm.) | | | | 1 | 153.29 |
| Chest Floor to Groun (cm.) | | | | | 82.25 |
| Body Le m.) | | | | | 154.48 |
| Weight | | | | | 1061. |
| Standard d weights fro | | | | | ±59.93 |

## Presentation of Data

The foaling tables give data on approximately 85 Percheron and Belgian draft foals dropped during the years 1936 to 1939, inclusive. Measurements were taken on only the 67 foals dropped in 1936-37-38. Of this number, only 43 remained in the College herd long enough to obtain sufficient data for this study on weights and measurements. Table 2 presents averages of the weights and 8 body measurements taken from these 43 foals. The 43 foals included 8 Belgian fillies, 14 Belgian colts, 14 Percheron fillies and 7 Percheron colts.

On page21, Figure 7, is shown a very smooth growth curve when the average of body depths are plotted against time. Similar curves are produced when each of the different body measurements from Table 2 is plotted against time as in Figures 8, 10, 12 and 13. This brings out the fact that horses grow fast when very young, but the rate of growth decreases as the individual increases in age. Figure 13 illustrates this very well, since the average increase in weight of all foals during the first 30 days was 142.46 pounds or 4.74 pounds daily. During the last period when the foals were yearlings, the average daily gain was only 1.21 pounds.

Figure 5 on page19 presents the relation of weight increases to increases in body depth. The data are taken from Table 2. This graph shows that the weight increase is much faster than the growth in body depth. Expressed in other terms, the weight increased 909.46 pounds or 600 per cent while the body depth increased 30.7 centimeters or 86.52 per cent. Similar curves are presented in Figures 6, 9 and 11 when weight is plotted against height at withers, length of body and heart girth, respectively.

Table 3.

AVERAGE INCREASES

IN BODY MEASUREMENTS AND WEIGHTS

Growth, Birth to One Year of Age

| | Average Increase | Per Cent Increase |
|---|---|---|
| Hip Width | 24.53 cm. | 95.70 |
| Body Depth | 30.70 cm. | 86.52 |
| Heart Girth | 78.30 cm. | 82.68 |
| Shoulder Width | 17.81 cm. | 67.86 |
| Height at Withers | 42.03 cm. | 39.48 |
| Height at Rump | 44.74 cm. | 41.21 |
| Chest Floor to Ground | 11.38 cm. | 16.05 |
| Body Length | 70.92 cm. | 84.87 |
| Weight | 909.46 lbs. | 600.14 |

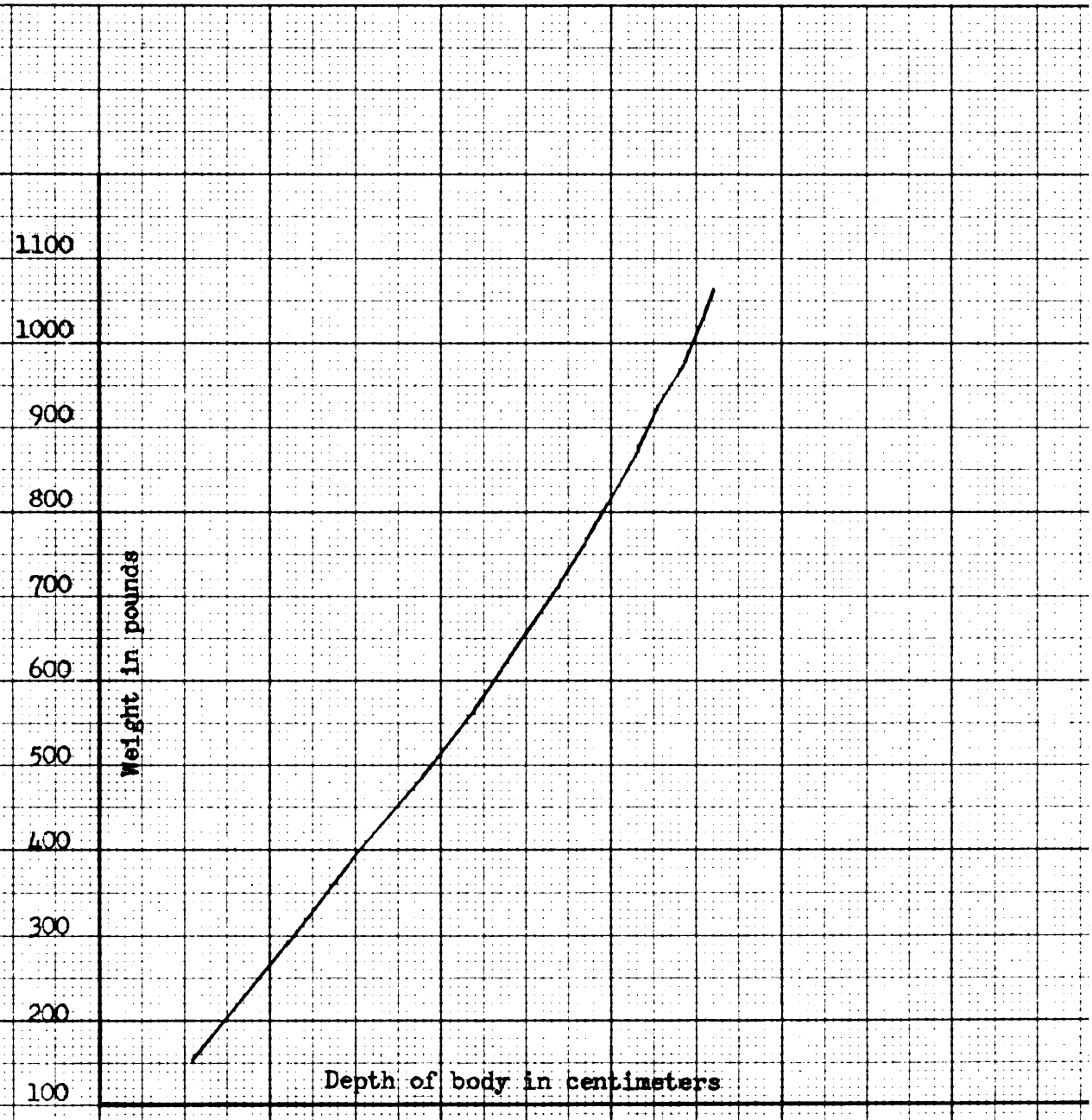
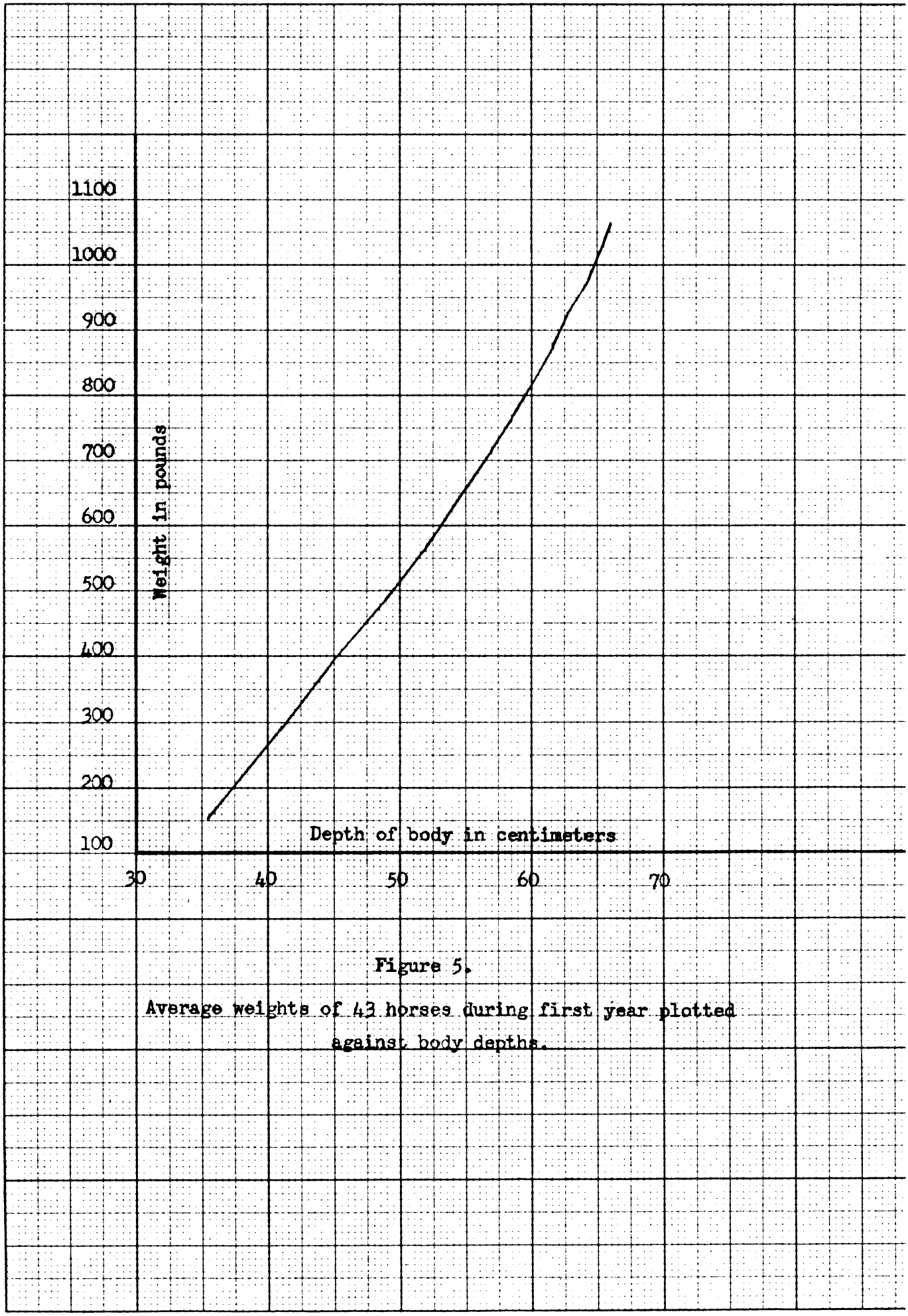



Figure 5.

Average weights of 43 horses during first year plotted against body depths.

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Average weights of 43 horses during first year plotted against body depths.

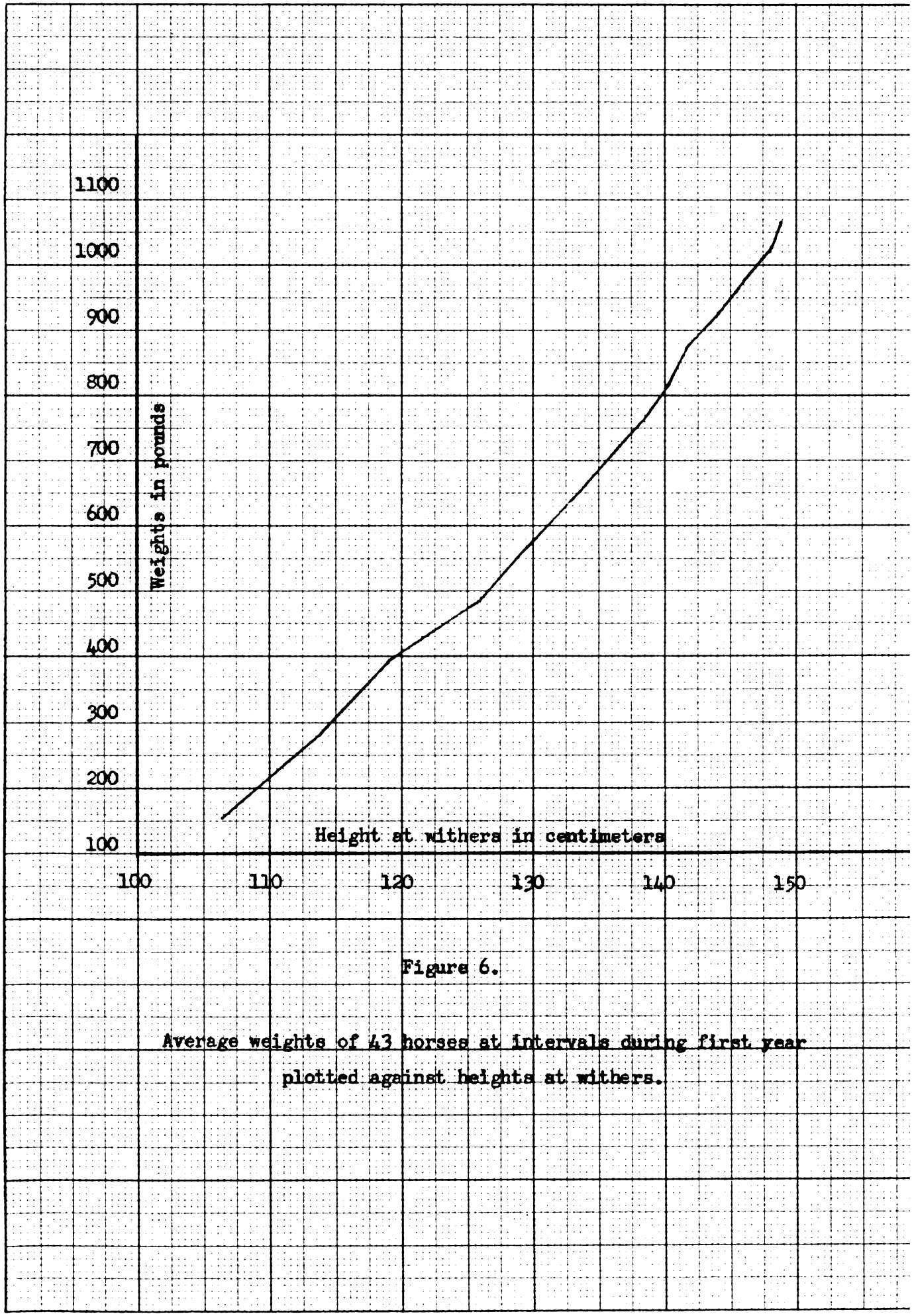


Figure 6.

