A STUDY OF *TRYPANOSOMA EQUIPERDUM* INFECTION IN THE RAT, WITH PARTICULAR REFERENCE TO BLOOD SUGAR, ERYTHROCYTES, HEMOGLOBIN, PLATELETS, PLASMA PROTEINS AND CAUSE OF DEATH

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INTRODUCTION AND HISTORICAL REVIEW

Since the turn of the century, much has been written about trypanosomes. Many workers have described their life history, pathogenicity, serology and effect of the trypanosomes on the blood chemistry of infected animals. However, in spite of this wealth of information, no author has presented a satisfactory theory of the cause of death in experimental trypanosomiasis substantiated by conclusive experimental data. There are several well known theories, but there is too much conflicting evidence to give credence to any one of them.

In order to establish a satisfactory method of treatment of trypanosomiasis, a knowledge of the mechanism by which the parasites cause death of the host should be available. Because of the conflicting evidence on this subject, a study was undertaken to re-examine the known data and investigate further the mechanism by which Trypanosoma equiperdum causes death of the albino rat.

Trypanosomes are single celled parasites of the phylum Protozoa, and genus Trypanosoma. The exact number of species is not known because of the lack of knowledge of the complete life cycle of each species. Many trypanosomes are given new names on the basis of morphological characteristics, only to find they represent a phase of the life cycle of a species already known.

The trypanosome is an elongated cell, tapering at each end which gives it the appearance of a curved willow leaf. The nucleus is located midway between the two tapering ends. At one end of the cell is a free flagellum with which the trypanosome pulls itself through the medium. On the basis of movement, this is designated the anterior end of the cell. The posterior end of the cell contains the kinetoplast, composed of two deeply staining bodies. The larger is the parabasal body and the smaller located near the surface of the cell in life is the blepharoplast. Arising from the blepharoplast, a filament termed the axoneme, extends to the surface of the cell and continues free of the surface of the cell to the anterior end where it attaches, then extends for some distance beyond as a free flagellum. It is on the basis of this flagellum that this species is called flagellates. Those found in the blood exclusively are termed hemoflagellates. Between the margin of the axoneme and the body of the cell is a delicate membrane, the undulating membrane, which provides the chief means of locomotion. Reproduction takes place by longitudinal fission. After division of the kinetoplast and nucleus with formation of a new flagellum, fission commences at the anterior end and extends posteriorly until two flagellates are formed.

For convenience, trypanosomes can be classified on the basis of pathogenicity. There are those which are pathogenic to man and those which are pathogenic only to animals. Trypanosoma equiperdum is rapidly fatal to the albino rat

while human serum is trypanolytic to this parasite. Trypanosoma gambiense causes African sleeping sickness in man and is fatal if untreated while when inoculated into the rat, it may fail to produce an infection, or may produce a mild, chronic disease which lasts for a year or more (66).

Trypanosomes may be classified further on the basis of the symptomology of the disease (38). One group: Trypanosoma brucei, Trypanosoma evansi, Trypanosoma equinum and Trypanosoma equiperdum produce an acute blood infection in rats where the disease is of short duration comparable to a bacterial septicemia. Another group: Trypanosoma cruzi, Trypanosoma rhodesiense and Trypanosoma gambiense in the human cause a chronic type of infection where the disease is of long duration and there is tissue involvement.

Trypanosoma equiperdum was discovered and named by Doflein in 1901 (64). The same parasite was observed a few days later by Laveran and Mesnil who named it Trypanosoma rougeti. However, the nomenclature of Doflein has been retained and the name suggested by Laveran and Mesnil has become a synonym.

This species of Trypanosoma differs from the majority of the trypanosomes in not having an intermediate host. At present there is no invertebrate host known for this parasite compared with the tsetse fly for Trypanosoma gambiense and Trypanosoma rhodesiense, the rat flea for Trypanosoma lewisi and the reduviid bug for Trypanosoma cruzi. Trypanosoma equiperdum is transmitted by direct mucous membrane contact and in its natural host, the horse, during coitus. For this reason, this

parasite is often referred to as the etiological agent of dourine or "horse syphilis." The disease in the horse is of a chronic nature. After infection, the first symptoms are noted in about two weeks which consist of edema of the sexual organs. In about a month, characteristic lesions in the shape of plaques appear on the skin of the horse. These plaques are hard subcutaneous discs and may persist for a few hours or days. The horse becomes weak, emaciation and anemia occur and finally paraplegia and various nervous symptoms appear which terminate in the death of the animal. The disease may last from a few months to more than a year.

As the size of the animal host becomes smaller, the intensity of the disease increases. The disease lasts four to five months in the dog, three to four months in the rabbit, one to two months in the guinea pig and three to five days in the mouse and rat. Trypanosomiasis in the rat due to this parasite follows a characteristic course which comes to a spectacular termination in about 90 hours.

The first trypanosome was described in 1841 by Valentin of Berne, who observed them in the trout, Salmo fario (65). Very little was written on trypanosomes until the latter part of the 19th century. Laveran and Mesnil summarize the knowledge on these flagellates up to the year 1912. From this period up to 1930, the literature is well covered in the works of Andrews, Johnson and Dormal (1), Linton (35) and Perla (39). However, an attempt has been made to review the trypanosome literature for the past twenty years with

particular emphasis on the metabolism of the parasite and the cause of death in trypanosomiasis.

The oldest theory to explain the cause of death was one involving the elaboration of a toxin by the trypanosome which killed the host (45). This theory has been relegated to a position of historical interest on the basis of inability of later workers to demonstrate the presence of a toxin. Kligler, Geiger and Comaroff (31) failed to find any toxic effects from the injection of massive doses of dead trypanosomes into rats. Further, injection of plasma from the rat at death due to trypanosomiasis failed to elicit any toxic manifestations whereas inoculation of the same rats with a viable culture of the parasites did not fail to produce the disease. Andrews, Johnson and Dormal (1) likewise failed to observe any toxic reactions from the injection of dead trypanosomes into the rat.

An acidosis theory has been proposed by Kligler, Geiger and Comaroff (31). These workers discovered a great increase in the lactic acid content of the blood of the rat at death from trypanosomiasis. They found the lactic acid content to increase to a value three to four times the normal value at death and demonstrated in a few animals that life could be prolonged 50 per cent by the administration of sodium bicarbonate. In a later paper, these authors (32) demonstrated that Trypanosoma evansi, in the presence of oxygen, would rapidly ferment glucose with the production of lactic acid in vitro. The optimum pH of the medium was about 7.4, but

decreased with the formation of lactic acid to a limiting pH of 6.3 to 6.4 and an inhibiting pH of 6.8. Geiger, Kligler and Comaroff (14) found that for every molecule of glucose consumed by the trypanosomes, two molecules of lactic acid were formed. Death of the infected animal, according to these authors, is caused by the accumulation of the products of trypanosome metabolism, chiefly lactic acid, leading to a decrease in the pH and production of a fatal acidosis. Andrews, Johnson and Dormal (1) report finding a decrease in the pH as well as a decrease in the CO_2 combining power of the blood during the course of the trypanosome infection. Scheff (48) also observed a decrease in the CO_2 combining power and the pH of the blood of the infected rat. He further pointed out a lowering of the oxygen carrying power of the blood during infection and attributed death to the production of an "inner asphyxia" due to utilization of the oxygen by the parasites. Andrews, Johnson and Dormal (1) also report a lowering of the oxygen carrying power of the blood of the infected animal. Kligler, Geiger and Comaroff (31) however, failed to find any significant difference between the oxygen utilization of the infected and normal rat.

A mechanical asphyxiation theory has been proposed by Andrews, Johnson and Dormal (1) whereby death is caused by partial obstruction of the circulation by the agglutination of the trypanosomes in the heart and lungs. After the trypanosomes have reached a certain concentration in the blood, they agglutinate for "reasons unknown at present" and

cause emboli which interfere with the circulation of the blood through the left heart resulting in pulmonary edema and death from asphyxiation. Voegtlin, Dyer and Miller (63) also attribute death to a mechanical cause "due to the presence of the large number of parasites which may lead to the formation of emboli in vital parts of the circulatory system". Raffel (42) similarly concludes that death is primarily due to mechanical obstruction by the agglutinated parasites in the heart and lungs resulting in asphyxia.

A radically different theory has been proposed by Zwemer and Culbertson (70) who observed that the typical convulsions associated with the trypanosome death is similar to those found in potassium poisoning. They investigated the serum potassium level of the rat infected with Trypanosoma equiperdum and found this element to increase 100 per cent above the normal value at death, and suggested that death in trypanosomiasis is due to potassium poisoning.

Death due to hypoglycemia is one of the oldest and most controversial theories on the cause of death. Schern (49) observed in 1928 that trypanosomes suspended in serum lost their motility after a short time but could be revived by suspension in fresh serum. He ascribed the stimulating factor in fresh serum to glucose and discovered that blood sugar was diminished during the course of infection in a small number of rats. Schern was the first to suggest that death was due to a fatal hypoglycemia arising as a result of the trypanosome infection. Fenyvessy (12) similarly observed

the decrease in the blood sugar at death and attributed it to a disturbance in the insulin mechanism as a result of the trypanosome infection. Scheff (48) also found the blood sugar to be lowered during the course of infection and the glycogen of the liver depleted at death but pointed out that while the trypanosomes primarily use carbohydrates, eventually other substances are consumed to produce irreversible changes which cause death by an "inner asphyxia." Working with Trypanosoma lewisi, Linton (36) found no significant change in the blood sugar of the rat during the infection. In a later paper, Linton (35) observed the liver glycogen to be lower than normal early in the infection with Trypanosoma equiperdum in rats and completely absent at death. The blood sugar remained normal during the course of infection until very late in the disease. He reports the hypoglycemia only as a terminal phenomenon and does not make any definite conclusion as to the cause of death, although he suggests kidney damage due to the trypanosomes as an important contributory factor.

Evidence of the utilization of glucose in vitro is furnished in the excellent work of Yorke, Adams and Murgatroyd (69) who found that 400 million trypanosomes were capable of metabolizing 2.0 to 2.5 milligrams of glucose per hour. Christophers and Fulton (6) maintain that "the most important circumstance modifying the oxygen uptake by trypanosomes is the presence or absence of glucose in the medium". Reiner, Smythe and Pedlow (46) also recognize the

importance of glucose in the medium for the proper growth of the trypanosome and endeavor to explain the in vitro metabolism of glucose by the trypanosomes. Further information on the in vitro metabolism of glucose by trypanosomes is found in the excellent work of Fulton (13).

To summarize briefly, four theories to explain the cause of death in trypanosomiasis are currently quoted in the literature: acidosis, mechanical asphyxia, potassium poisoning and hypoglycemia.

EXPERIMENTAL

Trypanosomes. The strain of Trypanosoma equiperdum used throughout this work was obtained from the National Institute of Health, Bethesda, Maryland.* Two albino rats were received, each with a moderate infection of the parasite. A transfer was made by diluting a quantity of the infected rat blood with a glucose-citrate-saline diluting fluid and inoculating two rats and two guinea pigs. Rats, in which the disease runs an acute course and guinea pigs, in which the disease is of a chronic nature were both used to maintain the strain in this laboratory. For all experimental work the trypanosomes were used from the rat host exclusively.

Animals. Normal albino rats purchased from the Research Supply Company, Philadelphia, Pennsylvania were used in this work. Two rats were kept in a small cage equipped with a drinking bottle and a hopper containing cubes of a compressed dog ration manufactured by the Carnation Company. Food and water were available to the animals at all times. A movable frame holding twenty four of these small cages furnished space for forty eight rats. The small cages which were

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*The author wishes to thank Mr. T. F. Probey of the National Institute of Health for supplying and identifying this strain of Trypanosoma equiperdum, for use in this work (41) (34).

bottomless, rested on 1/4 inch wire screen below which were dropping pans. The animals during the experiments were kept in these cages in the laboratory apart from the animal room for at least a week prior to use. Rats for infection were selected within a weight range of 160 to 200 grams without preference as to sex. Each rat was assigned a serial number and marked for identification. Where possible or necessary, more than one determination was made on a single rat. For this reason, the same "Rat No." appears in more than one table.

Number of animals used. An attempt has been made to use a sufficient number of animals for each determination to permit a statistical evaluation of the accuracy of the experimental results. As suggested by Trevan (62), a minimum of at least 30 animals have been used in each series of determinations, unless otherwise noted. A summary of the number of animals used in each experiment is given in Table 1.

Method of Infection. Based on the work of Morrell, Chapman and Allmark (37), an infecting dose of 2 million parasites was used throughout this work. An infected "seed" rat was weighed and placed in a convenient holding apparatus (to be described later) from which the tail was readily accessible. A small portion of the tip of the tail was snipped off with a scissors and the first drop of blood discarded. The tip of a red cell Thoma diluting pipette was held in the second drop of blood and the blood drawn to the

0.5 mark and diluted by drawing up a glucose-citrate-saline diluting fluid to the 101 mark, thus making a 1:200 dilution. This diluting fluid is a slight modification of that used by Morrell, Chapman and Allmark (37). The amount of sodium citrate was reduced from 1.00 per cent to 0.75 per cent to diminish the distortion of the red cells. This change did not alter the ability of the solution to prevent coagulation of the blood. The diluting fluid used in this work was as follows:

Sodium Citrate	3.0 grams
Sodium Chloride	3.0 grams
Anhydrous Dextrose, C.P.	0.8 gram
Distilled Water, q.s.	400.0 cc.

The solution was boiled gently for five minutes to prevent the growth of molds and bacteria and when kept in a flask with a small beaker over the stopper, remained free from obvious growth for at least three weeks during which time it was opened one or more times daily to remove a portion of the solution for counting the trypanosomes. In a hanging drop preparation, the trypanosomes remained alive and active for at least 5 hours. This time was far in excess of the period in which dilutions were made for counting the trypanosomes on the hemocytometer.

After making the 1:200 dilution, the diluted blood was shaken in the pipette for 3 minutes after which half the contents of the bulb was discarded onto a piece of absorbent

paper by blowing through the rubber tubing connected to the pipette. An Improved Double Neubauer Ruling counting chamber was charged with a small drop of the remaining dilution and allowed to settle for 5 minutes. Using a mechanical counter, the number of trypanosomes in the central square millimeter, which is divided into 400 squares, was counted. If 100 motile trypanosomes were counted in this area, the concentration is 100 trypanosomes in 0.1 cmm. of the diluted blood. Since the depth of the hemocytometer chamber is 0.1 mm., multiplying by 10 would mean 1000 trypanosomes in 1 cmm. of the diluted blood and multiplication by the dilution factor, 200, would mean 200 thousand trypanosomes in 1 cmm. of the infected blood. Therefore, there should be 200 million trypanosomes in 1 cc. of the rat's blood, or 20 million trypanosomes in 0.1 cc. of blood. By means of a sterile, 20 gauge hypodermic needle and a 1 cc. Tuberculin syringe, exactly 0.1 cc. of blood was drawn from the heart of the rat held on an operating board without the use of anesthesia. The blood was immediately added to 9.9 cc. of the glucose-citrate-saline diluting fluid and thoroughly mixed. One cc. of this diluted blood containing 2 million trypanosomes was immediately inoculated intraperitoneally into each rat to be infected. The entire procedure from the time the blood was first withdrawn from the heart of the "seed" rat until a series of 10 normal rats was infected could be accomplished in a period of 6 minutes. The infecting dilution was agitated between each

inoculation to insure adequate distribution of the parasites throughout the inoculum. The short period of time between removing the blood from the infected host and transferring it to a new host was maintained to obviate any great change in the number of trypanosomes in the infecting medium. A cover slip preparation was always examined at the conclusion of infection of a series of rats to insure that the trypanosomes were present and motile in the inoculum.

The holding apparatus mentioned above, consists of a 500 cc. wide mouth glass jar from which the bottom has been carefully removed. A screen of 1/16 inch mesh is placed over the open bottom and held in place by adhesive tape. A large rubber stopper with a one centimeter hole in the center is used to close the mouth of the jar. The jar is supported, bottom side up, by means of a large claw clamp attached to a ring stand. The rat is induced to enter the jar and his tail inserted through the hole in the stopper which is then put in place to make a closed container for the rat with only his tail protruding. The jar is adjusted so that the rat is sitting upright and the tail hanging down. In this position, venous return in the tail is decreased due to gravity and blood is readily obtained by snipping the tail without interference on the part of the rat.

Infection of a series of rats was made between nine and ten o'clock in the morning so that observations could be made at exactly 24 hour intervals. Unless otherwise noted, the

observations reported in this work were made at 24, 48, 72 hours after infection and at death. Each "at death" observation reported in this work was taken during the convulsive seizure approximately five minutes preceding death.

Method of Counting the Trypanosomes. A viable count using a red cell Thoma pipette and hemocytometer was used in preference to other methods of indicating the degree of infection, such as estimating the count by determining the ratio of the number of trypanosomes to the number of red blood cells in a fixed preparation (29) (39) (57). It is always questionable when examining a fixed preparation whether the trypanosomes being counted are all alive at the time the smear is made, or whether both live and dead trypanosomes are included. It is known that dead trypanosomes are quickly screened out of the blood by the reticulo-endothelial system, but the possibility of counting dead trypanosomes which might have escaped and appear in the fixed preparation along with those that are alive cannot be over-looked. Because observation of live trypanosomes, which can be assumed to be capable of causing infection in the rat; and because it is possible to observe the motile parasites and count their number in a definite volume of solution, the procedure for counting the trypanosomes described under Method of Infection, page 11, was adopted for use in this work.

A comparison of the results obtained by counting the

trypanosomes by the hemocytometer and estimating their number by the smear method was made (Tables 2, 3, and 4). It will be observed that the agreement between the two methods is not as close as it should be for quantitative work. Calculation of trypanosome count by the smear method depends on the number of trypanosomes per 1000 red blood cells. The red blood cell count of 100 normal adult albino rats gave a mean value of 8.48 ± 0.679 million (Table 12). This mean was used to calculate the number of trypanosomes per cubic millimeter of blood and the results obtained were 2.58 times higher than the hemocytometer count after 24 hours infection. The values were 1.88 and 1.85 times higher than the hemocytometer count after 48 and 72 hours infection respectively. When the red blood cell count at death, 5.62 million, was used as a conversion factor, the results by the smear count were also higher than by the hemocytometer count. Values 1.71, 1.23 and 1.23 times higher than those obtained by the hemocytometer count were obtained for 24, 48 and 72 hours after infection respectively. If the trypanosome count by the smear method was estimated on the basis of counting less than 1000 red blood cells, the variation from the hemocytometer values was even greater.

Kligler and Comaroff (29) found they could use the hemocytometer and smear method of estimating the trypanosome infection interchangeably. They point out, however, that since there is a progressive anemia during the course of infection, it is advisable to make a red blood cell count of

the rat in the later stages of the infection prior to calculating the number of trypanosomes by the smear method. The differences found between the smear and hemocytometer methods (Tables 2, 3, and 4) does not justify the use of the two methods interchangeably. Further, as Kligler and Comaroff (29) suggest, if a red blood cell count is made prior to the smear count, it would be easier to make a direct count of the viable trypanosomes by means of the hemocytometer instead of making two counts to estimate the number of trypanosomes.

The blood diluting pipette and hemocytometer are subject to error. From the results of an excellent study by Berkson, Magath and Hurn (2), it was shown that considering two times the standard error as significant, a plus or minus 16 per cent deviation may be expected. The possibility of error in this method leaves much to be desired, but until a more accurate method of estimating the cellular elements in blood is developed, the hemocytometer method is the most accurate for counting trypanosomes and was adopted for use in this work.

Method of Counting the Erythrocytes. The rat was placed in the holding apparatus and a portion of the tip of the tail snipped off. The first drop of blood being discarded and a dilution of blood from the second drop made by inserting the tip of a red cell Thoma pipette into the drop and drawing the blood exactly to the 0.5 mark. The blood was diluted 1:200 immediately by drawing Hayem's diluting fluid into the pipette to the 101 mark. Blood for a count was never forced from the

tail. The pipette was shaken on a mechanical shaker for three minutes and half the contents of the pipette discarded by blowing through the rubber tube attached to the pipette. A small drop of the remaining dilution was placed on the chamber of an Improved Double Neubauer Ruling hemocytometer counting chamber and allowed to settle for five minutes. The number of red blood cells in 80 squares of 1/400 square mm. each of the central square millimeter of the hemocytometer chamber was counted. A definite pattern for counting was used by counting the cells in 1/25 square mm. at each corner of the central square millimeter and counting one 1/25 square mm. in the middle of this central square millimeter. The number of red cells in 80 squares of 1/400 square mm. each indicates the number of cells in an area of 80/400 or 1/5 square mm. Multiplication of this figure by 10,000 (5 to convert to 1 square mm., 10 for depth of the chamber and 200 for dilution) gives the erythrocyte count per cubic millimeter of blood. The microscope employed was an Ernst Leitz Wetzlar instrument equipped with a X45 objective and a X10 ocular.

Because of the various values given for the normal erythrocyte count of the adult albino rat (37) (8) (15) (47), a series of 100 counts were made and the value of two standard deviations calculated (Table 12).

Hemoglobin Determination. A clinical model of the Haden-Hausser Hemoglobinometer, manufactured by the A. H. Thomas Company, was adopted for use in this work because of the

small quantity of blood necessary to make the determination. It is advisable to avoid withdrawing too large a quantity of blood to reduce the effect on the subsequent hemoglobin values. A white cell Thoma pipette was used to make a dilution from the second drop of blood from the tail after it was snipped. The blood was drawn to exactly the 0.5 mark and diluted 1:20 by drawing N/10 hydrochloric acid up into the pipette to the 11 mark. The pipette was shaken for one minute to insure adequate mixing of the blood with the acid and then allowed to stand for 30 minutes to permit development of maximum color of the acid hematin solution. Then the solution in the capillary was discarded and the contents of the bulb discharged onto the special chamber of the instrument. The intensity of color of the solution was compared with the stained glass standard squares of the hemoglobinometer corresponding to definite quantities of hemoglobin per 100 cc. of blood, thus permitting a direct determination of hemoglobin in grams per 100 cc. of blood. A 75 watt Mazda lamp at 450 centimeters was used as the source of illumination.

Expression of hemoglobin in terms of grams per 100 cc. of blood is preferred to the use of per cent hemoglobin. If desired, these values may be converted to per cent hemoglobin by means of Haden's equivalent for humans of 15.4 grams per 100 cc. of blood for a count of 5 million red blood cells per cmm. taken as 100 per cent (19).

Sedimentation Rate and Packed Cell Volume Determination.

A Wintrobe hematocrit tube (59) was used for these determinations. Approximately 1 cc. of blood was withdrawn from the rat by cardiac puncture without the aid of anesthesia and placed in a 5 cc. wide mouth bottle containing approximately 1 milligram of heparin. The bottle was stoppered and the blood immediately mixed with the heparin by inverting several times. Within a half hour after withdrawal, the blood was transferred to the Wintrobe tube by means of a capillary pipette and filled to the 10 cm. mark. The tube was placed in an exactly vertical position in a special holder. The amount of fall of the erythrocytes during the period of one hour was recorded from a direct reading of the millimeter scale on the tube.

After taking the sedimentation reading, the tube was centrifuged for 30 minutes at 1800 revolutions per minute. The height of the packed cells from the bottom of the tube was read directly from the millimeter scale on the tube and the total volume in a 100 mm. column of blood calculated in per cent.

Coagulation Time Determination. Capillary tubes with a 1.0 to 1.5 mm. bore were drawn from pyrex glass tubing. The tubes were cut to 100 mm. lengths and stored in a dust proof container.