Average weights of 43 horses at intervals during first year plotted against heights at withers.

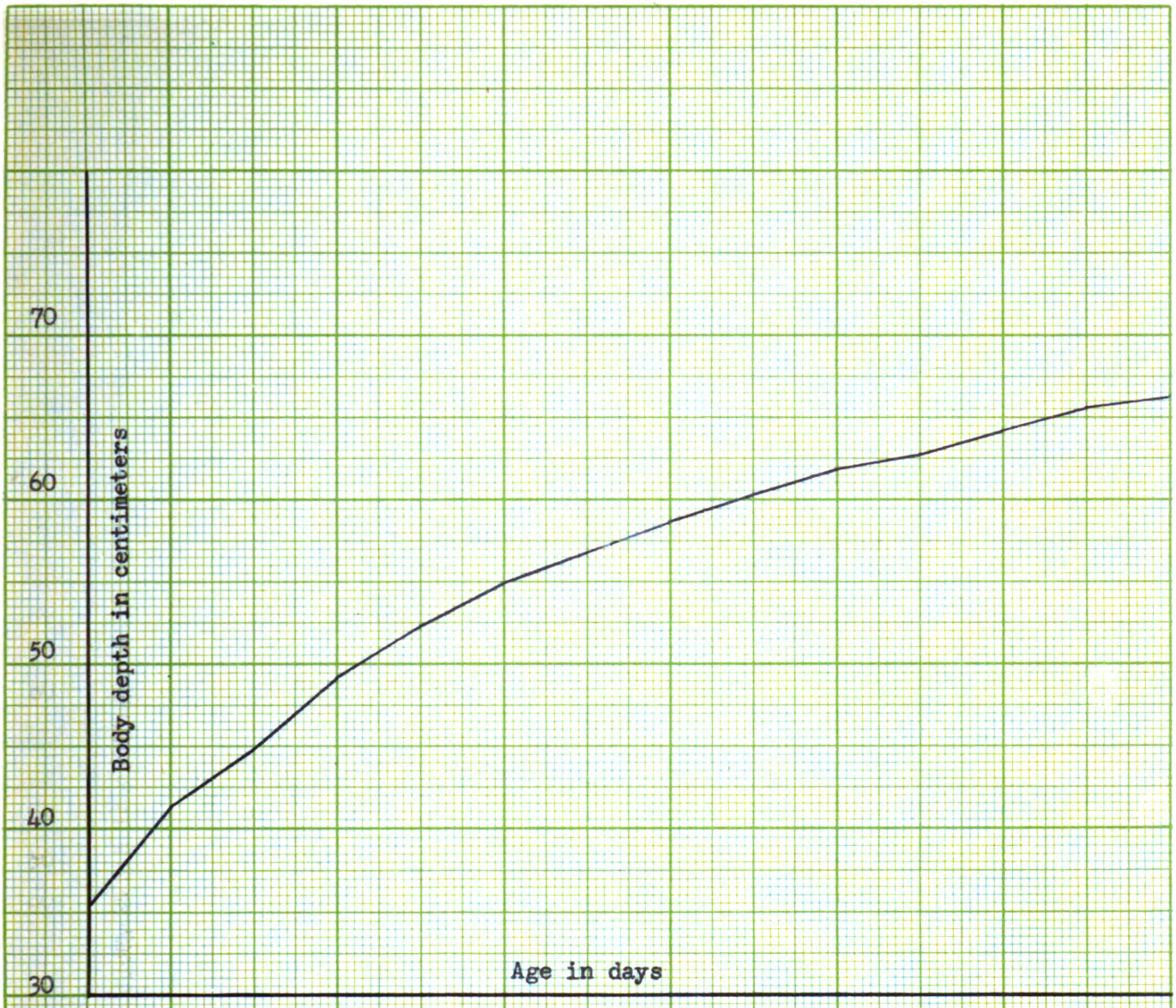


Figure 7.

Growth curve for average body depths of 43 young draft horses.

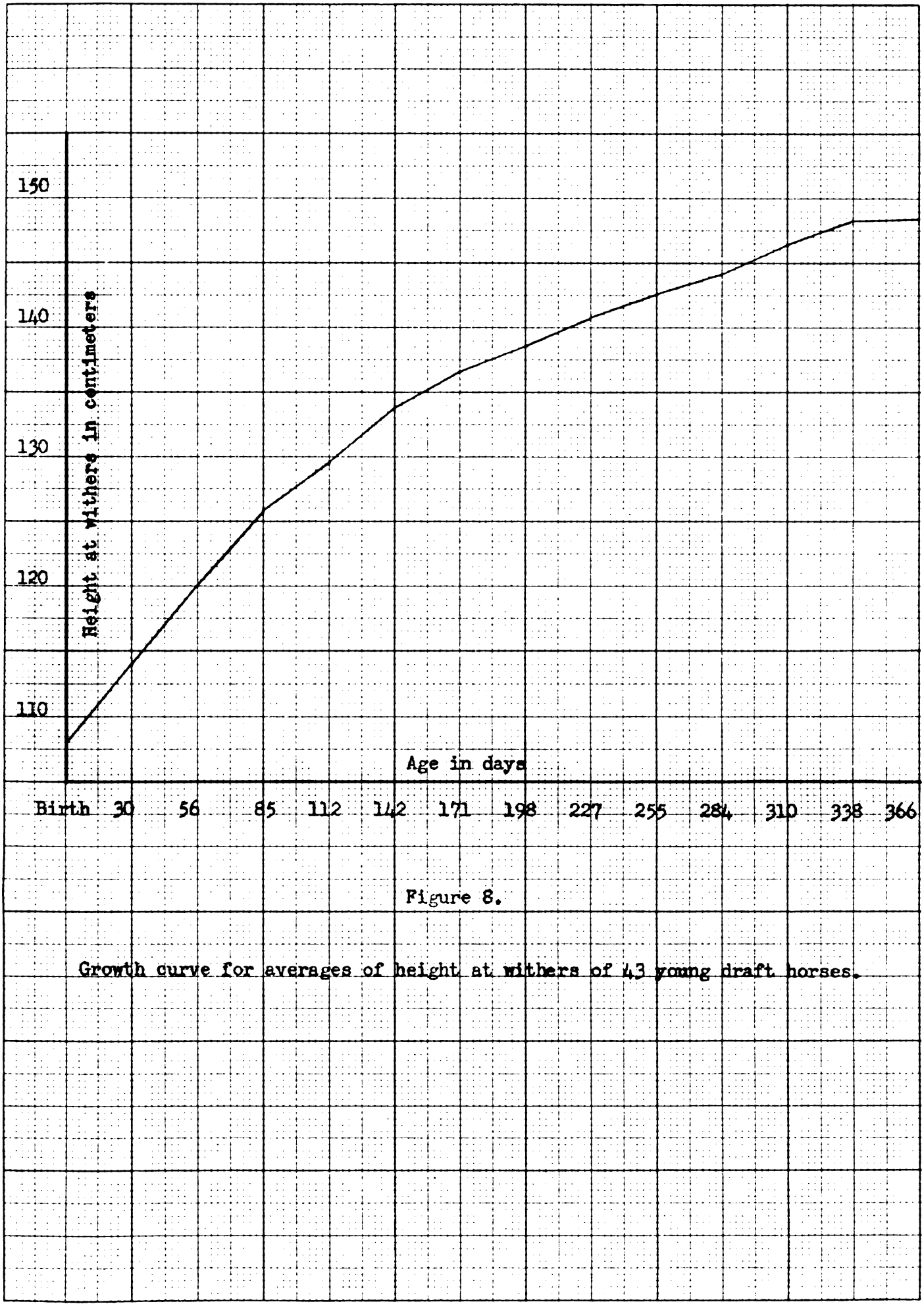


Figure 8.

Growth curve for averages of height at withers of 43 young draft horses.

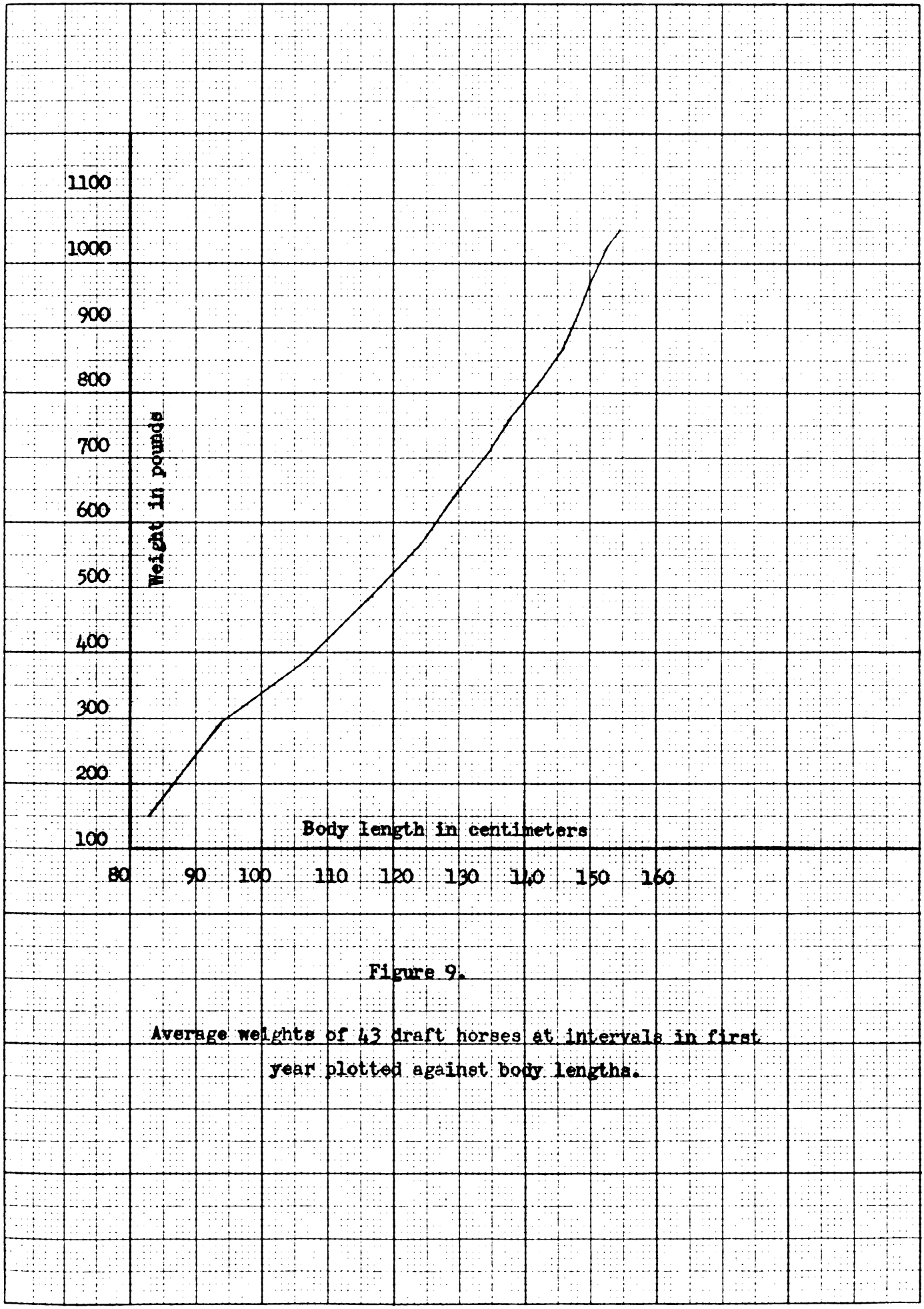


Figure 9.

Average weights of 43 draft horses at intervals in first year plotted against body lengths.

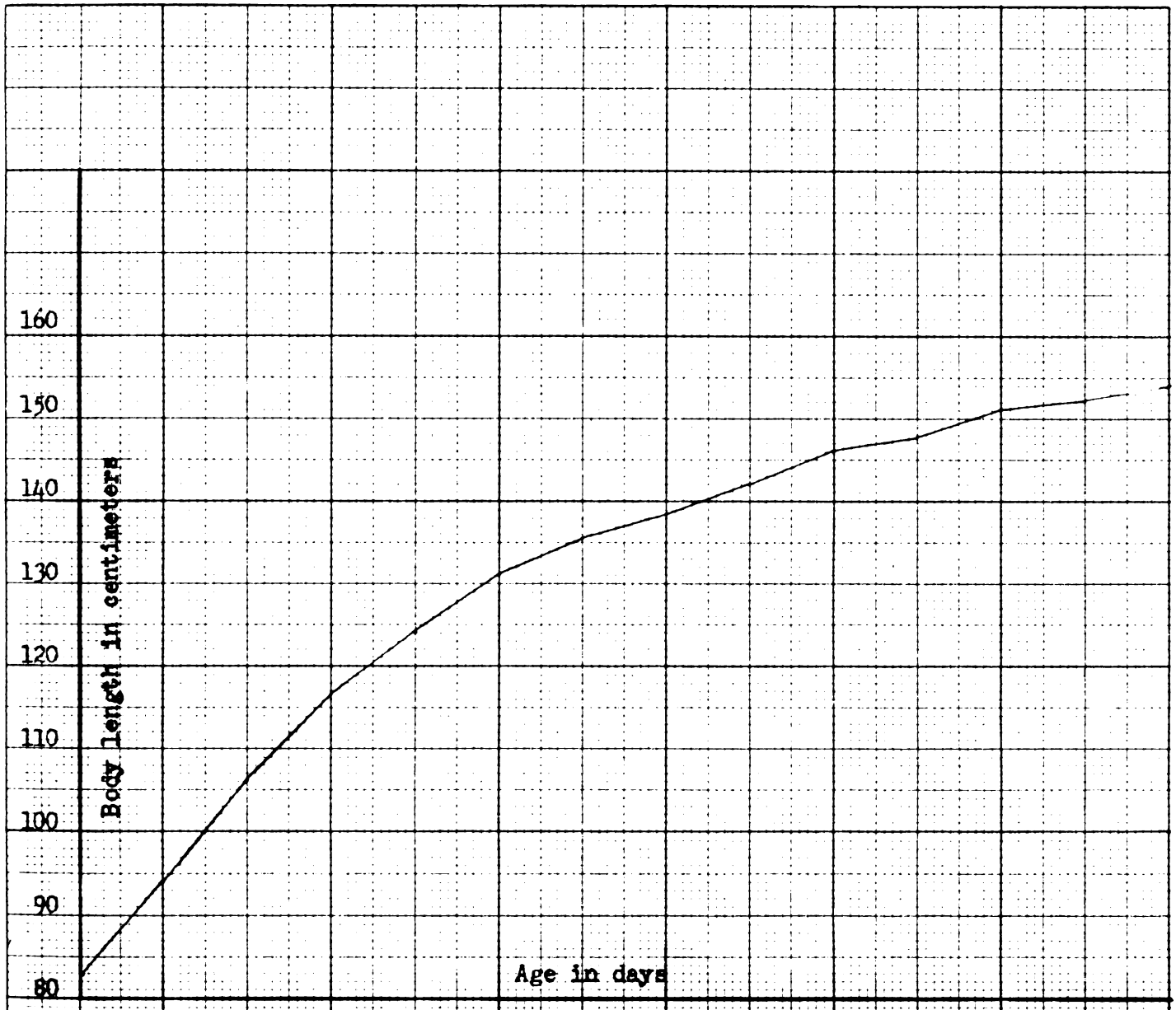


Figure 10.

Growth curve for averages of body lengths taken from 43 young draft horses.

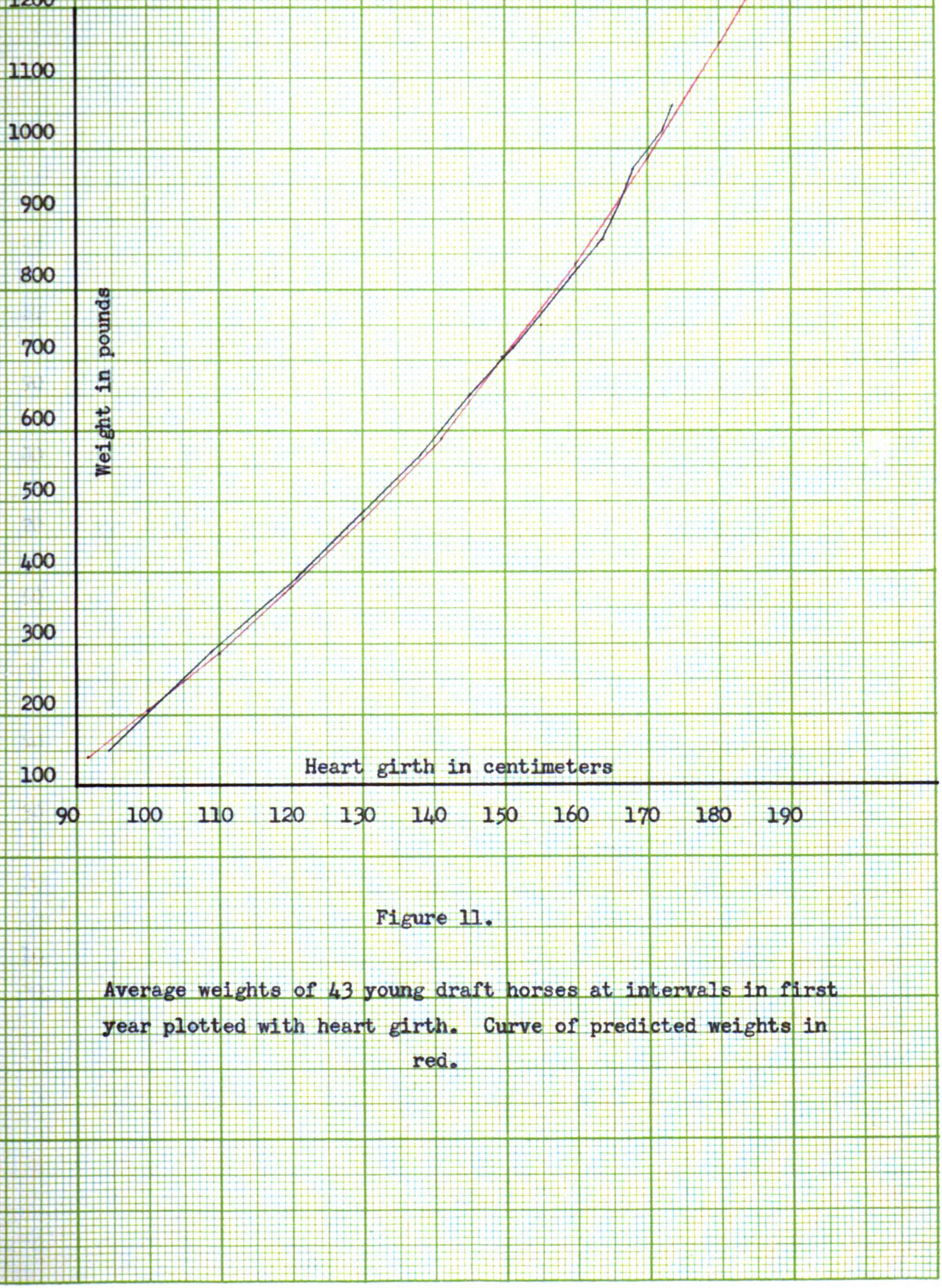


Figure 11.

Average weights of 43 young draft horses at intervals in first year plotted with heart girth. Curve of predicted weights in red.

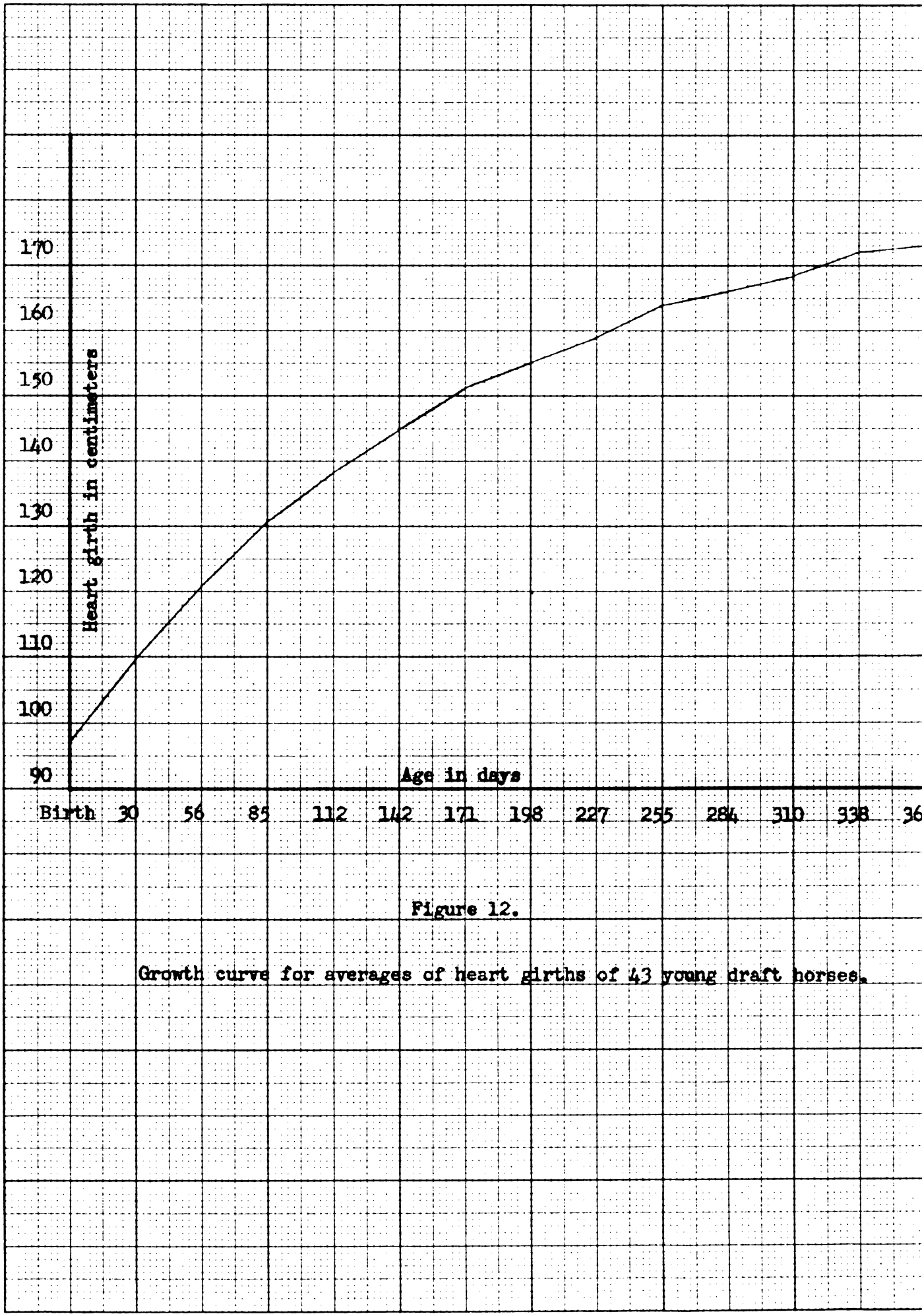


Figure 12.

Growth curve for averages of heart girths of 43 young draft horses.