At the time the rat's tail was snipped, a stopwatch reading to 0.2 second was started. Blood from the second drop was allowed to fill the capillary tube and a 5 mm. section

broken off at 30 second intervals for the first 90 seconds, after which a section was broken off at 10 second intervals. Immediately upon observing a strand of fibrin to join the broken ends of the capillary, the stopwatch was stopped and the time in seconds taken as the coagulation time for the blood.

Blood Platelet Determination. The platelets were counted in the same manner described for the method of counting the erythrocytes (page 17) except that the glucose-citrate-saline diluting fluid was used instead of Hayem's diluting fluid. Blood from the second drop after snipping the rat's tail was drawn to the 0.5 mark and then diluted to the 101 mark of the red cell Thoma pipette with glucose-citrate-saline diluting fluid described on page 12. By using this diluting fluid, none of the elaborate technics described for making platelet counts were found necessary (52) (20) (43) (7) (60).

Total Protein Determination. The falling drop method of determining the total proteins in plasma and serum has been used with success by Kagan (28) and Scudder (50). Scudder (50) obtained a close agreement between the values by the Kjeldahl and the falling drop method.

The total protein determinations were made by the falling drop method on the plasma obtained after completion of the packed cell volume estimations. After centrifuging the Wintrobe tubes, the plasma was removed for use in these determinations.

The total serum protein determinations were made by

withdrawing approximately 0.5 cc. of blood from the rat by cardiac puncture without the aid of anesthesia. The blood was placed in a 75 x 8 mm. agglutination tube and allowed to clot. When the clot was fully formed, the tube was centrifuged for 30 minutes at 1800 revolutions per minute and the clear serum used for the total serum protein determinations.

Blood Sugar Determination. The method of Folin and Wu (61) was used to determine the normal blood sugar and the blood sugar of the rats during infection with Trypanosoma equiperdum. By means of a 1 cc. Tuberculin syringe fitted with a sterile, 20 gauge needle, 0.75 cc. of blood was withdrawn from the heart of the rat without aid of anesthesia and immediately added to 6.0 cc. of N/12 sulfuric acid. When hemolysis was complete, 0.75 cc. of 10 per cent sodium tungstate was added. When filtered through a No. 42 Whatman filter paper in a small funnel, sufficient filtrate was obtained to measure exactly 2.0 cc. for use in the blood sugar determination.

A clinical type Cenco photelometer was used. A reference standard curve (Figure 1) was constructed by using the Folin and Wu procedure on a series of solutions each containing an accurately weighed amount of anhydrous dextrose. Each solution was heated for 6 minutes in boiling water, then cooled for 2 minutes in a beaker of cold water. The reading on the photelometer was taken two minutes from the time the molybdate phosphate solution was added to the reduced copper solution. This same schedule was used in each of the blood sugar

determinations.

Body Weight Determination. The change in body weight during infection was followed by weighing each animal on a dietetic balance at 24 hour intervals during the infection. The body weight determinations were made with an accuracy of 2 grams.

RESULTS

Mathematical Treatment of Results. The mean and standard deviation for each series of experimental results have been calculated and recorded in the tables. The Standard Deviation was determined in the usual manner:

$$\sigma = \sqrt{\frac{\Sigma d^2}{n - 1}}$$

where σ = standard deviation of the mean

Σ = denotes summation

d = deviation of each determination from the mean

n = number of observations.

Standard Error of the mean was calculated as follows:

$$\epsilon = \frac{\sigma}{\sqrt{n}}$$

Significance of difference between two means was calculated from:

$$\frac{m_1 - m_2}{\sqrt{\epsilon_1^2 + \epsilon_2^2}}$$

where m_1 = mean of the first series

m_2 = mean of the second series

ϵ_1 = standard error of the first series

ϵ_2 = standard error of the second series

When this value is greater than 2.00, the difference between

the means is considered significant with a probability of $P = 0.05$ or less, with a minimum of 30 observations.

Effect of the Trypanosome Infection on Body Weight. It was found that the infected male rat gained weight at a normal rate up to 48 hours after infection, following which he lost weight and continued to lose weight until the time of death (Table 6). The mean gain in weight of a series of 35 normal male rats with an average weight of 194 grams, observed over a period of four days was found to be 1.7 grams per day (Figure 2, Table 5). This observation period corresponds to the average duration of the infection with Trypanosoma equiperdum in the albino rat in this work. Donaldson (10) reports an average increase for male rats in the same weight range as the rats used in this series, of 1.27 grams per day over an observation period of 30 days.

Trypanosome Count During Infection. In more than 600 rats infected with 2 million trypanosomes each, there never has been a case of spontaneous recovery. The infection always follows a characteristic course which is a fulminating type, terminating fatally in approximately 90 hours (Figure 3). Twenty four hours after infection, the trypanosomes appear in the blood in sufficient numbers to permit a hemocytometer count. In the counting method described on page 11, from 0 to 20 trypanosomes were counted in the central square millimeter of the hemocytometer counting chamber.

The average trypanosome count per cubic millimeter of blood during the course of infection is as follows:

4.4 ± 5.89 thousand at 24 hours for 202 rats, Table 7.
104.0 ± 103.00 thousand at 48 hours for 208 rats, Table 8.
860.0 ± 556.00 thousand at 72 hours for 191 rats, Table 9.
1,566.0 ± 287.00 thousand at death, for 101 rats, Table 10.

Effect of the Trypanosome Infection on the Erythrocyte Count. A progressive anemia occurs during the infection. The extent of the anemia amounts to a decrease of 31.6 per cent from the average normal erythrocyte count (Figure 4). The average red blood cell count of 40 normal adult rats with an average weight of 208 grams before infection was found to be 8.22 ± 0.672 million per cubic millimeter of blood (Table 13). Various values are reported in the literature for the average red blood cell count of the rat, ranging from 7 to 10 million (37) (8) (15) (47).

The average red blood cell count per cubic millimeter of blood during the course of infection is as follows:
7.93 ± 0.796 million at 24 hours for 40 rats, Table 14.
7.38 ± 1.060 million at 48 hours for 40 rats, Table 15.
6.23 ± 1.160 million at 72 hours for 40 rats, Table 16.
5.62 ± 0.785 million at death for 32 rats, Table 17.

Effect of the Trypanosome Infection on the Hemoglobin. The hemoglobin content of the rat's blood decreases parallel with the decrease in the erythrocytes to a point 24.6 per cent below normal at death (Figure 5). The mean hemoglobin value for 56 normal rats with an average weight of 198 grams before infection was found to be 13.8 ± 0.84 grams per 100 cc. of blood (Table 18). Andrews, Johnson and Dormal (1) report

an average hemoglobin value of 13.32 grams per 100 cc. of blood in a series of 20 normal rats.

During the course of the infection, the average hemoglobin value per 100 cc. of blood is as follows:
13.0 ± 1.57 grams at 24 hours for 47 rats, Table 19.
12.2 ± 1.86 grams at 48 hours for 44 rats, Table 20.
11.0 ± 1.53 grams at 72 hours for 42 rats, Table 21.
10.4 ± 1.32 grams at death for 40 rats, Table 22.

Effect of the Trypanosome Infection on the Packed Cell Volume. In the infected rat, the packed cell volume remained relatively constant for the first 48 hours of the infection after which it decreased as the number of trypanosomes increased (Figure 6). The average packed cell volume in a series of 39 normal adult rats with an average weight of 194 grams was found to be 49.8 ± 4.7 per cent (Table 23). This figure agrees with the value, 50 cc. per 100 cc. of blood given by Griffith and Farris (16).

The packed cell volume in terms of per cent during the course of infection is as follows:
50.1 ± 4.3 per cent at 24 hours for 33 rats, Table 24.
49.5 ± 6.4 per cent at 48 hours for 33 rats, Table 25.
33.2 ± 6.6 per cent at 72 hours for 34 rats, Table 26.
32.6 ± 5.6 per cent at death for 43 rats, Table 27.

Effect of the Trypanosome Infection on the Sedimentation Rate. The sedimentation rate increased as the infection progressed up to 72 hours after infection and showed a sharp drop at the point of death (Figure 7). For 40 normal adult

rats with an average weight of 192 grams, the mean sedimentation rate for 1 hour was found to be 0.95 ± 0.765 millimeter (Table 28) which approximates the value 0.7 millimeter in 1 hour reported by Griffith and Farris (17).

The effect on the sedimentation rate during the infection, in millimeters in 1 hour is as follows:

2.36 ± 3.54 millimeters at 24 hours for 33 rats, Table 29.

2.85 ± 4.55 millimeters at 48 hours for 33 rats, Table 30.

4.94 ± 8.05 millimeters at 72 hours for 34 rats, Table 31.

1.90 ± 4.75 millimeters at death for 34 rats, Table 32.

Effect of the Trypanosome Infection on the Coagulation Time. The coagulation time decreased slightly up to 48 hours after infection and then increased to about 6 per cent more than the average coagulation time of the normal rat at death (Figure 8). The average coagulation time of 58 normal adult rats with a mean weight of 194 grams was found to be 160.1 ± 24.8 seconds (Table 33), which compares with the average value of 150 seconds given by Griffith and Farris (17) and slightly more than the 138 seconds found by Ingle and Corwin (22).

The coagulation time in seconds during the course of infection is as follows:

151.0 ± 22.8 seconds at 24 hours for 49 rats, Table 34.

146.0 ± 22.6 seconds at 48 hours for 47 rats, Table 35.

153.5 ± 21.2 seconds at 72 hours for 44 rats, Table 36.

170.0 ± 32.0 seconds at death for 40 rats, Table 37.

Effect of the Trypanosome Infection on the Blood Platelets. The platelet count was found to decrease gradually up to 48 hours after infection, then rapidly to the point of death (Figure 9). In this work, for 46 normal adult rats with an average weight of 196 grams, the mean platelet count was found to be 772.4 ± 152.7 thousand platelets per cubic millimeter of blood (Table 38). Cramer, Drew and Mottram (7) report an average platelet count of 850 thousand per cubic millimeter in rats weighing approximately 150 grams. Griffith and Farris (18) give the average platelet count for the rat at 800 thousand with a range of 500 thousand to 1,000 thousand per cubic millimeter of blood.

The number of platelets per cubic millimeter of blood during the infection is as follows:

742.6 ± 147.0 thousand at 24 hours for 88 rats, Table 39.
630.2 ± 163.0 thousand at 48 hours for 83 rats, Table 40.
296.7 ± 164.0 thousand at 72 hours for 81 rats, Table 41.
171.8 ± 82.5 thousand at death for 40 rats, Table 42.

Effect of the Trypanosome Infection on the Plasma Specific Gravity and the Total Plasma Proteins. During the course of infection, there is a slight increase in the plasma specific gravity (Figure 10). Since the total plasma proteins were calculated from the specific gravity determinations, the same increase applies (Figures 10 and 11). The value obtained by calculation of the significance of difference between the means at death and the normal total plasma proteins was 2.34 (P = 0.02) which is just significant. The average

specific gravity of the plasma in a series of 44 normal adult rats with a mean weight of 189 grams was found to be 1.0265 ± 0.001 (Table 43). The average total plasma proteins calculated for the same series of 44 normal adult rats was 6.65 ± 0.343 grams per 100 cc. of plasma (Table 48).

The specific gravity determinations of the plasma during infection are as follows:

1.0268 ± 0.0006 at 24 hours for 33 rats, Table 44.

1.0267 ± 0.0014 at 48 hours for 33 rats, Table 45.

1.0269 ± 0.0016 at 72 hours for 36 rats, Table 46.

1.0271 ± 0.0016 at death for 36 rats, Table 47.

Total plasma protein values calculated from the specific gravity determinations during infection are as follows:

6.78 ± 0.233 grams per 100 cc. at 24 hours for 33 rats, Table 49.

6.76 ± 0.453 grams per 100 cc. at 48 hours for 33 rats, Table 50.

6.81 ± 0.544 grams per 100 cc. at 72 hours for 36 rats, Table 51.

6.87 ± 0.480 grams per 100 cc. at death for 36 rats, Table 52.