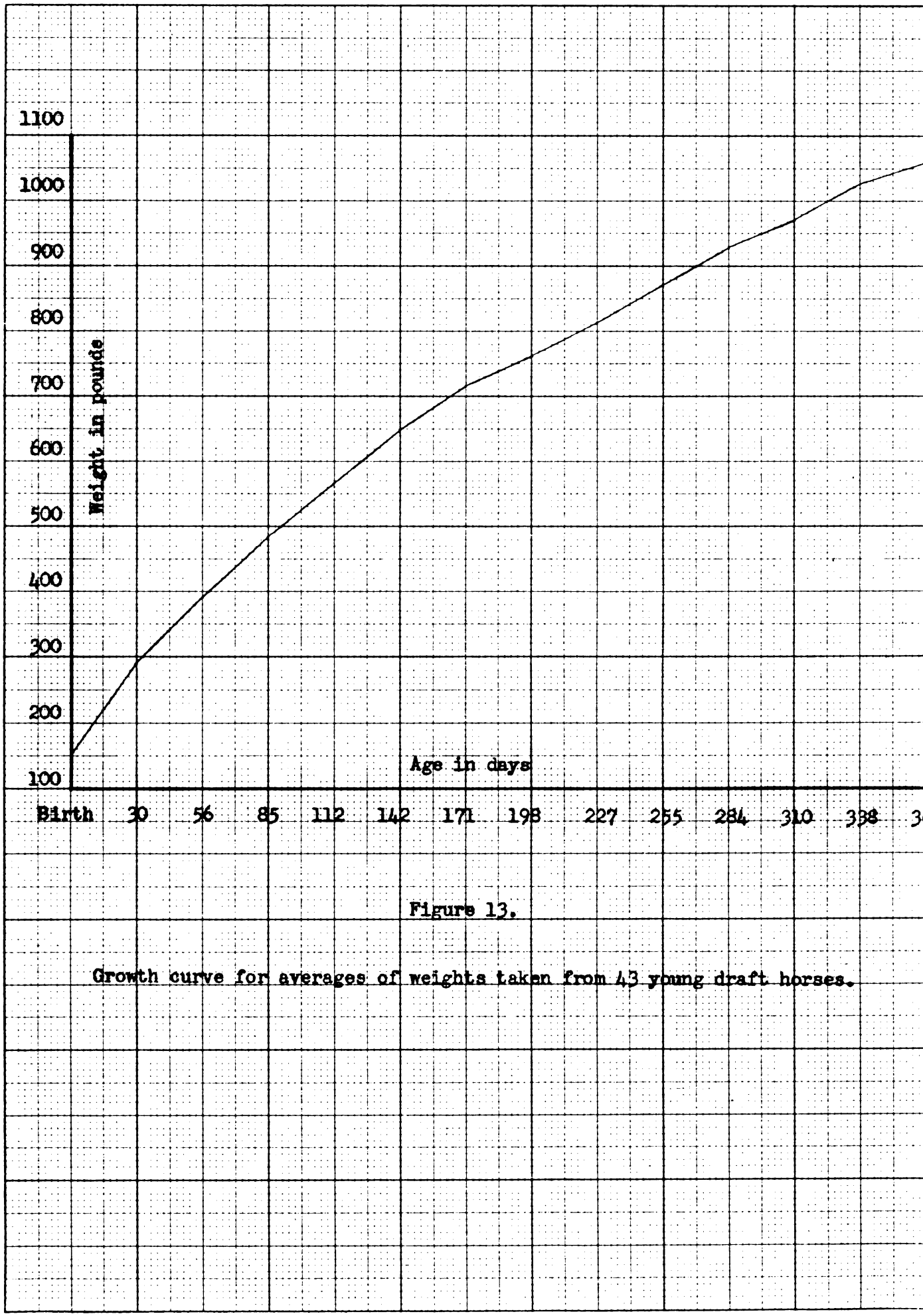


Figure 13.

Growth curve for averages of weights taken from 43 young draft horses.

According to Table 3, hip width, body depth, heart girth, and body length all increased 82 per cent or more during the period of this study. The heart girth and body length measurements, however, actually increased 70 centimeters or more while other measurements increased 44.74 centimeters or less.

The foregoing charts and tables show quite clearly that the heart girth measurement, while increasing slower than weight, continues at a uniform rate over the entire period studied. It is well-known that a horse which becomes fat takes on a rather uniform layer of fat over the entire body. The heart girth measurement would, therefore, compensate more for change in the fatness of an animal than any other one measurement studied. This measurement is also simple and convenient to obtain.

For these reasons, the heart girth was used as the basis for estimating weight. Obviously any predicted weight based on a straight line correlation of weight and heart girth would be subject to considerable error. Several curvilinear equations were, therefore, tested to see how well they fitted the curve established by the average weights and heart girth measurements. All equations tested and found not suitable involved standard deviations of $\pm$ 14.58 or more from the observed average weights. The following equation: $y - c = ae^{bx}$ when tested with observed average weights and measurements, gave a standard deviation of $\pm$ 12.32. (The curve established by predictions from this equation is found in Figure 11 in red.)

The equation $y - c = ae^{bx}$ was developed by Lipka (1918). In this equation y represented predicted weights, and x the known heart girth measurement in centimeters. The terms, c, a, e and b are constants calculated in the solution of this equation. The values

were - 572.15, 286.46, 2.718 and .00996, respectively, for the foregoing constants. For convenience, Table 4 is prepared in half inches and corresponding measurements in centimeters with weights as predicted by use of the above-mentioned equation.

Since the curve of predicted weights is based on averages as taken from Table 2, it must be pointed out that 87 per cent of all foals at birth were within a range of ± 25 pounds from the average. As yearlings, the range was greater with 60 per cent within a ± 50 pounds of the average and 85 per cent within ± 75 pounds of the average. The standard deviation of weights from the average is shown below Table 2.

When 28 head of horses, not used in the table of averages, were measured, it was found that 50 per cent of the individuals were within a ± 60 pounds of the predicted weight. Sixty-seven per cent were within a ± 100 pounds and 89.2 per cent were within ± 150 pounds of the predicted weight.

## Growth Rate Comparisons in Breeds and Sexes

There have been many different opinions expressed on the rate of growth between different breeds and sexes of draft horses. One common opinion is that Percherons develop much slower than Belgians. Conversely, it has been postulated that both breeds develop at approximately the same rate. Very little work has been done to confirm or disprove any or all of these theories.

Ancestry of the individuals, as well as nutrition and other environmental factors play a big part in rate of growth and bodily development. Realizing that body development resolves itself into

Table 4

ESTIMATED WEIGHTS OF DRAFT HORSES

FROM HEART GIRTH MEASUREMENTS

| Heart Girth | | Weight |
|---|---|---|
| Centimeters | Inches | Pounds |
| 91.44 | 36 | 140.09 |
| 92.71 | 36.5 | 149.15 |
| 93.98 | 37 | 158.35 |
| 95.25 | 37.5 | 167.65 |
| 96.52 | 38 | 177.05 |
| 97.79 | 38.5 | 186.60 |
| 99.06 | 39 | 196.25 |
| 100.33 | 39.5 | 206.05 |
| 101.6 | 40 | 215.95 |
| 102.87 | 40.5 | 225.99 |
| 104.14 | 41 | 236.15 |
| 105.41 | 41.5 | 246.35 |
| 106.68 | 42 | 256.85 |
| 107.95 | 42.5 | 267.35 |
| 109.22 | 43 | 278.05 |
| 110.49 | 43.5 | 288.95 |
| 111.76 | 44 | 300.00 |
| 113.03 | 44.5 | 310.95 |
| 114.30 | 45 | 322.25 |
| 115.57 | 45.5 | 333.65 |
| 116.84 | 46 | 345.15 |
| 118.11 | 46.5 | 356.85 |
| 119.38 | 47 | 367.85 |
| 120.65 | 47.5 | 380.65 |
| 121.92 | 48 | 392.75 |
| 123.19 | 48.5 | 405.05 |
| 124.46 | 49 | 417.45 |
| 125.73 | 49.5 | 430.65 |
| 127 | 50 | 442.85 |
| 128.27 | 50.5 | 455.85 |
| 129.54 | 51 | 468.85 |
| 130.81 | 51.5 | 481.85 |
| 132.08 | 52 | 495.85 |
| 133.35 | 52.5 | 508.85 |
| 134.62 | 53 | 522.85 |
| 135.89 | 53.5 | 536.85 |
| 137.16 | 54 | 550.85 |
| 138.43 | 54.5 | 565.25 |
| 139.7 | 55 | 579.85 |
| 140.97 | 55.5 | 594.35 |
| 142.24 | 56 | 609.35 |
| 143.51 | 56.5 | 624.25 |
| 144.78 | 57 | 639.45 |
| 146.05 | 57.5 | 654.95 |
| 147.32 | 58 | 670.55 |
| 148.59 | 58.5 | 686.35 |

Table 4 (Cont.)

| Heart Girth | | Weight |
|---|---|---|
| Centimeters | Inches | Pounds |
| 149.86 | 59 | 702.35 |
| 151.13 | 59.5 | 718.65 |
| 152.40 | 60 | 735.95 |
| 153.67 | 60.5 | 751.65 |
| 154.94 | 61 | 768.55 |
| 156.21 | 61.5 | 785.60 |
| 157.48 | 62 | 802.85 |
| 158.75 | 62.5 | 820.35 |
| 160.02 | 63 | 838.15 |
| 161.29 | 63.5 | 856.05 |
| 162.56 | 64 | 884.25 |
| 163.83 | 64.5 | 891.85 |
| 165.10 | 65 | 910.85 |
| 166.37 | 65.5 | 930.25 |
| 167.64 | 66 | 949.35 |
| 168.91 | 66.5 | 968.75 |
| 170.18 | 67 | 988.35 |
| 171.45 | 67.5 | 1008.15 |
| 172.72 | 68 | 1028.35 |
| 173.99 | 68.5 | 1048.65 |
| 175.26 | 69 | 1069.25 |
| 176.53 | 69.5 | 1090.25 |
| 177.8 | 70 | 1111.35 |
| 179.07 | 70.5 | 1132.85 |
| 180.34 | 71 | 1154.55 |
| 181.61 | 71.5 | 1176.45 |
| 182.88 | 72 | 1198.75 |
| 184.15 | 72.5 | 1221.35 |
| 185.42 | 73 | 1244.35 |
| 186.69 | 73.5 | 1267.25 |
| 187.96 | 74 | 1303.15 |
| 189.23 | 74.5 | 1314.45 |
| 190.5 | 75 | 1338.45 |
| 191.77 | 75.5 | 1362.75 |
| 193.04 | 76 | 1387.35 |
| 194.31 | 76.5 | 1412.35 |
| 195.58 | 77 | 1437.55 |
| 196.85 | 77.5 | 1463.15 |
| 198.12 | 78 | 1489.05 |
| 199.39 | 78.5 | 1515.35 |
| 200.66 | 79 | 1541.95 |
| 201.93 | 79.5 | 1568.75 |
| 203.2 | 80 | 1596.05 |
| 204.47 | 80.5 | 1623.75 |
| 205.74 | 81 | 1651.65 |
| 207.01 | 81.5 | 1679.85 |
| 208.28 | 82 | 1708.55 |

the increase of body measurements, including weight, the following study was made.

Figures 14 to 21 inclusive present graphs showing the average increase of body measurements and weights during the first year of 43 Belgian and Percheron foals. Each line of the several graphs represents the average for a group of foals as indicated on the graph. Measurements and weights were taken at regular intervals. The averages for 14 Percheron and 8 Belgian fillies are summarized in Table 6. Likewise, the averages for 14 Belgian and 7 Percheron colts are summarized in Table 5. The figures 14 to 21 are based on data from Tables 5 and 6.

A careful study of the graphs reveal several striking characteristics. The first noticeable tendency is toward a definite growth curve in each graph. Several slight variations are found as in Figures 15 and 16 when the average measurement of the Percheron colts dropped slightly below the average for all others. However, where such variations occur there is definite tendency in all cases for the group to catch up with the general curve at a later period. All graphs show a common rate of growth, with slight variations. The variations in graphs 14, 15, 16, 17 and 19 seem to be greater after 250 to 300 days. As has been pointed out, all 4 groups of foals seem to have a similar rate of growth. However, Figure 19 showing chest floor to ground growth curve, brings out a definite difference between the Belgians and Percherons. The Belgians, in this case, were built with bodies closer to the ground than the Percherons. In Figure 21, the weight of Percheron fillies and Belgian colts seems to stay consistently above that of the Belgian fillies and Percheron colts. This is also true with heart girth measurement in Figure 16.