Effect of the Trypanosome Infection on the Total Serum Proteins. The total serum proteins increased until 48 hours after infection, then decreased to the point of death (Figure 12). The average total serum proteins on a series of 22 normal adult rats with an average weight of 193 grams was found to be 6.15 grams per 100 cc. of serum (Table 53) which compares favorably with the value 6.2 grams per 100 cc. of serum for rats in the same weight range reported by Donaldson (9).

The total serum protein values in grams per 100 cc. of serum during the course of infection are as follows:

6.34 grams at 24 hours for 9 rats, Table 54.

6.47 grams at 48 hours for 7 rats, Table 55.

6.32 grams at 72 hours for 8 rats, Table 56.

6.28 grams at death for 25 rats, Table 57.

Fibrinogen values were calculated on a series of 21 normal adult rats by subtracting the total serum protein from the total plasma protein. The average value was found to be 0.40 gram of fibrinogen per 100 cc. of plasma (Table 58). In the same manner, fibrinogen values were calculated on a series of 24 infected rats at death. The average value was found to be 0.62 gram of fibrinogen per 100 cc. of plasma (Table 59). This represents an increase of 55 per cent from normal during the course of infection.

Effect of the Trypanosome Infection on the Blood Sugar. The blood sugar remains at a normal level for the first 48 hours of the infection. At this point when the number of trypanosomes begins to increase at a rapid rate, the blood sugar falls at an increasing rate to a point 77.4 per cent below normal at death (Figure 13). The average blood sugar of 100 normal adult rats with a mean weight of 168 grams was found to be 145.6 ± 21.8 milligrams per cent (Table 60).

During the course of infection, the effect on the blood sugar is as follows:

141.0 ± 8.6 mg. per cent at 24 hours for 40 rats, Table 61.

141.4 ± 14.7 mg. per cent at 48 hours for 42 rats, Table 62.

109.6 ± 45.6 mg. per cent at 72 hours for 40 rats, Table 63.

32.8 ± 9.2 mg. per cent at death for 40 rats, Table 64.

DISCUSSION

Trypanosome Growth Curve. An intraperitoneal inoculation of 2 million trypanosomes (Trypanosoma equiperdum) into the adult albino rat results in a fulminating type of infection which terminates fatally in 3 to 4 days. The average survival time of a series of 314 infected rats was found to be 90.65 ± 34 hours (Table 11). The constancy of the infection in different laboratories is illustrated by comparison with the work of Morrell, Chapman and Allmark (37), who found an average survival time of 90.6 ± 11.1 hours for 179 rats infected with the same infecting dose of trypanosomes. The standard deviation is considerably larger than that found by Morrell et al. The value, which is 37.5 per cent of the mean, indicates a large individual variation in the response. It follows from this, that after inoculation of a series of rats with 2 million parasites, every rat in the series would not have the same degree of infection in 24 hours. In this work, 80 to 90 per cent of the rats, each infected with 2 million parasites, developed the infection in 24 hours to the extent that the trypanosomes in the peripheral blood could be counted by means of a hemocytometer. The remaining 10 to 20 per cent did not show trypanosomes in the peripheral blood until 48 to 72 hours after infection. Perla (39) observed an immediate outpouring of mononuclear

phagocytes within 10 minutes after intraperitoneal inoculation of trypanosomes into the rat. In 2.5 hours, 64 per cent of the cellular exudate consisted of neutrophilic leukocytes. He further observed that the smaller the number of trypanosomes injected, the less the likelihood of sufficient numbers escaping phagocytosis and entering the blood. This might explain the individual variation in the rats to the infection. The rats in the 10 to 20 per cent group apparently are capable of a greater leukocytic response so that only a few trypanosomes escape phagocytosis to enter the blood and consequently, the infection develops at a slower rate than in the majority of the animals.

After the trypanosomes appear in the peripheral blood, they continue to increase in numbers at an increasing rate to the point of death (Figure 3). Johnson (24) however, counting 15 infected rats at 24 hour intervals, found that the count levels off shortly before death. In this study, no evidence was found that the number of trypanosomes diminishes just before death. They continue to increase at a definite rate until suddenly stopped by the death of the host.

The trypanosome growth curve can be divided into three parts: a lag phase, during the first 24 hours; an accelerated growth phase following 24 hours after infection and finally, a logarithmic growth phase which continues from 48 hours after infection until death of the rat. During the first 24 hours, the number of trypanosomes is kept down by

the defense mechanism of the host mainly through phagocytosis by the cells of the reticulo-endothelial system and the mononuclear phagocytes. Beginning 24 hours after infection, when sufficient trypanosomes appear in the blood, the effect on their number by phagocytosis becomes less apparent and acceleration of the increase in numbers follows. Forty eight hours after infection, the increase in the number of trypanosomes is logarithmic and there is no apparent resistance on the part of the host. The trypanosome growth curve resembles the first part of the curve obtained by plotting the number of bacteria grown in a test tube against time (4). Comparison with the complete bacterial growth curve cannot be made because death of the host prevents the completion of the trypanosome growth curve.

Many statements appear in the literature about the multiplication of Trypanosomes in the rat. Voegtlin, Dyer and Miller (63) point out that Trypanosoma equiperdum double in number in 7 hours. Morrell, Chapman and Allmark (37) state that Trypanosoma equiperdum increase in the blood of rats in a geometric progression throughout a large part of the disease, the interval required for doubling the numbers being 6 hours. Taliaferro and Taliaferro (57) maintain that the curve of increase in trypanosomes in the rat follows a geometric progression. Perla (39) points out that although the trypanosomes develop in the blood in a geometrical progression, this is not mathematically true since the trypanosomes die off as a result of unfavorable conditions in the host late in the

disease. From the results of this study, no definite interval of doubling was observed. Twenty four hours after infection, the trypanosomes double in number every 4 to 6 hours. Forty eight hours after infection they double every 8 hours and at 72 hours after infection until death, the number has not quite doubled in 14 hours.

Since no constant rate of increase was found, the increase does not seem to follow a geometric progression in the ordinary sense of the term. If, as suggested (37), the count doubles every 6 hours, then starting with 4.4 thousand trypanosomes per cmm. at 24 hours, in 72 hours the count would be 1,166.4 thousand which does not agree with the 860 thousand found. In 84 hours after infection the count would be 4,665 thousand, which is far in excess of the 1,566 thousand found at death in 86 hours. The trypanosome growth curve (Figure 3) from 48 hours after infection until death of the host, resembles an exponential curve. No attempt has been made to derive an equation for this curve because of the impossibility of obtaining a sufficient number of points to permit satisfactory calculations. However, it is possible to determine whether or not the experimental data fit an exponential curve by plotting these data on semi-logarithmic paper (3). If the points lie on a straight line, the curve is exponential in form. When the data from this study were plotted on semi-logarithmic paper, the points from 48 hours after infection until death were on a straight line. If sufficient points were available to develop an equation for

this curve, the rate of increase could thereby be calculated. Since the rate of increase in the number of trypanosomes cannot be determined from the data available, the term logarithmic increase should be used to describe the increase in the number of trypanosomes from 48 hours after infection to death. During the first 48 hours of the infection, the influence of the defensive factors in the rat makes it impossible to make any positive statement about the rate of increase during this period.

Course of Infection. The course of infection with Trypanosoma equiperdum follows a characteristic pattern in the rat. There are no obvious symptoms until approximately 6 hours prior to death when a general listlessness is observed and the pink color of the eyes becomes less pronounced. About a half hour before death, an incoordination in the hind legs appears and develops into a marked paralysis. This paralysis soon extends to the front legs. Occasional fibrillary twitchings of the general musculature are noted. About 5 minutes prior to death, the rat begins to make great efforts to move about the cage and becomes dyspneic. There is a characteristic sharp cry, followed by a quick series of clonic and tonic convulsions during which the rat threshes about the cage in a violent manner. This excitement period terminates in a sustained tonic convulsion of about 10 to 15 seconds duration, after which a bloody froth appears at the external nares and the respiration ceases. The heart continues to beat for approximately a minute after cessation

of the respiration. Most of these symptoms of trypanosomiasis in experimental animals have been described by several authors (38) (25) (63) (70) (39) (48). The convulsions at death have been observed by these investigators, but little clinical significance has been attributed to them.

Blood Sugar. Following infection, the blood sugar remains constant during the first 48 hours. At the beginning of the logarithmic phase of growth, the blood sugar begins to drop and continues to drop as the number of trypanosomes increases (Figure 13). At death, the blood sugar falls 77.4 per cent below normal which is below the physiological limit necessary for the rat, comparable to the value after a fatal dose of insulin (Table 66). The convulsions accompanying death from trypanosomiasis and death from insulin in the rat are remarkably similar. The rate at which the blood sugar is falling during the trypanosome infection, increases as the trypanosome count increases. From 48 hours to 72 hours, the rate of fall is approximately one per cent per hour and from 72 hours to death, the rate of fall is approximately 3 per cent per hour - an increase of 3 times. The greatest fall in the blood sugar occurs from one to 4 hours preceding death, since rats examined at random 4 to 6 hours before death still had blood sugar levels of 80 to 90 milligrams per cent. The blood sugar is maintained at a normal level for the first 48 hours of the infection by glycogenolysis and food intake. When the number of trypanosomes begins to increase rapidly, the supply of glucose is not

sufficient to keep up the normal level and finally the blood sugar reaches a fatal hypoglycemic limit.

Schern (49) was one of the first workers to point out that glucose was necessary to the life of the trypanosome and that sugar depletion was the cause of death of the host. Fenyvessy (12) found that a drop in the blood sugar occurs late in the infection and the liver is depleted of its glycogen at death. Scheff (48) showed that the sugar depletion increases as the number of trypanosomes increases and liver glycogen depletion is complete at death. He found that "Bayer 205" killed the trypanosomes and the blood sugar level returned to normal following treatment with this drug but offered no explanation. Scheff (48) also noted that following an injection of epinephrine, the blood sugar of the normal rat increased to double the normal value. The infected rat, however, following injection with a similar dose of epinephrine did not show an increase in blood sugar, but a decrease over the same time interval during which the controls were observed. Regendanz (44) found a final hypoglycemia with a fatal Trypanosoma lewisi infection in rats. He reported a blood sugar level at death of 20 milligrams per cent in which the hypoglycemia appeared to be a terminal phenomenon. Linton (35) also, in a study of Trypanosoma equiperdum in the rat, observed a terminal hypoglycemia. He further found that early in the infection there is some depletion of the liver glycogen and at death, no glycogen could be found in the liver. Of these authors, Schern (49) states

that death is due to a fatal hypoglycemia. The others agree that hypoglycemia is a terminal phenomenon but that death is due to some other factor or combination of factors.

It will be observed in Figure 13, that the trypanosome growth curve is abruptly terminated with the blood sugar below the limit compatible with life of the rat. This suggests that hypoglycemia is the fundamental cause of death. What would happen if the blood sugar was prevented from reaching this level by the administration of glucose? Kligler, Geiger and Comaroff (31) attempted to prolong the life of the rat infected with Trypanosoma evansi by the daily injection of 0.5 cc. of a 10 per cent glucose solution. They did not find that the glucose injections prolonged the life of the infected rats. In an in vitro study of the rate of glucose consumption by trypanosomes, Yorke, Adams and Murgatroyd (69) found that 400 million trypanosomes consumed from 2.0 to 2.5 milligrams of glucose in one hour and 12.0 to 12.5 milligrams of glucose in five hours. On the basis of this work, it can be calculated that one billion trypanosomes would consume from 5.0 to 6.25 milligrams of glucose per hour. If the blood volume of the rat is taken at 6.7 cc. per 100 grams of body weight (5), a 200 gram rat would have 13.4 cc. of blood. When the infection is one million trypanosomes per cmm., the total number of trypanosomes in a 200 gram rat is 13.4 billion. Then the trypanosomes in the body of this rat would be expected to consume 5 times 13.4 or 67 milligrams of glucose in one hour. This is the

amount required by the trypanosomes and does not include the glucose metabolized by the tissues of the host. Therefore, the amount of glucose injected by Kligler, Geiger and Comaroff (31) once daily would constitute less than one hour's supply for a 200 gram rat with a trypanosome count of one million per cmm. This would explain why they found that glucose would not prolong the life of the infected rat.