From the foregoing graphs and data, Belgian and Percheron colts and fillies appear to grow and develop at about the same rate during the first year of life. The greatest difference which consistently held true was in the measurement of chest floor to ground. In other words, the Belgians are low-set while the Percherons are upstanding in their general conformation.

| Range in Age (Days) | 294 | 295-316 | 330-349 | 351-378 |
|---|---|---|---|---|
| **Belgian Colts** | | | | |
| Hip Width (cm.) | .7 | 48.1 | 49.28 | 50.2 |
| Body Depth (cm.) | .5 | 64. | 65.07 | 65.7 |
| Heart Girth (cm.) | .59 | 168.3 | 170.64 | 170.3 |
| Shoulder Width (cm.) | .4 | 43.2 | 44.35 | 44 |
| Height at Withers (cm.) | .27 | 145.05 | 147.5 | 147 |
| Height at Rump (cm.) | .9 | 149.95 | 152.64 | 15 |
| Chest floor to Ground (cm.) | .79 | 81. | 82.42 | |
| Body Length (cm.) | .63 | 149.75 | 151.3 | |
| Weight (lbs.) | .27 | 978. | 1035.7 | |

| Range in Age (Days) | 288 | 308-315 | 337-34 |
|---|---|---|---|
| **Percheron Colts** | | | |
| Hip Width (cm.) | . | 46.16 | 46.8 |
| Body Depth (cm.) | .16 | 64.33 | 64. |
| Heart Girth (cm.) | .30 | 163. | 168.3 |
| Shoulder Width (cm.) | .00 | 41.16 | 42.5 |
| Height at Withers (cm.) | .60 | 148.66 | 146.83 |
| Height at Rump (cm.) | .16 | 151.33 | 153.5 |
| Chest floor to Ground (cm.) | .5 | 84.33 | 82.83 |
| Body Length (cm.) | .83 | | 149.16 |
| Weight (lbs.) | .3 | | 978.33 |

| Range in Age (Days) | 53-266 | 269-294 | 304-320 | 325-336 | 351-378 |
|---|---|---|---|---|---|
| **Belgian Fillies** | | | | | |
| Hip Width (cm.) | 45.6 | 46.3 | 48.3 | 51.16 | 50.4 |
| Body Depth (cm.) | 61.5 | 62.5 | 63.8 | 65.5 | 65.6 |
| Heart Girth (cm.) | 62.9 | 165. | 167. | 174.6 | 173.5 |
| Shoulder Width (cm.) | 41.2 | 40.93 | 42.3 | 43.3 | 42.8 |
| Height at Withers (cm. | 40.2 | 142. | 144.5 | 145.5 | 145.7 |
| Height at Rump (cm.) | 45.2 | 146.7 | 149 | 150.1 | 151.1 |
| Chest Floor to Ground (cm.) | 78.7 | 79.5 | 8 | 80. | 80. |
| Body Length (cm.) | 44.7 | 145.62 | 1 | 3 | 153. |
| Weight (lbs.) | 73.5 | 908. | | | 1061.7 |

| Range in Age (Days) | 47-257 | 275- | | | 365-376 |
|---|---|---|---|---|---|
| **Percheron Fillies** | | | | | |
| Hip Width (cm.) | 45.8 | 47. | | | |
| Body Depth (cm.) | 62.3 | 63. | | | |
| Heart Girth (cm.) | 65.3 | 168. | | | |
| Shoulder Width (cm.) | 41.1 | 41. | | | |
| Height at Withers (cm. | 44.5 | 147. | | | |
| Height at Rump (cm.) | 51.8 | 153. | | | |
| Chest Floor to Ground (cm.) | 82.1 | 82.7 | | | |
| Body Length (cm.) | 47.3 | 3 | | | |
| Weight (lbs.) | 65. | | | | |

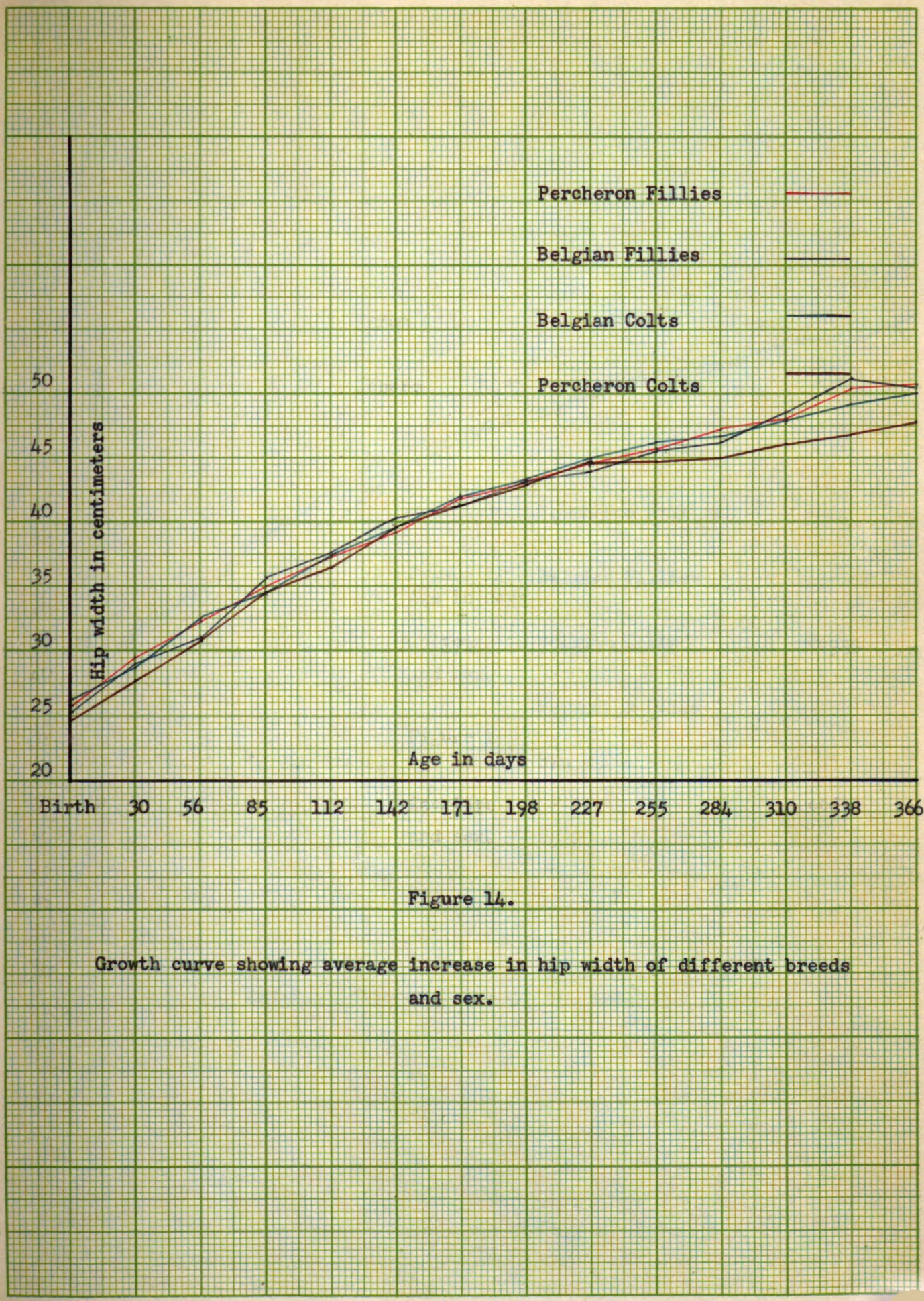


Figure 14.

Growth curve showing average increase in hip width of different breeds and sex.

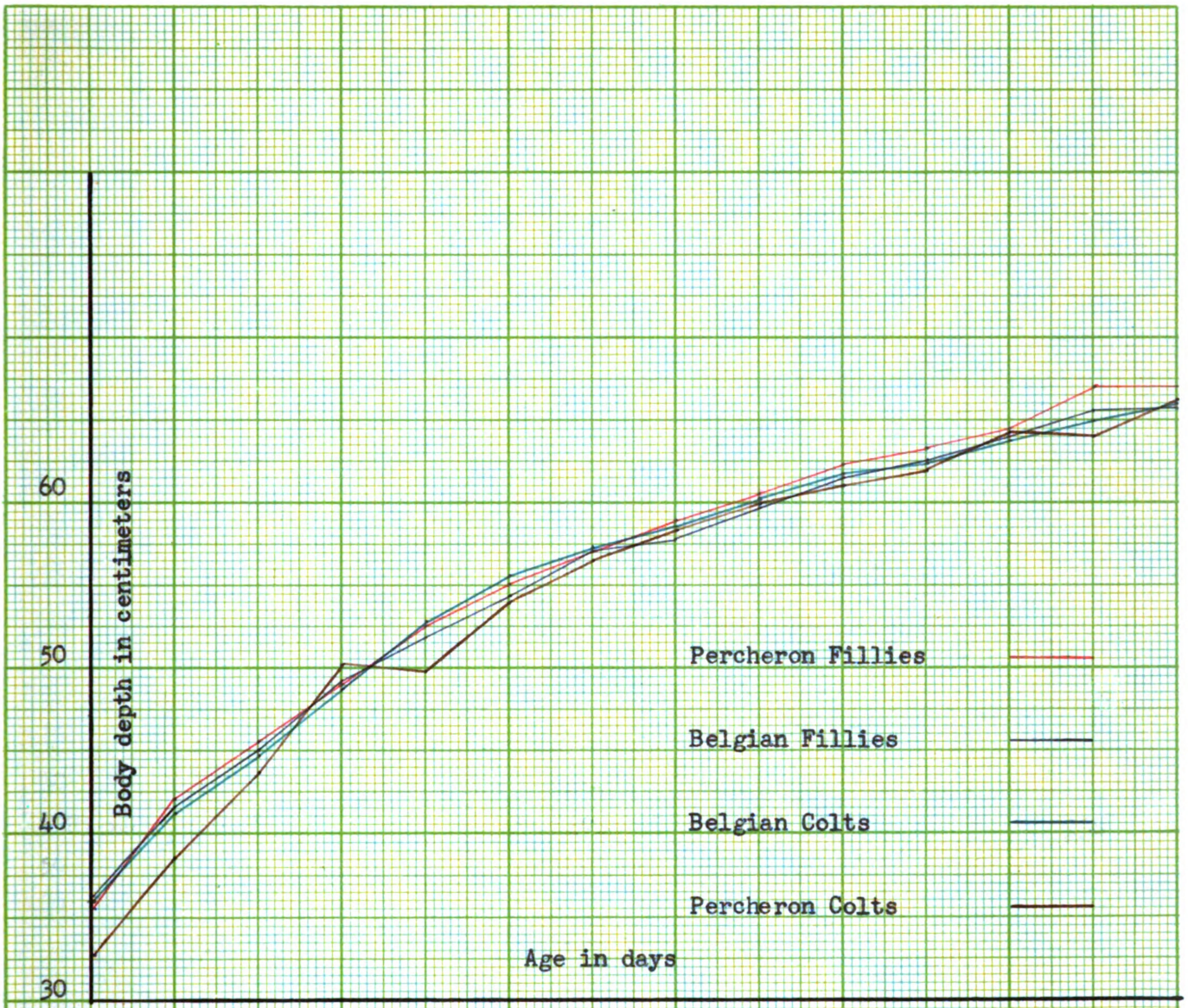


Figure 15.

Growth curve showing average increase in depth of body of Belgian and Percheron males and females.

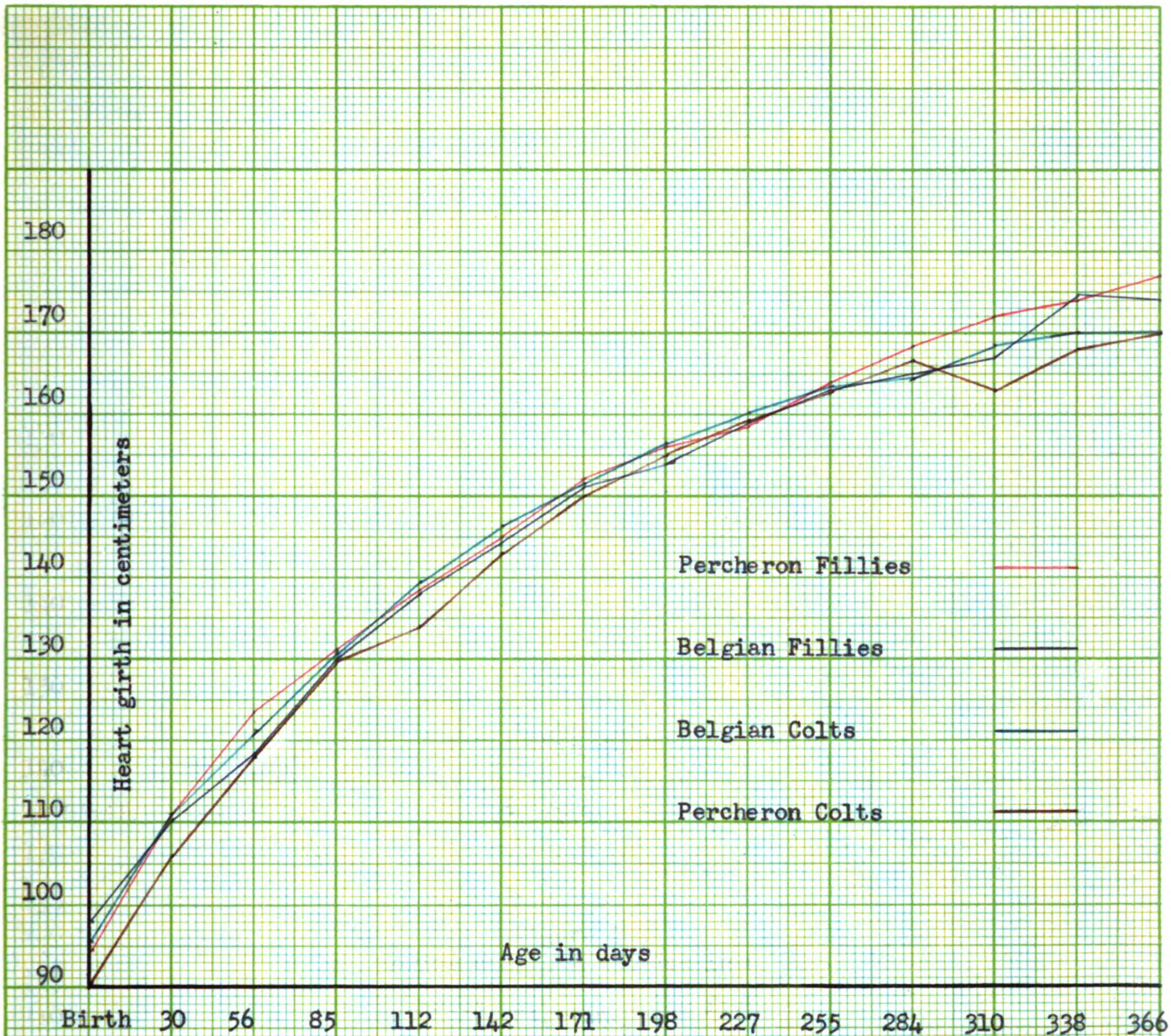


Figure 16.