If sufficient glucose is administered, the life of the rat should be prolonged. To test this assumption, based on the previous calculation that one billion trypanosomes will consume 5 milligrams of glucose per hour, a series of 38 infected rats were administered 500 milligrams per 100 grams of body weight of anhydrous dextrose contained in a 50 per cent aqueous solution over a period beginning 3 to 4 hours before death was expected. One cc. was administered orally by means of a 5 cc. syringe equipped with an 18 gauge, blunt-pointed needle, at exactly three hour intervals. It was found that the trypanosome count instead of terminating at 1.566 million per cmm., increased at the same rate observed during the normal course of infection from 48 hours to death, to an average count for 34 rats, of 3.744 million, or 2.38 times the normal count at death (Figure 14, Table 65). The infected rats given glucose survived on the average, 18 hours longer than infected rats not treated with glucose. The survival time for a few animals increased as much as 30 hours and the trypanosome count was as high as 5.25 million per cmm. The counts when plotted on semi-logarithmic paper showed that

the points from 48 hours after infection to death with 3.744 million trypanosomes per cmm. fell along a straight line. This would indicate that the rate of growth of the trypanosomes was logarithmic and that the infection proceded at a rate, following the administration of glucose, no different from the normal growth rate when the infection terminates at a count of 1.566 million.

During these experiments when the last few doses of dextrose were being given, it was observed that the rats became progressively weaker in each succeeding 3 hour period between doses. When administering glucose every three hours, a point should be reached when the trypanosomes due to increase in numbers, should consume all the added glucose during this period, and the rat should die of hypoglycemia before more glucose is given. Of the 30 rats in this group on which blood sugar determinations were made at death, 26 (87 per cent) died in the 20 minute interval just prior to the time for the next dose of dextrose. It would be expected then, that these 26 rats would have a hypoglycemia near the limit necessary to sustain life. It was found that all of these 26 rats were hypoglycemic with an average blood sugar of 37.3 milligrams per cent. The remaining 4 rats which died within 45 minutes after administration of dextrose, as would be expected, had a high blood sugar level - over 300 milligrams per cent. These 4 animals, however, were moribund when they were given the sugar. Rats with a very high trypanosome count and in the characteristic lethargic

state preceding death, were revived dramatically by a dose of 500 milligrams of glucose per 100 grams of body weight.

It might be calculated on the basis of the maximum value given by Yorke, Adams and Murgatroyd (69) that a rat weighing 200 grams with an infection of 2 million trypanosomes per cmm. would need (2 billion x 13.4 cc. of blood x 6.25 milligrams of glucose x 3 hours) 503 milligrams of glucose to keep the trypanosomes alive for 3 hours. At a 3 million trypanosome infection, the rat would need 754 milligrams for the 3 hour period and at a count of 4 million trypanosomes per cmm., the rat would require 1,005 milligrams of glucose to keep the trypanosomes alive for 3 hours. These calculations do not take into consideration the increase in the number of trypanosomes and resultant increase in the consumption of glucose during the 3 hour period. Nor do they account for the glucose metabolized by the tissues of the rat and the glucose eliminated in the urine shortly after administration of the glucose. So that when 1000 milligrams of glucose is administered to a 200 gram rat every 3 hours, it would be expected when the trypanosome count reaches a value of slightly less than 4 million per cmm., that this amount of glucose would be consumed in less than three hours and the rat would die of hypoglycemia. It was found that the average trypanosome count at death was 3.744 million per cmm. and 87% of the rats had a fatal hypoglycemia (Table 62). These data are in reasonable agreement with the <u>in vitro</u> findings of Yorke, Adams and Murgatroyd (69).

If at any time, after beginning glucose administration and the trypanosome count had developed to a point above the normal death count, the glucose administration was stopped, the rat soon died and the blood sugar was always found to be at a fatal hypoglycemic level of approximately 35 milligrams per cent.

If on the other hand, glucose is taken away from the rat during the course of infection by some substance such as insulin, it will be found that the infected rat is much more susceptible to insulin than the normal rat (Table 67). Rats with an infection of at least 48 hours when the blood sugar is just starting to drop, will survive a dose of one to five units of insulin per kilogram of body weight, where 75 per cent of the normal rats studied survived a dose of 400 units of insulin given intraperitoneally. Earlier in the infection, the rat will survive much larger doses of insulin, but after 48 hours infection, progressively smaller doses of insulin are necessary to halt glycogenolysis so that the trypanosomes in the blood consume the blood sugar present and rapidly cause death of the rat. The average blood sugar, 26.2 milligrams per cent, of the infected rats following death from insulin is even lower than the value 32.8 milligrams per cent found at death following the normal course of the infection. The value, 26.2 milligrams per cent by the Folin and Wu method represents complete exhaustion of the blood sugar after the work of Somogyi (51) who gives a value of 27 ± 4 milligrams per cent for the non-sugar reducing

substances of blood. The increased sensitivity to insulin suggests that if the influx of glucose into the blood from glycogen is halted, the trypanosomes present will use the glucose as long as it is available and cause death by reducing the blood sugar to a level below the normal physiological limit for the rat.

Further evidence of the diminished supply of glucose in the blood of the infected rat is furnished by the work of Scheff (48) in showing that while epinephrine caused a marked rise in the blood sugar of the normal rat, a similar dose of epinephrine in the trypanosome infected rat caused no rise in the blood sugar.

Anemia. One of the characteristic features of the blood picture in trypanosomiasis is the progressive anemia associated with the infection (39) (23) (42) (31) (26). The erythrocyte count drops from an average of 8.22 million red blood cells per cmm. in a series of 40 adult, normal albino rats before infection to 5.62 million at death from the infection (Figure 4). This drop of 31.6 per cent is not sufficient in itself to cause death. A series of splenectomized rats survived a reduction in the number of red blood cells 61 per cent below normal (Figure 15, Table 69). Another series of rats subjected to hemorrhage, survived a reduction of 50.5 per cent below normal (Figure 16, Table 70). The anemia appears to be due to an increased destruction of the red blood cells by an activated reticulo-endothelial system, particularly the cells of the spleen and the Kupffer cells

of the liver. The spleen becomes greatly enlarged during the course of infection. Perla (39) points out that the macrophage cells are active in the ingestion of trypanosomes and it is likely that this greatly enhances their capacity for destroying the red blood cells. He presents histological evidence to demonstrate that the enlarge spleen and to a certain extent, the Kupffer cells contain more fragmented red blood cells than normal, during the trypanosome infection. The anemia could be due to destruction of the red blood cells by the trypanosomes, but during the examination of hundreds of wet preparations containing active trypanosomes and red blood cells, no trypanosomes were observed to enter or destroy a red blood cell. The anemia might be explained on the basis of decreased erythropoiesis. If this were true, evidence could be found in the reduction of the reticulocyte count. However, no reduction in the reticulocyte count was found, in fact in the few determinations made, there was a slight increase. Perla (39) reports finding no increase in the reticulocytes during infection of the rat with Trypanosoma equiperdum. The plasma at death is clear and colorless which indicates that there is no hemolysis.

The hemoglobin is reduced during the infection parallel with the decrease in the red blood cells, which indicates that the loss of hemoglobin is due to a diminution in the number of red blood cells. Andrews, Johnson and Dormal (1) maintain there is no significant change during infection, although they report a reduction from 13.12 grams to 11.52 grams per

100 cc. of blood at death in 17 rats. While the hemoglobin reduction in this work was found to be less than that of the red cell count in terms of per cent, the 24.6 per cent decrease was a statistically significant lower value than the normal of 13.8 grams per 100 cc. of blood. However, this change is not sufficient to cause death. The series of splenectomized rats mentioned previously survived a reduction of 57 per cent in the hemoglobin and the rats subjected to hemorrhage survived a 45 per cent reduction.

The packed cell volume determinations show no change during the first 48 hours of the infection. At the beginning of the logarithmic phase of trypanosome growth, the value drops rapidly to 34.5 per cent below normal (Figure 6). The rats subjected to hemorrhage, survived a reduction of 36.8 per cent in the packed cell volume (Figure 16, Table 70). The change in the packed cell volume during infection also can be discarded as a direct cause of death.

While there is a significant reduction in the red blood cell count, hemoglobin value and packed cell volume which occurs as a result of the injury to the hemopoietic system of the animal, these changes are not sufficient to cause death from anemia.

Platelets. During the course of the infection, a reduction of 77.6 per cent occurs in the platelet count of the rat (Figure 9). Whether this is sufficient to cause death is not known. Tocantins (58) mentions that the platelet count decreases in kala-azar. The coagulation time, contrary

to popular belief, does not change significantly during the infection (Figure 8). The bleeding time, on the other hand, is much increased and the retractility of the clot is greatly reduced. When the rat is placed in the holding apparatus and the tail snipped, the blood will continue to ooze for 10 to 15 minutes after the clot has formed. The clot takes the form of a long gelatinous drop and is easily removed, whereas, in the normal rat, the clot retracts in 2 to 3 minutes and is not easily removed.

Upon infection, the activity of the cells of the reticulo-endothelial system is concentrated on the destruction of the invading parasite. Evidence for this is found in the hypertrophy of the spleen and the cells of the reticulo-endothelial system in general (39). The megakaryocytes, the source of the platelets, in the bone marrow may be decreased in number due to diversion of the normal activity of the bone marrow which now places emphasis on the destruction of the trypanosomes. Tocantins (58) gives the life of the platelet at 4 days. If normal production is curtailed on infection, it is conceivable that the platelets present in the blood at the time of infection, would disappear in the 3 to 4 days of the trypanosome infection. Furthermore, since red blood cells are destroyed by the cells of the reticulo-endothelial system, it is possible that there is an increase in phagocytosis of the platelets by this same mechanism, which would further account for the low platelet count during the trypanosome infection. The number of platelets decrease progressively

as the number of trypanosomes increase. This fact could be used as an index of the severity of the injury to the hemopoietic system.

The method of counting platelets is an improvement over the methods used at present (52) (20) (43) (7) (60). The blood when diluted with the glucose-citrate-saline solution provides an excellent medium in which to preserve and count the platelets. These are seen as pale, colorless discs from one to five microns in diameter, while some appear as rods, "cigar" shaped and "comma" shaped bodies, depending apparently on the angle from which they are observed (58) (68). Definite motility is observed in the majority of the platelets on first examination. After standing for some time, those showing motility become motionless. Tocantins (58) mentions that platelets are often confused with parasites because of their movement. He further points out that they decolorize methylene blue and consume oxygen, lending support to the fact that they consist of living protoplasm. Very few, if any, can be found when the blood is examined using Hayem's solution. The mercuric chloride of this solution presumably accounts for their destruction. Using the trypanosome diluting fluid however, and treating the blood in the usual manner for making a red blood cell count (page 17), the platelets are easily counted and no fixative need be added to prevent their disintegration (20). The special precautions outlined in various methods for preserving their integrity for counting were not observed (52) (20) (43) (7) (60).

The normal rat platelet count is given at 800 thousand per cmm. with a range of 500 thousand to 1,000 thousand per cmm., by Griffith and Farris (18). Cramer, Drew and Mottram (7) report a range of 700 thousand to 900 thousand for the adult albino rat. The average platelet count in a series of 46 normal, adult albino rats with a mean weight of 196 grams was found to be 772.4 ± 152.7 thousand per cmm. of blood (Table 38).

It is known that the platelet count is increased following splenectomy and hemorrhage (20). A series of rats were splenectomized and the platelet count followed for 115 days (Figure 15). Every one of the series survived for at least 115 days, which would question the importance of bartonella infection as a cause of death following splenectomy (40). By the 6th day following splenectomy, the average platelet count had risen from 778 thousand to 1,760 thousand per cmm. and then returned to normal in 30 days (Figure 15, Table 69). Another group of rats was subjected to hemorrhage by removing 1.1 cc. of blood by cardiac puncture on each of 5 successive days. The platelet count increased from an average of 766 thousand to 1,330 thousand per cmm. on the 9th day following the initial bleeding and returned to approximately normal 14 days later (Figure 16, Table 70).