Growth curve showing average increase in heart girth of different breeds and sex during first year.

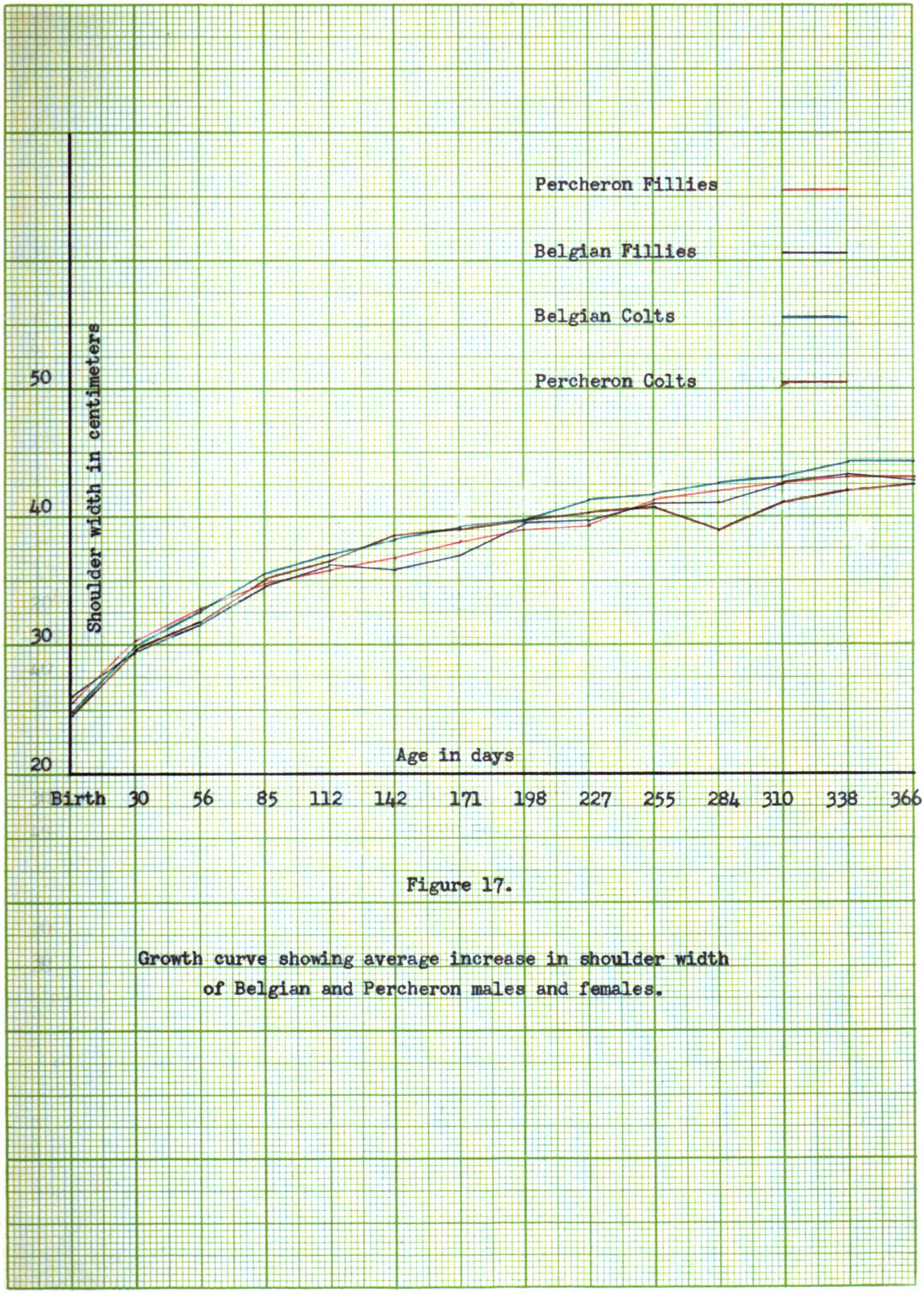


Figure 17.

Growth curve showing average increase in shoulder width of Belgian and Percheron males and females.

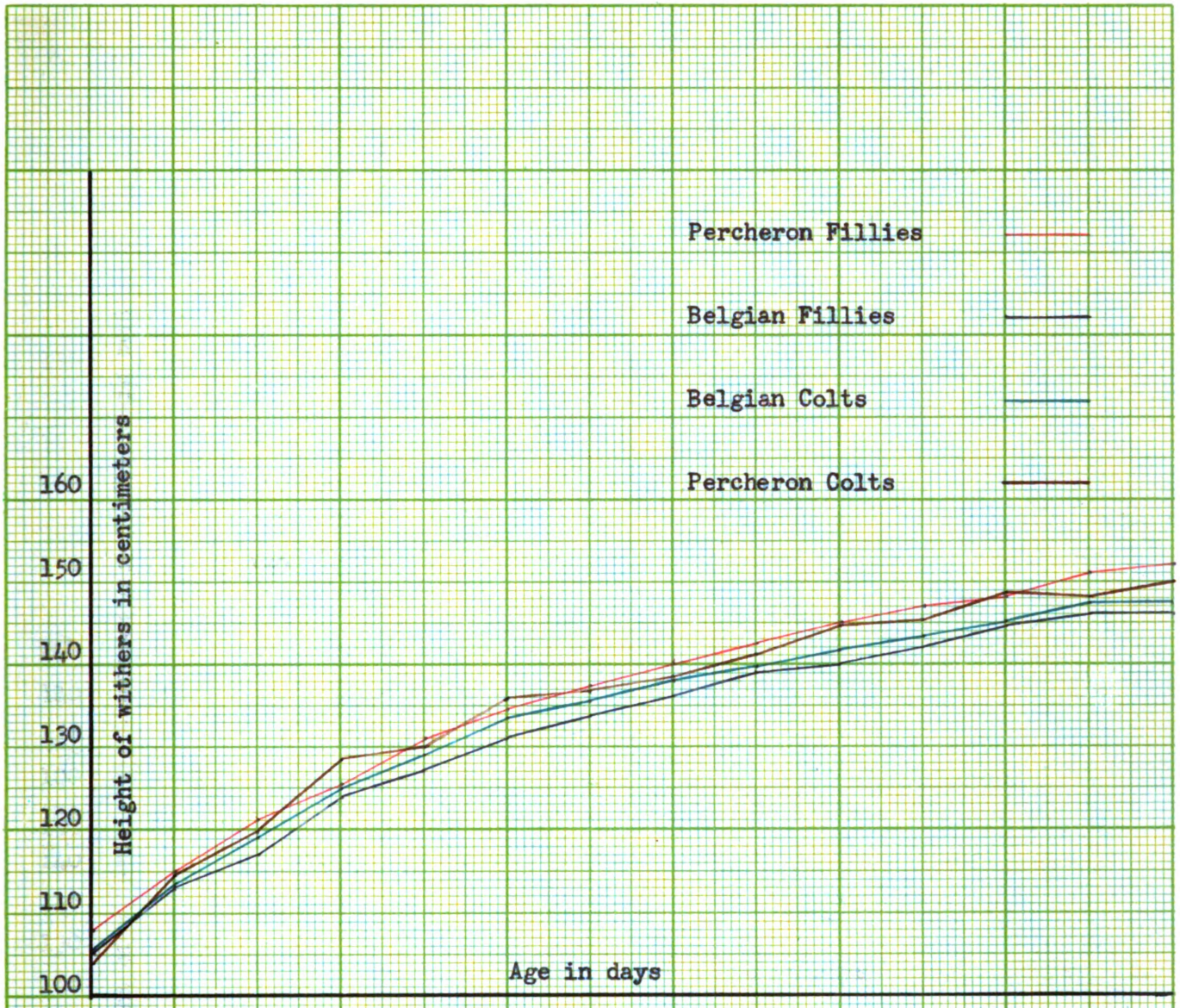


Figure 18.

Growth curve showing average increase in height of withers of different breeds and sex.

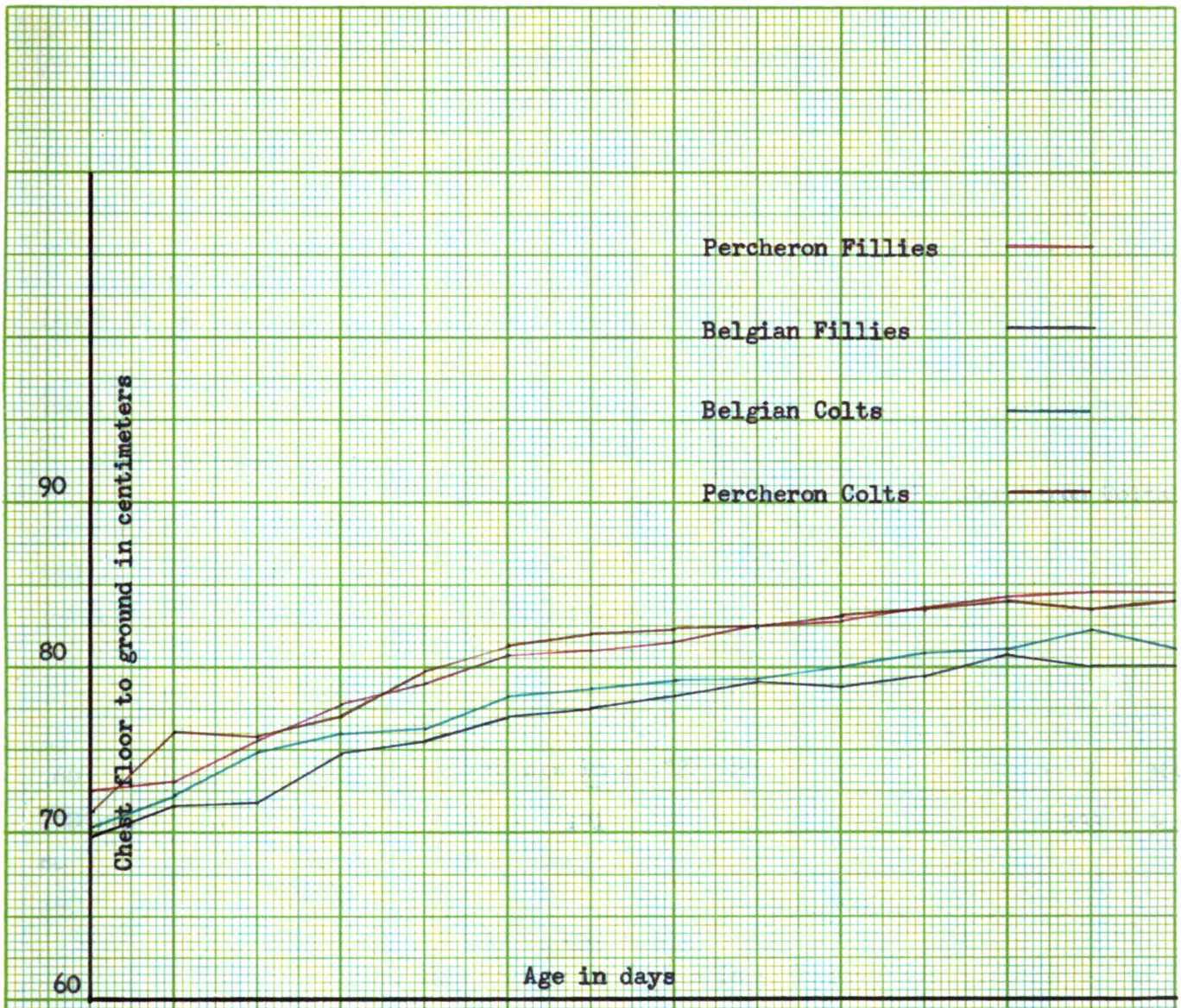


Figure 19.

Growth curve showing average increase in chest floor to ground of different breeds and sex.