Total Plasma and Serum Proteins. The total proteins of the plasma and serum are not affected in the same manner as are the red blood cells, hemoglobin, blood sugar, packed cell

volume and platelets of the rat. Instead there is a slight increase in the plasma proteins throughout the infection to a level above the normal which is just statistically significant while the serum proteins increase up to 48 hours after infection, then decrease continuously to the point of death. The average total plasma proteins increased from 6.65 grams per 100 cc. of plasma in the normal rat to 6.87 grams per 100 cc. of plasma in the infected rat at death. The series of rats subjected to hemorrhage demonstrated an increase in the total plasma proteins from 6.45 to 6.57 grams per 100 cc. of plasma, or an increase of 0.12 grams due to the effect of repeated cardiac puncture. This minimizes the importance of the increase of 0.22 gram in the total plasma proteins of the infected rat during the course of the infection. It may be assumed that approximately 0.12 gram of this increase was due to the effect of the loss of blood used in making the daily determinations.

The serum proteins were found to increase from a normal of 6.15 to 6.47 grams per 100 cc. of serum after 48 hours infection and then decrease to 6.28 grams per 100 cc. of serum at death. It is possible that antibody formation is stimulated on infection, resulting in an increase in the globulin fraction of the serum up to the 48 hour period, but following this period, when the trypanosomes begin to greatly increase in numbers, the damage to the reticulo-endothelial system results in decreased production of antibodies with an associated drop in the serum proteins. When the curves

for the total proteins of the plasma and serum are compared, a divergence after 48 hours of infection is observed (Figure 12).

There is an increase of 0.22 gram in the fibrinogen during the course of infection (Tables 58 and 59). This value was obtained by subtracting the serum protein from the plasma protein in a series of determinations on normal rats and on infected rats at death.

The sedimentation rate increases steadily up to 72 hours after infection, after which there is a dramatic drop at the point of death (Figure 7). Fåhreus (11) states that the sedimentation rate is increased in all acute general infections and is associated with the composition of the plasma proteins. He points out also, that the falling time of the red blood cells is most rapid in a solution of fibrinogen, less in a solution of globulin and uniformly suspended in a solution of albumin. The increase in the sedimentation rate in the trypanosome infected rats might be associated with a slight increase in the globulin fraction. It is impossible from the experimental data available to account for the sudden drop in the sedimentation rate at death. It was thought that the activity of the trypanosomes in the blood might constitute sufficient agitation to prevent the red blood cells from aggregating and settling. Comparing the sedimentation rate of infected blood at death with a quantity of the same blood to which mercuric chloride was added to kill the trypanosomes, did not disclose any difference.

Cause of Death. Death of the albino rat infected with

Trypanosoma equiperdum is caused by a fatal hypoglycemia. The blood sugar of the rat is consumed by the trypanosomes at an increasing rate which eventually exceeds the ability of the rat to supply sufficient glucose to keep it alive.

Evidence of this is found in the fact that glucose, when administered in adequate quantities, will prolong the life of the rat as much as 30 hours and permit the trypanosomes to increase to an average of 2.38 times the normal count at death. In some cases, the trypanosome count exceeded 5 million per cmm. at death. That the liver is depleted of glycogen has been amply demonstrated (49) (48) (35). Scheff (48) found that while epinephrine would cause a rise in the blood sugar of the normal rat, no rise could be evoked by a similar dose of epinephrine into infected rats. Infected rats were found to tolerate a much smaller dose of insulin than normal rats. Rats 48 hours after infection, tolerate less than 10 units of insulin per kilogram of body weight, whereas normal rats tolerate approximately 400 units per kilogram of body weight. As the number of trypanosomes increases, the rat withstands increasingly smaller doses of insulin and conversely, more insulin can be given to rats at the beginning of the infection.

In the comprehensive work by Linton (35), in which a large number of factors of the blood chemistry of the rat was investigated, there is little positive evidence to designate the fall in blood sugar as the primary cause of death. He points out a breakdown in kidney structure and mentions it

as an important contributory cause of death, but does not make any definite conclusions as to the direct cause of death. Andrews, Johnson and Dormal (1) discuss the hypoglycemia, and on the basis of conflicting evidence in the literature concerning the completion of the glycogen exhaustion and glucose utilization by the trypanosomes along with unsuccessful attempts to prolong the life of the infected rat by the administration of glucose (no data given), dismiss this factor as not having any clinical significance in connection with death. Johnson (27) proposed a theory to explain the cause of death based on the reduced oxygen content of the blood of the infected rat. He concluded:

> that the lowering of the oxygen in the blood of infected animals is not due to the clumping of the trypanosomes resulting in circulatory blockage, but that the trypanosomes clump and degenerate because the lowering of the oxygen brings about changes in the blood which are not favorable for their continued existence. The lowering of the oxygen is due in part to its consumption by the parasite but more to the change produced in the blood by some unknown condition which prevents its being taken up and distributed to the tissue of the host. The lactic acid accumulation is also dependent upon the decrease in the oxygen content of the blood, the tissue being unable to metabolize it. The following theory is suggested: The trypanosomes, in an unknown way, affect the power of the blood to carry oxygen. This leads to a decrease in the oxygen content and a subsequent rise in lactic acid. These conditions are not favorable for the trypanosomes and they degenerate and clump, producing emboli which cause the death of the animals.
>
> The key to the situation apparently rests upon the elucidation of the true cause or causes for the reduction of the oxygen content of the blood in animals experimentally infected with Trypanosoma equiperdum.

Andrews, Johnson and Dormal (1), Raffel (42) and Voegtlin, Dyer and Miller (63) mention the presence of emboli in the

lungs and vital parts of the circulatory system resulting in death by a mechanical asphyxia. Contrary to Johnson's observations (27), no evidence of the clumping of the trypanosomes was found in the blood of the infected rats at death, during the course of this work. Perla (39) observed occasional trypanosomes in the capillaries of the lungs, but reports that he failed to find emboli. Further evidence to refute the mechanical asphyxia theory, is found in this work in the effect of the administration of adequate amounts of glucose. If the mechanical asphyxia theory were true, the rat would die when the trypanosome count reached 1.566 million per cmm., due to clumping of the trypanosomes and formation of emboli. When 500 milligrams of glucose per 100 grams of body weight was administered every three hours, the rats did not die when the count reached 1.566 million, but continued to live an average of 18 hours beyond the point when they normally would have died. At the same time, the trypanosome count increased to 3.744 million per cmm., or 2.38 times the normal count at death. The rats when they died, were found to have a blood sugar below the physiological limit necessary to sustain life. The life of the infected rat could be regulated at will by the administration or withdrawal of glucose. In the series of rats where the trypanosome count was increased above normal by the administration of glucose, the life of the rat could be terminated readily by cessation of the administration of glucose, and in each case the rat was found to have a fatal hypoglycemic blood sugar

level. Evidence for the fact that the trypanosomes use glucose as a normal metabolite is seen in the extension of the growth curve (Figure 14) which is a straight line from 48 hours after infection to death of the glucose treated rats when these data are plotted on semi-logarithmic paper. If glucose were not a normal metabolite, interference with the metabolism of the parasite should be reflected in a departure from the normal logarithmic increase during the normal span of the infection.

The lactic acid and uncompensated, non-volatile acidosis theory proposed by Kligler, Geiger and Comaroff (31) is criticized from the standpoint that the lactic acid accumulation is due to faulty oxidation resulting from the increased utilization and subsequent exhaustion of the glucose. As the blood sugar is consumed at an increasing rate in the progress of the disease, less glucose is available for oxidation of the lactic acid, and the lactic acid accumulates. The lactic acid is a product of glucose metabolism and is a result of the mechanism causing death, not a primary cause of death.

Noting the characteristic convulsions associated with death in trypanosomiasis, Zwemer and Culbertson (70) considered the similarity with the symptoms of death in potassium poisoning. They found that within 24 hours prior to death, the serum potassium of the Trypanosoma equiperdum infected rat increased to double the normal value at death. They suggest that this elevated serum potassium is a significant

factor in the cause of death. They found the serum potassium in 14 rats to increase from 22.3 to 41.3 milligrams per cent at death. They do not mention having administered potassium to the rat to produce an increase in the serum potassium equivalent to that found in the infected rats to determine whether or not this would cause death of the normal, uninfected rat.

The early toxin theory of the cause of death (45) has been discarded as untenable due to the inability of various workers to demonstrate the toxic effect of injection of a suspension of dead trypanosomes or plasma from a rat at death due to trypanosomiasis (1) (31).

Antibody production during the course of the trypanosome infection has been investigated by numerous authors (56) (55) (54) (53) (42) (30). Raffel (42) attempted to demonstrate antibodies in the rat infected with Trypanosoma equiperdum. He reports that an acute infection is obtained in the rat with heavy infective doses, but with small doses, the rat may show an immunity to the parasites which "invariably results in a fatal relapse." Kligler and Olitzki (33) demonstrated that 60 per cent of the Trypanosoma evansi cell consists of lipoid material. They point out the universally poor antigenic properties of lipoid material and reason that the difficulty in obtaining a satisfactory antibody response with this organism is due to its high lipoid content. Kligler and Comaroff (30) working with Trypanosoma evansi, which causes an infection in the rat similar to Trypanosoma equiperdum (67)

could demonstrate no antibodies in the serum of the rat either *in vitro* or *in vivo*.

Based on the time element of the infection with *Trypanosoma equiperdum*, there is much reason to doubt that antibodies could be produced in this short time in sufficient concentration to affect the course of the infection. The trypanosomes seem to grow in the blood of the rat much as bacteria grow in a test tube. The defense of the rat apparently is accomplished entirely by the cells of the reticulo-endothelial system in which phagocytosis is the chief means of defense. However, this defense is soon overcome by the overwhelming numbers of the parasites which flourish in the nutrient medium of the blood until death of the host intervenes.

On the basis of Lundsgaard's work on muscle metabolism (21) in which he used iodoacetic acid to prevent the formation of lactic acid from glycogen, a brief study was made of the effect of this reagent on the trypanosome infection in the rat. The sodium salt of the acid was found to be less toxic than the free acid and when given intravenously, resulted in a reduction in the number of trypanosomes in the blood (Table 68). Doses were administered on the basis of kilogram body weight. Twenty milligrams given intravenously effected an average reduction in the trypanosome count of 84.6 per cent in 2 hours, but the trypanosomes reappeared to eventually cause death of the animal. Repetition of this dose in 3 hours caused the trypanosomes to disappear from the blood, but

invariably resulted in death of the rat in a few hours following the second injection. Increasing the dose to 50 milligrams resulted in an average reduction in the count of 96.5 per cent in two hours, but the mortality due to the drug was increased. Intraperitoneal adminstration in divided doses was less effective, although there was a reduction in the trypanosome count which was incomplete and doses necessary to kill the trypanosomes also killed the rat. However, by chemical modification, the toxicity of the iodoacetic acid for the host might be reduced without sacrificing the toxicity for the parasite so that a compound lethal to the trypanosomes may be safely administered. A successful trypanocidal substance would be one which would interfere with the glucose metabolism of the trypanosome without injuring the host.

SUMMARY

1. Death in the normal adult albino rat infected with Trypanosoma equiperdum is due to a fatal hypoglycemia, caused by the consumption of the blood sugar at a rate in excess of the ability of the rat to furnish glucose sufficient to maintain life.
2. The oral administration of 5 grams of glucose per kilogram of body weight every three hours, prolonged the life of the rat an average of 18 hours and permitted the trypanosome count to increase from the normal average of 1.566 million at death, to 3.744 million per cmm. at death following glucose administration. The growth curve of the trypanosomes in rats receiving glucose continued at a logarithmic rate identical with that observed during the normal course of infection. The sensitivity of the infected rat to insulin increased with an increase in the number of trypanosomes.
3. The growth curve of the trypanosomes in the infected rat was divided into three parts: an initial lag phase during the first 24 hours, an accelerated growth phase during the second 24 hours and a logarithmic phase from 48 hours after infection to death.
4. The infected rat gained weight at a normal rate for the first 48 hours after infection, and at the beginning of

the logarithmic phase of the growth curve began to lose weight and lost weight continuously to the time of death.

5. The platelet count decreased 77.6 per cent during the infection from a normal of 772.4 thousand to 171.8 thousand per cmm. at death.
6. No significant change in the coagulation time of the blood during the infection was found.
7. The bleeding time was greatly increased and the retractility of the clot was severely reduced.
8. A progressive anemia accompanied the course of infection in which the erythrocyte count decreased from 8.22 million to 5.62 million per cmm. at death, or a decrease of 31.6 per cent from the normal.
9. There was a progressive decrease in the hemoglobin parallel with the decrease in the erythrocytes from 13.8 grams to 10.4 grams per 100 cc. of blood.
10. The sedimentation rate increased during the first 72 hours of the infection, after which it dropped sharply at the point of death.
11. The packed cell volume remained constant during the first 48 hours of the infection, after which it rapidly decreased from 49.8 to 32.6 per cent at death.
12. A severe decrease in the blood sugar was found from 145.6 to 32.8 milligrams per cent at death, or a decrease of 77.4 per cent from the normal.
13. The platelet count in the uninfected, splenectomized rat

increased from an average of 778 thousand to 1,760 thousand per cmm. and returned to approximately normal in 35 days.

14. The platelet count in the normal uninfected rat subjected to hemorrhage, increased from an average of 766 thousand to 1,330 thousand per cmm. and returned to approximately normal in 23 days.

15. A new method of counting platelets has been devised which eliminates the necessity of elaborate precautions to prevent their disintegration.

16. The plasma specific gravity increased during the course of infection from 1.0265 to 1.0271 at death.

17. The total plasma proteins increased during the infection from 6.65 to 6.87 grams per cent at death. Part of this increase may have been due to the daily loss of blood necessary in making the determinations, because normal rats subjected to repeated hemorrhage showed an increase of 0.12 gram per cent in the total plasma proteins due to the effect of hemorrhage. This reduces the significance of the increase of 0.22 grams per cent in the total plasma proteins of the infected rat during the course of the infection.

18. The total serum proteins increased from 6.15 to 6.47 grams per cent after 48 hours infection, following which the serum proteins decreased to 6.28 grams per cent at death.

19. The fibrinogen content of the plasma increased from

0.4 gram to 0.62 gram per cent in the infected rat at death.

20. Iodoacetic acid was effective in reducing the trypanosome infection, but doses sufficient to kill all the trypanosomes also killed the rat.

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Figure 1.

STANDARD DEXTROSE SOLUTION CURVE

Constructed from solutions containing accurately weighed quantities of anhydrous dextrose treated by the method of Folin and Wu. This standard curve was used for all blood sugar determinations.

Photelometer	= Cenco, clinical type.
Cell	= tubular
Filter	= none used
Standard	= distilled water

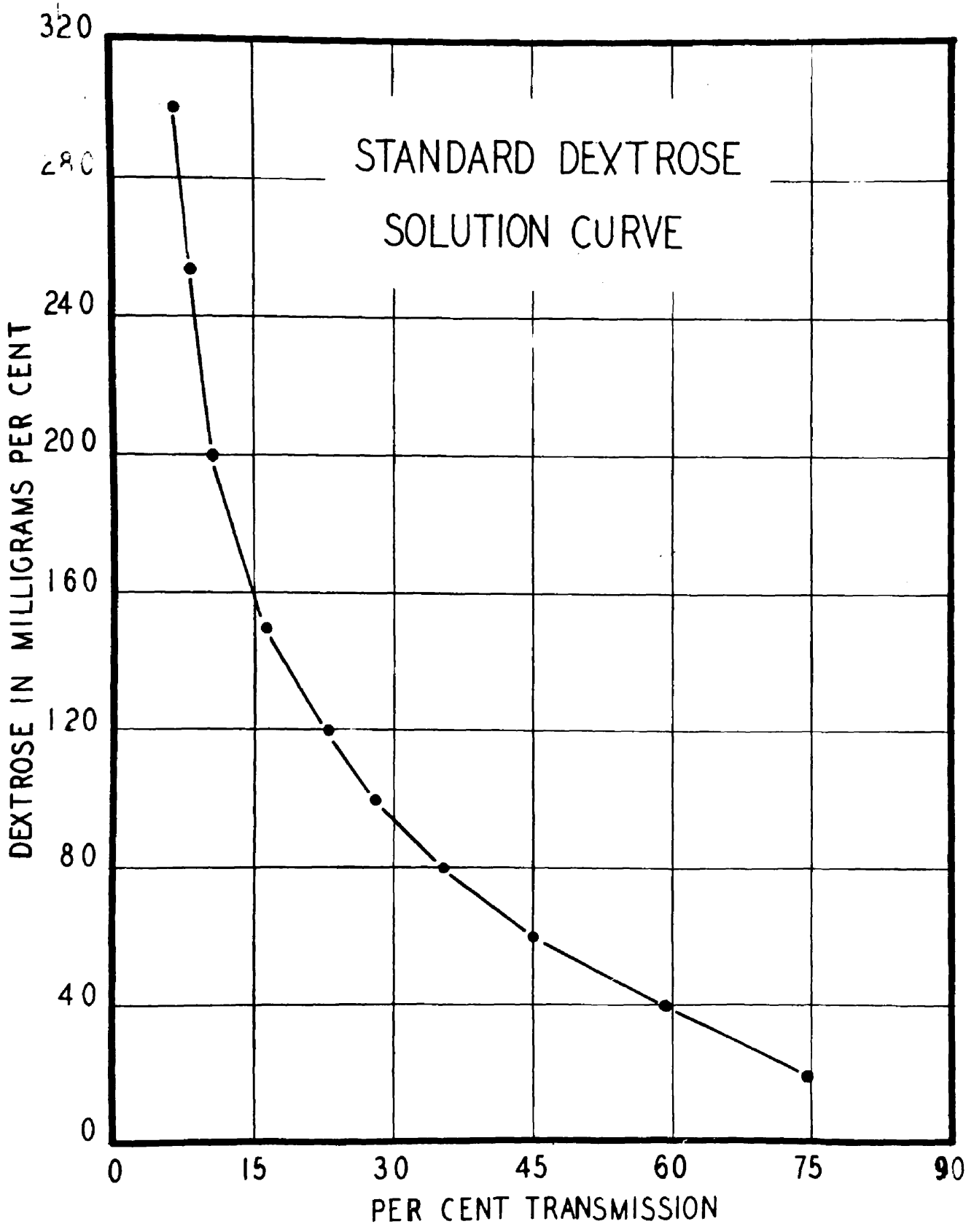
STANDARD DEXTROSE
SOLUTION CURVE
DEXTROSE IN MILLIGRAMS PER CENT
320
280
240
200
160
120
80
40
0
0
15
30
45
60
75
90
PER CENT TRANSMISSION

Figure 2.

CHANGE IN BODY WEIGHT DURING INFECTION

The mean change in body weight of the adult albino rat infected with Trypanosoma equiperdum is given in Table 6. The mean change in body weight of the normal adult albino rat observed over a period equivalent to the duration of the trypanosome infection is given in Table 5.

The trypanosome growth curve (Figure 3) is superimposed for reference.

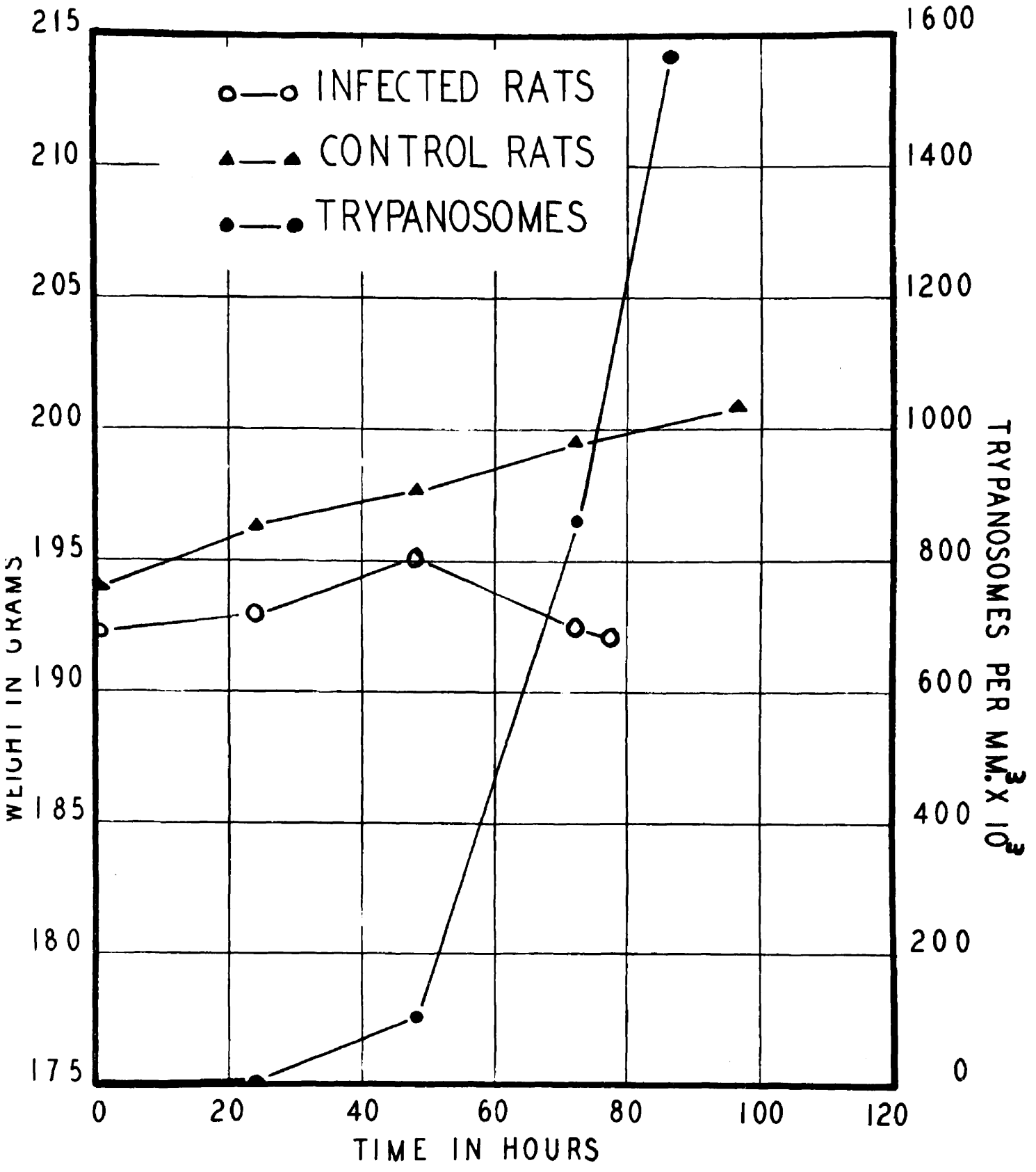
INFECTED RATS
CONTROL RATS
TRYPANOSOMES
WEIGHT IN GRAMS
TRYPANOSOMES PER MM.³ X 10³
TIME IN HOURS
215
210
205
200
195
190
185
180
175
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120

Figure 3.

TRYPANOSOME GROWTH CURVE

The increase in number of trypanosomes in the normal adult albino rat infected with Trypanosoma equiperdum is given in Tables 7, 8 and 9.