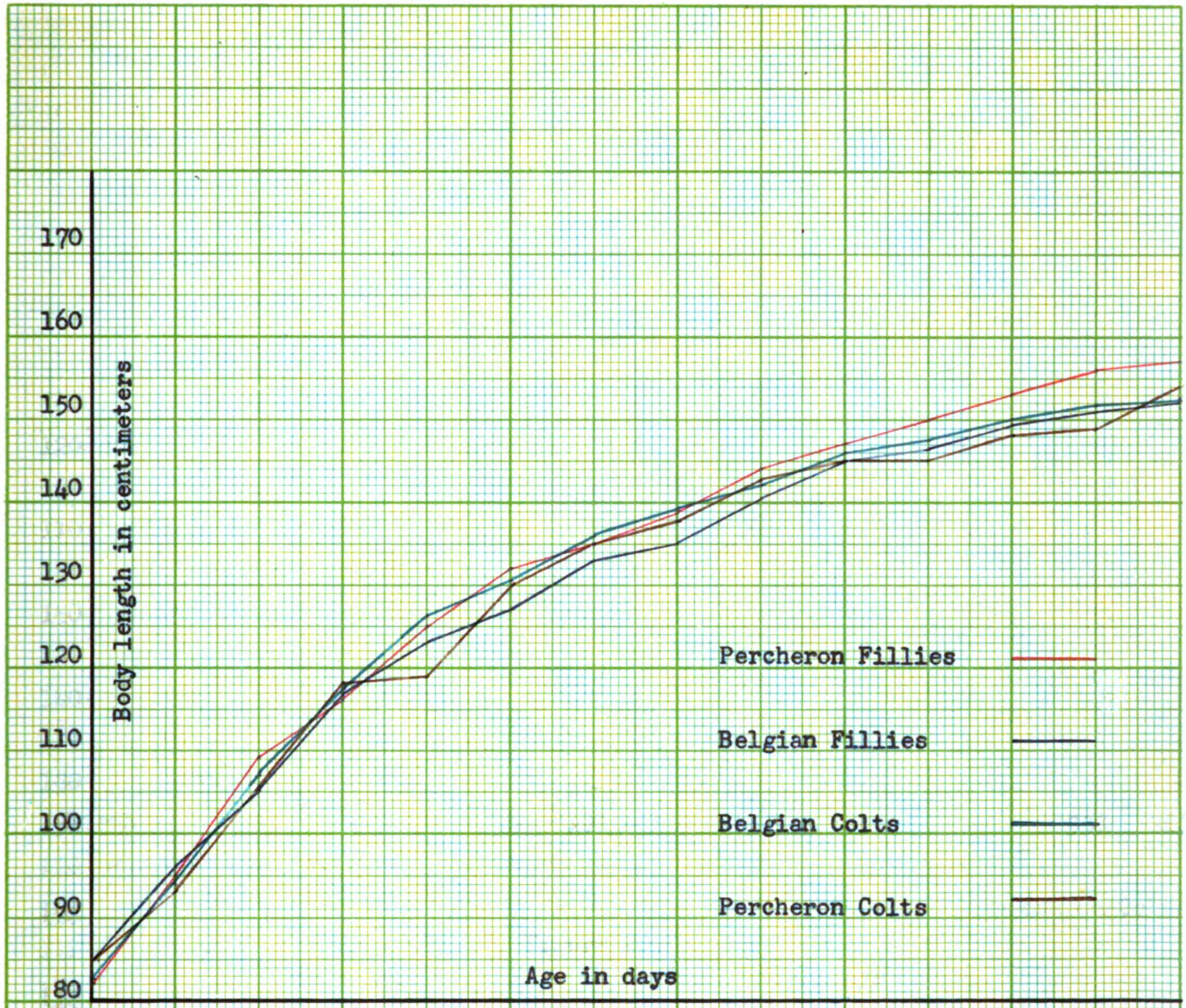


Figure 20.

Growth curve showing average increase in body length of different breeds and sex during first year.


Figure 21.

Growth curve showing average increase in weight during first year of life.

# PART III

## MULTIPLE BIRTHS IN HORSES

The occurrence of multiple births, and especially twins, is not uncommon in man and animals. The frequency of occurrence as reported by several workers, however, is not high in uniparous species such as man and cattle.

Gowen (1918) reports twins occurring in one out of 125 cases in cattle. White (1924) in a study of 1,300 births in cattle reports that twins occurred about once in 76 times.

Jones and Rouse (1928) in a study of sheep and beef cattle report that the number of twins increases with the age of the cow. Among 12 and 13-year-old cows, they found 6.92 cases of twins per 1,000 births, or about one in 144.

In a study of 940 calvings, Lamb (1935) reports 29 cases of multiple birth, a ratio of one multiple birth to 32.41 single births or 3.085 per cent.

The ratio in the different breeds was as follows:

| | |
|---|---|
| Holsteins | 1 : 23.3 |
| Jerseys | 1 : 58.33 |
| Guernseys | 1 : 82.5 |
| Ayrshires | 1 : 22.67 |
| Brown Swiss | No twins or triplets. |

Jenkins (1927) reported that multiple births occur in man less frequently than in dairy cattle.

Lush (1925) found 16 pairs of twins in 181 births in Holstein cattle, or a ratio of 1 : 11.31.

## Data on the College Purebred Herd

In this study of foaling records, the twinning ratio was found to agree very closely with that reported by Lamb in cattle. The records used as a basis for this study involved 102 purebred Belgian and Percheron mares of draft breeding. There were 403 parturitions recorded of which 13 gave twins. The ratio would, therefore, be 1 : 31 or 3.22 per cent twins. As shown in Table 7, only 3 pairs of twins, or 1 : 58 were recorded in the Belgian breed while ten pairs or 1 : 22.9 were recorded among the Percherons.

The sex ratio was very near normal, being 203 males to 206 females. Several of the twins which aborted were not recorded as to sex, which accounts for the difference of 6 between foals and parturitions.

It is of interest to note that 7 of the 13 pairs of twins aborted early in the gestation period. In 2 of the remaining cases, only one individual was alive at birth, and in 2 cases, both were dead or died soon after birth. Both of the 2 remaining mares foaled normally a pair of twin fillies.

While this may or may not be representative, it indicates that multiple births in horses are usually abnormal, often causing death of one or both twins. The second pair of twin fillies pictured on page 46 was normal, but the dam suffered much and nearly died as a result of the twin birth.

**Figure 22.**

**Colet and Twin Filly Foals**

**The second complete set of twins raised at M.S.C.**

Table 7.

FOALING SUMMARY AT MICHIGAN STATE COLLEGE

| | Belgian | Percheron | Total |
|---|---|---|---|
| Mares foaling | 46 | 56 | 102 |
| Number of parturitions | 174 | 229 | 403 |
| Male foals | 90 | 113 | 203 |
| Female foals | 87 | 119 | 206 |
| Pairs of twins | 3 | 10 | 13 |
| Twinning Ratio | 1 : 58 | 1 : 22.9 | 1 : 31 |
| Twin births | 1.72% | 4.37% | 3.23% |

Table 7.

FOALING SUMMARY AT MICHIGAN STATE COLLEGE

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| Male foals | 90 | 113 | 203 |
| Female foals | 87 | 119 | 206 |
| Pairs of twins | 3 | 10 | 13 |
| Twinning Ratio | 1 : 58 | 1 : 22.9 | 1 : 31 |
| Twin births | 1.72% | 4.37% | 3.23% |

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# PART IV

## COLOR DEVELOPMENT IN DRAFT FOALS

### Review of Literature

Color inheritance in horses has been studied by numerous workers in Europe as well as in America. The majority of these studies have been conducted with color descriptions from herd books used as a foundation.

Anderson (1914) tabulating the work of Hurst, Wilson, Harper, Sturtevant and others, which involved the color of 42,165 horses, concluded that there was a definite mode of inheritance in coat colors. Regarding the basic colors, he concluded that chestnut was recessive to black, black recessive to bay, and bay recessive to the three coordinate colors, gray, roan and dun.

McCann (1916) confirmed Anderson's conclusions, but pointed out that sorrel had been disregarded. He further stated: "Although sorrel may be only a light chestnut, evidence indicates that it is inherited separately and is, therefore, a distinct unit. Sorrel color is the easiest one for the breeder to produce at will."

Crew and Buchanan Smith (1930), also confirming previous findings, made several additions to the existing fund of information. Their hypothesis for explaining inheritance of coat colors demanded two pairs of factors. These factors were as follows: B - black, b - chestnut; I - partial inhibition of black, i - absence of this partial inhibition.

Heizer (1931) in summarizing previous work pointed out how Belgian breeders could eliminate undesirable bays by breeding to dominant roan individuals.

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Gremmel (1939), after a comprehensive physical, chemical and microscopic study of horse hair came to the following conclusions:

Coat colors of horses may be divided into two classes:

(A) Basic colors which include black, bay, chestnut, Ysabella and all of their variations.

(B) Color patterns which include gray, roan, dun, paint or pied, and all variations.

He proposed a tentative hypothesis to explain color inheritance which assumed that the basic colors are due to the qualitative and quantitative effects of genes at three major loci. Gremmel further concluded that but one pigment produces color in horses. This amber-colored pigment in different amounts and clusters of irregular shapes and sizes determines the color and shade of the hair.

Regarding the color of foals at birth, Gremmel states: "Roans are foaled roan and gray is foaled a solid color".

## Color of Foals at Birth

During the 4-year period over which this study has been in progress, the writer has observed carefully the coat color of approximately 60 foals. It was very simple to detect the 6 roan foals at birth, but the ultimate color of the 28 sorrel foals could not be determined until the first coat was shed in the fall. In several cases, sorrel or dark chestnut horses having a distinct white foot marking when fully shed, could not be distinguished at birth from light sorrels with no definite white marking. In other words, sorrels and chestnuts may or may not be the same color at birth.

Observations on 31 black foals at birth, 10 of which were ultimately gray, have revealed a condition which aids one in determining whether the foal will be black or gray. While all black foals are the

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same to the casual observer, they can be classified into 2 groups. First, there are the foals which appear jet black in color, and second, those which are, as many grooms say, a "mouse color". This so-called "mouse color" on a close examination is found due to light-tipped hairs scattered through the entire hair coat and usually more numerous over the body of the foal. Microscopic examinations of these hairs show either an entire absence of pigment at the tip or a smaller amount of pigment than normal thus producing the light or colorless condition. Foals possessing the light-tipped hair condition invariably become black in color, but the jet black coat develops into some shade of gray. The shade of gray apparently cannot be predetermined. In some cases, it is rather difficult to decide the ultimate color. In such border-line individuals, the absence of a gray parent will always decide that the color can only be black. The presence of a gray parent and a border-line case may necessitate a more rigid check. The presence of many entirely white or colorless hairs over the eyes will confirm an ultimate gray color.

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## SUMMARY

Curly hair coat, which appeared first in the Michigan State College purebred Percheron herd on March 27, 1931, seems to be due to a Mendelian recessive gene possessed by the Percheron stallions, Treviso 144394, and Sir Laet 190277, and some of their get.

Growth measurements taken from 43 growing foals when plotted form very definite growth curves.

Weights predicted from heart girth measurements by use of the formula $y - c = ae^{bx}$ are more accurate at birth than at one year of age.

There is very little difference and no consistent difference between the growth rate of male and female Percheron and Belgian foals according to these data. There is, however, a consistent difference in the height of Belgians and Percherons studied, as shown by the distance from chest floor to ground, and by the height at withers. The Percherons, according to measurements, were taller and more upstanding in body than Belgians.

Twin births have occurred at the ratio of once to every 31 parturitions in the Michigan State College herd of purebred Percheron and Belgian horses. Of the 13 pairs of twins born, only 2 pairs have lived.

The color of a Belgian or Percheron foal at birth may not indicate color at maturity. Roan, black and gray horses can be detected at birth by careful examination of the hair coat. The shade of sorrel, roan, or gray apparently can be determined most accurately after the first hair coat is shed.

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# APPENDIX

Table 8.

FOALING RECORD 1936

Belgians

| Dam | Sire | Foaled | Sex | Weight at Birth-Lbs. |
|---|---|---|---|---|
| Belle Phoenix | Rubis de Wolfe | Mar. 7 | F | 160 |
| Venche de Wolfe | DeBois Martin | Apr. 6 | S | 174 |
| Winnie de Rubis | Ginger | Apr. 25 | S | 129 |
| Phoven de Wolfe | DeBois Martin | Apr. 28 | S | 182 |
| Bellora | DeBois Martin | Apr. 30 | S | 157 |
| Pho de Wolfe | DeBois Martin | May 1 | S | 142 x |
| Calista de Rubis | Ginger | May 2 | S | 134 - |
| Phovenche de Wolfe | DeBois Martin | May 10 | F | 152 x |
| Ravenche de Wolfe | DeBois Martin | May 11 | S | 107 x |
| Ravenche | DeBois Martin | May 17 | S | 156 x |
| Jewell de Wolfe | DeBois Martin | June 2 | F | 141 |

Percherons

| | | | | |
|---|---|---|---|---|
| Coro | Mediator | Mar. 16 | F | 138 |
| Colo | Oak Forest Echo | Mar. 24 | F | 165 |
| Reno | Oak Forest Echo | Apr. 17 | F | 150 x |
| Colene | Oak Forest Echo | May 6 | S | 180 x |
| Claudaet | Oak Forest Echo | May 14 | F | 129 x |
| Leot | Oak Forest Echo | May 14 | F | 135 x |
| Coreen | Oak Forest Echo | May 15 | F | 90 ** |
| Leina | Oak Forest Echo | June 5 | S | 142 x |

x Died from severe influenza epidemic. ** Aborted. - Crippled with navel ill.

Table 9.

FOALING RECORD 1937

Percherons

| Dam | Sire | Foaled | Sex | Weight at Birth-Lbs. |
|---|---|---|---|---|
| Colet | Major H | Feb. 28 | F | 150 |
| Claude Laet | Major H | Apr. 1 | F | 143 |
| Claudet | Major H | Apr. 2 | F | 147 |
| Etola | Oak Forest Echo | Apr. 4 | S | 160 |
| Coet | Aglate | Apr. 4 | S | 154 (Killed) |
| Colo | Sir Laet | Apr. 22 | F | 176 |
| Castelle | Laet Bond | Apr. 23 | F | 135 |
| Marietta | Laet Bond | Apr. 28 | F | 141 |
| Reno | Aglate | May 3 | S | 158 |
| Coro | Aglate | May 11 | F | 144 |
| Loet | Aglate | May 15 | S | 129 |
| Maet | Major H | May 26 | S | 120 |
| Claudaet | Major H | June 1 | S | 140 |

Table 10.

FOALING RECORD 1937

Belgians

| Dam | Sire | Foaled | Sex | Weight at Birth-Lbs. |
|---|---|---|---|---|
| Lourette de Rubis | Ginger | May 20 | S | 117 |
| Premier de Rubis | Ginger | May 22 | F | Dead |
| Ravenche | Success de Cognebeau | May 28 | F | 180 |
| Venche de Wolfe | Ginger | May 31 | S | 113 |
| Belle Phoenix | Ginger | June 1 | F | 152 |
| Phovenche | Ginger | June 4 | S | 150 |
| Calista de Rubis | Ginger | June 4 | F | 140 |
| Phovenche de Wolfe | Ginger | June 7 | S | 145 |
| Bellora de Rubis | Ginger | June 8 | F | 135 |
| Pervenche | Ginger | June 9 | F | 150 |
| Winnie de Rubis | Ginger | June 10 | F | 125 (Died) |
| Bellora | Ginger | June 16 | S | 140 |
| Ravenche de Wolfe | Ginger | June 21 | S | 150 |
| Jewell de Wolfe | Ginger | June 23 | F | 159 |
| Phovenche de Wolfe | Ginger | July 1 | S | 121 |

Table 11

FOALING RECORD 1938

Belgians

| Dam | Sire | Foaled | Sex | Weight at Birth-Lbs. |
|---|---|---|---|---|
| Miller's Jewel | John De Bois II | Apr. 12 | S | 172 |
| Goldie | John De Bois II | May 20 | S | 160 |
| Lourette de Rubis | Loewenstein | June 14 | S | 145 |
| Ravenche de Wolfe | Loewenstein | June 19 | S | 165 |
| Phoven | Loewenstein | July 3 | S | 190 |
| Marjorie de Wolfe | John De Bois II | July 6 | F | 160 |

Percherons

| | | | | |
|---|---|---|---|---|
| Coet | Mediator | Aborted Dec. 17 | S & S | Twins |
| Colet | Mediator | Feb. 18 | S | 183 |
| Alice | Sir Laet | Mar. 7 | F | |
| Mable | Sir Laet | Mar. 10 | S & F | Twins |
| Colene | Mediator | April 10 | F | 167 |
| Castille | Sir Laet | April 11 | F | 162 |
| Treva | Sir Laet | April 17 | S | 170 |
| Colo | Mediator | April 30 | F | 177 |
| Coro | Sir Laet | May 27 | S | 150 |
| Marietta | Sir Laet | June 4 | F | 160 |
| Reno | Mediator | June 13 | F | 160 |
| Coreenet | Mediator | June 12 | F | 140 |

Table 12

FOALING RECORD 1939

Belgians

| Dam | Sire | Foaled | Sex | Weight at Birth-Lbs. |
|---|---|---|---|---|
| Phovenche | Loewenstein | Jan. 25 | F | 174 |
| Belle Phoenix | Loewenstein | Dead | F | |
| Pervenche | Loewenstein | Feb. 18 | S | 187 |
| Ravenche | Ginger | Mar. 9 | S | 188 |
| Venche de Wolfe | Ginger | Mar. 24 | F | 191 |
| Belle de Rubis | Loewenstein | Apr. 25 | S | 153 |
| Goldie | John De Bois II | May 19 | S | 172 |
| Ravenche de Wolfe | Loewenstein | June 2 | F | 160 |
| Phoven | Loewenstein | June 13 | S | 175 |
| Miller's Jewel | John De Bois II | June 12 | F | 150 |
| Marjorie de Wolfe | John De Bois II | June 20 | S | 160 |

Percherons

| | | | | |
|---|---|---|---|---|
| Treva | | Mar. 22 | F | 159 |
| Castille | | Mar. 31 | F | 158 |
| Mable | | Apr. 3 | F | 174 |
| Colo | Sir Laet | May 14 | F | 175 |
| Marietta | Sir Laet | May 19 | S | 168 |
| Colene | Sir Laet | May 29 | S | 196 |
| Colet | Sir Laet | June 15 | S | 178 |
| Coreenet | Mediator | June 17 | F | 170 |

| | | | | |
|---|---|---|---|---|
| | | | Seducteur | Indian 20028 |
| | | | 26252 | Eutine 9620 |
| | | Laet | | |
| | | 133886 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Sire: | Sir Laet | | | |
| | 190277 | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Rozelle | | |
| | | 123963 | Chloris | Cassius 35839 |
| | | | 78259 | Rosette 52054 (48054) |
| | | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Treviso | | |
| | | 144394 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Dam: | Colene | | | |
| | 191001 | | Glendale Pride | Superior 40605 |
| | | | 56304 | Zenetta |
| | | Coreen | | |
| | | 117580 | Alice | Kabyle 24761 |
| | | | 51491 | Louise D. |

Pedigree No. 1 - A Curly Colt Foaled in 1931.

| | | | | |
|---|---|---|---|---|
| | | | **Seducteur** 26252 | **Indian 20028** **Eutine 9620** |
| | | **Laet** 133886 | Couceorous 94852 | Harponneur 59010 Chorus 52606 |
| **Sire:** | **Sir Laet** 190277 | | | |
| | | | Dragon 52155 | Cronstadt 34112 Resida 49456 |
| | | **Rozelle** 123963 | Chloris 78259 | Cassius 35839 Rosette 52054 (48054) |



| | | | | |
|---|---|---|---|---|
| | | | Dragon 52155 | Cronstadt 34112 Resida 49456 |
| | | Treviso 144394 | Couceorous 94852 | Harponneur 59010 Chorus 52606 |
| Dam: | Colene 191001 | | | |
| | | | Glendale Pride 56304 | Superior 40605 Zenetta |
| | | Coreen 117580 | Alice 51491 | Kabyle 24761 Louise D. |

Pedigree No. 2 - Colonel Laet - A Curly Colt Foaled in 1932.

| | | | | |
|---|---|---|---|---|
| | | | Seducteur | Indian 20028 |
| | | | 26252 | Eutine 9620 |
| | | Laet | | |
| | | 133886 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Sire: | Sir Laet | | | |
| | 190277 | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Rozelle | | |
| | | 123963 | Chloris | Cassius 35839 |
| | | | 78259 | Rosette 52054 (48054) |
| | | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Treviso | | |
| | | 144394 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Dam: | Queen Eagle | | | |
| | 202035 | | Patrition | Eudistadt 132939 |
| | | | 161482 | Petrova 124324 |
| | | Mary's Eagle | | |
| | | 186891 | Mary | Kobalt 89667 |
| | | | 141563 | Juliet 116485 |

Pedigree No. 3 - Queenet - A Curly Filly Foaled in 1932.

| | | | | |
|---|---|---|---|---|
| | | | Seducteur | Indian 20028 |
| | | | 26252 | Eutine 9620 |
| | | Laet | | |
| | | 133886 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Sire: | Sir Laet | | | |
| | 190277 | | | |
| | | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Rozelle | | |
| | | 123963 | Chloris | Cassius 35839 |
| | | | 78259 | Rosette 52054 (48054) |
| | | | | |
| | | | Dragon | Cronstadt 34112 |
| | | | 52155 | Resida 49456 |
| | | Treviso | | |
| | | 144394 | Couceorous | Harponneur 59010 |
| | | | 94852 | Chorus 52606 |
| Dam: | Coro | | | |
| | 197515 | | | |
| | | | Glendale Pride | Superior 40605 |
| | | | 56304 | Zenetta |
| | | Coreen | | |
| | | 117580 | Alice | Kabyle 24761 |
| | | | 51491 | Louise D. |

**Pedigree No. 4 - A Curly Colt Foaled in 1933.**

| | | | | |
|---|---|---|---|---|
| | | | Seducteur<br>26252 | Indian 20028<br>Eutine 9620 |
| | | Laet<br>133886 | | |
| | | | Couceorous<br>94852 | Harponneur 59010<br>Chorus 52606 |
| Sire: | Sir Laet<br>190277 | | | |
| | | | Dragon<br>52155 | Cronstadt 34112<br>Resida 49456 |
| | | Rozelle<br>123963 | | |
| | | | Chloris<br>78259 | Cassius 35839<br>Rosette 52054 (48054) |
| | | | | |
| | | | Dragon<br>52155 | Cronstadt 34112<br>Resida 49456 |
| | | Treviso<br>144394 | | |
| | | | Couceorous<br>94852 | Harponneur 59010<br>Chorus 52606 |
| Dam: | Marge<br>216012 | | | |
| | | | Ingomar<br>30047 | Polinaire 15897<br>Lottie 13610 |
| | | Mars<br>146872 | | |
| | | | Paula<br>80505 | Athenes 53116<br>Gustine 60359 |

Pedigree No. 5 - Curly Laet - A Curly Colt Foaled in 1932.

| | | | | |
|---|---|---|---|---|
| | | | Seducteur<br>26252 | Indian 20028<br>Eutine 9620 |
| | | Laet<br>133886 | | |
| | | | Couceorous<br>94852 | Harponneur 59010<br>Chorus 52606 |
| Sire: | Sir Laet<br>190277 | | | |
| | | | Dragon<br>52155 | Cronstadt 34112<br>Resida 49456 |
| | | Rozelle<br>123963 | | |
| | | | Chloris<br>78259 | Cassius 35839<br>Rosette 52054 (48054) |
| | | | Urametre<br>181078 (145695) | Kroquet 91851<br>Navigation 113959 |
| | | Illini Charger<br>195958 | | |
| | | | Cavill<br>148721 | Dragon 52155 (63516)<br>Chloris 78259 |
| Dam: | Claudette<br>222940 | | | |
| | | | Treviso<br>144394 | Dragon 52155 (63516)<br>Couceorous 94852 |
| | | Claudie<br>200583 | | |
| | | | Dunham's Claudia<br>176703 | Kaboul 94591 (86725)<br>Dunham's Calista 134216 |

Pedigree No. 6 - A Curly Filly Foaled in 1939.

| | | | | |
|---|---|---|---|---|
| | | | Laet<br>133886 | Seducteur 26252<br>Couceorous 94852 |
| | | Sir Laet<br>190277 | | |
| | | | Rozelle<br>123963 | Dragon 52155<br>Chloris 78259 |
| Sire: | Koncel Laet<br>216069 | | | |
| | | | Koncarcalyps<br>175791 | Calyps 79632<br>Koncarness 150774 |
| | | Koncella B<br>204637 | | |
| | | | Marcella B<br>171979 | Honleux B 107824<br>Marcella 108864 |
| | | | Koncarcalyps<br>175791 | Calyps 79632<br>Koncarness 150774 |
| | | Konbellcar<br>204738 | | |
| | | | Bell K<br>184983 | Konolian 150779<br>Black Bell 118714 |
| Dam: | Lady Koncarcleviso | | | |
| | | | Treviso<br>144394 | Dragon 52155 (63516)<br>Couceorous 94852 |
| | | Clauro<br>191003 | | |
| | | | Dunham's Claudia<br>176703 | Kaboul 94591 (86725)<br>Dunham's Calista 134216 |

Pedigree No. 7 - A Curly Filly Foaled in 1939.

| | | | | |
|---|---|---|---|---|
| Sire: Koncel Laet 216069 | Sir Laet 190277 | Laet 133886 | Seducteur 26252 | |
| | | | Couceorous 94852 | |
| | | Rozelle 123963 | Dragon 52155 | |
| | | | Chloris 78259 | |
| | Koncella B 204637 | Koncarcalyps 175791 | Calyps 79632 | |
| | | | Koncarness 150774 | |
| | | Marcella B 171979 | Honleux B 107824 | |
| | | | Marcella 108864 | |
| Dam: Clauro 191003 | Treviso 144394 | Dragon 52155 (63516) | Cronstadt 34112 | |
| | | | Resida 49456 | |
| | | Couceorous 94852 | Harponneur 59010 | |
| | | | Chorus 52606 | |
| | Dunham's Claudia 176703 | Kaboul 97591 | Gazier 63850 | |
| | | | Mouvette 30969 | |
| | | Dunham's Calista 134216 | Kapon 97589 | |
| | | | Christiana 104961 | |

**Pedigree No. 8 - A Curly Filly Foaled in 1940.**