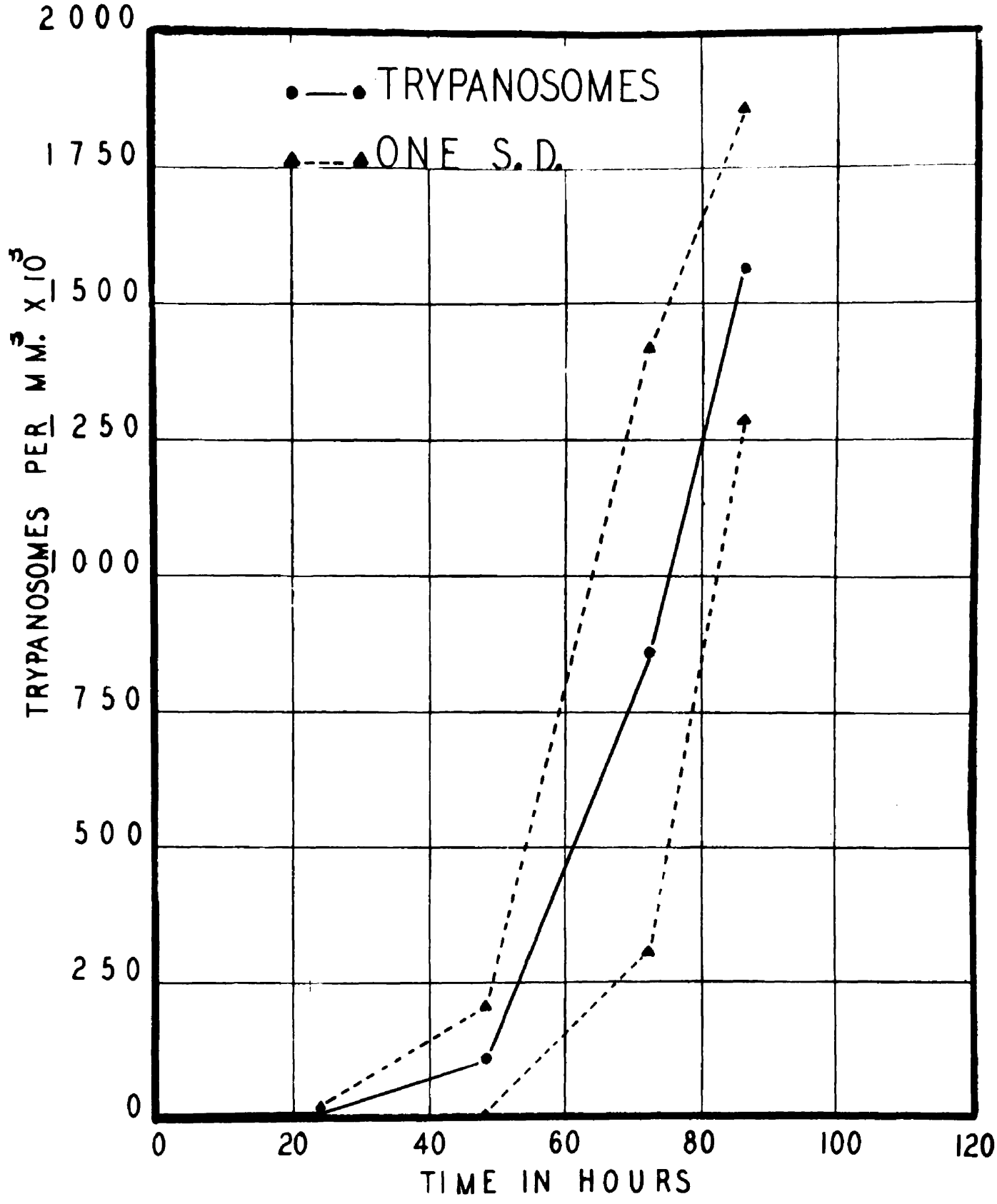
TRYPANOSOMES
ONE S.D.
TRYPANOSOMES PER MM.³ X 10³
2000
1750
1500
1250
1000
750
500
250
0
0
20
40
60
80
100
120
TIME IN HOURS

Figure 4.

ERYTHROCYTE COUNT DURING INFECTION

The mean change in the erythrocyte count of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 13, 14, 15, 16 and 17. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 4, page 70

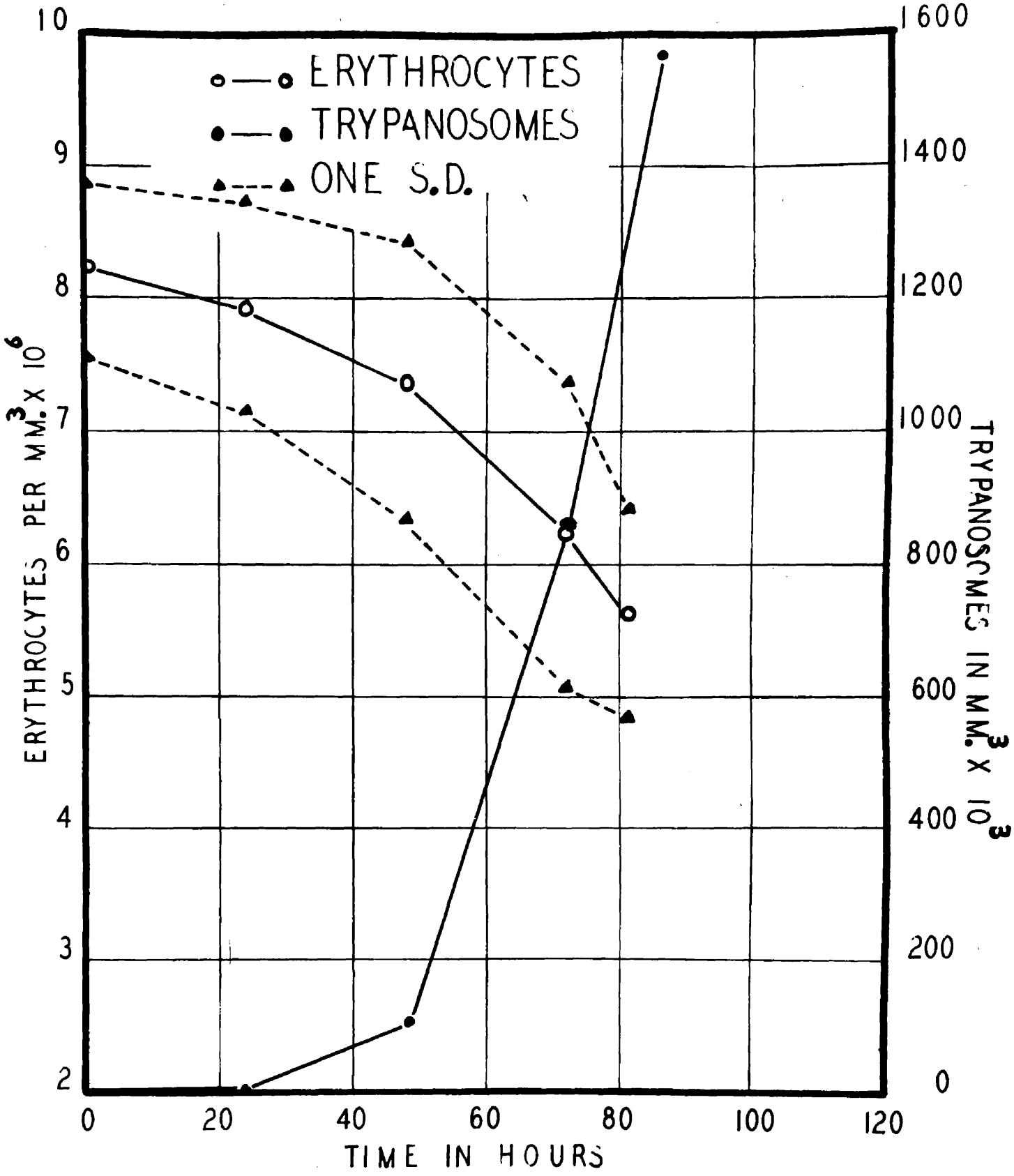

Figure 5.

HEMOGLOBIN DURING INFECTION

The mean change in the hemoglobin content of the blood of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 18, 19, 20, 21 and 22. The trypanosome growth curve (Figure 3) is superimposed for reference.

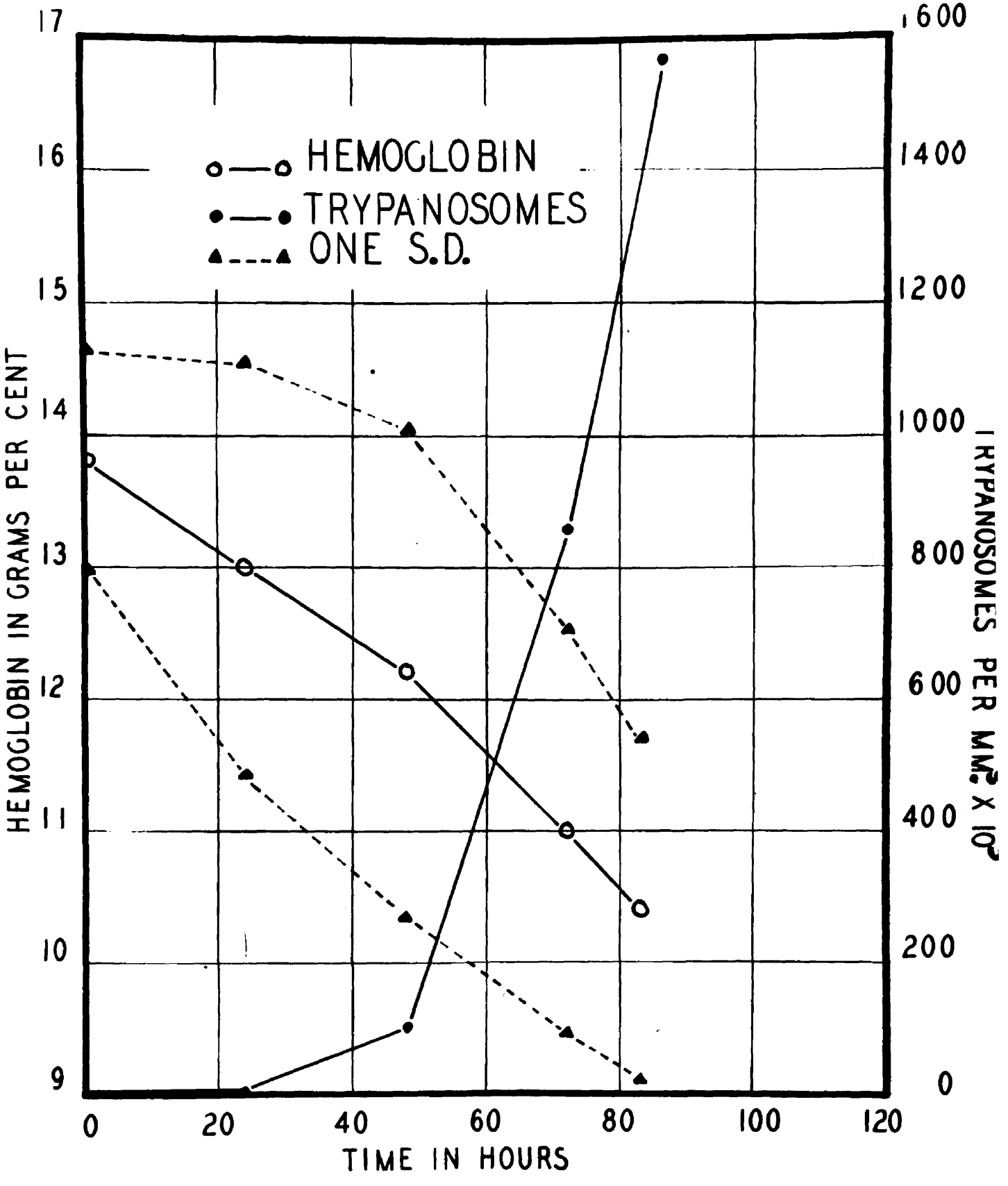
HEMOGLOBIN
TRYPANOSOMES
ONE S.D.
HEMOGLOBIN IN GRAMS PER CENT
TRYPANOSOMES PER MM³ X 10
TIME IN HOURS
17
16
15
14
13
12
11
10
9
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120

Figure 6.

PACKED CELL VOLUME DURING INFECTION

The mean change in the packed cell volume of the blood of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 23, 24, 25, 26 and 27. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 6, page 72

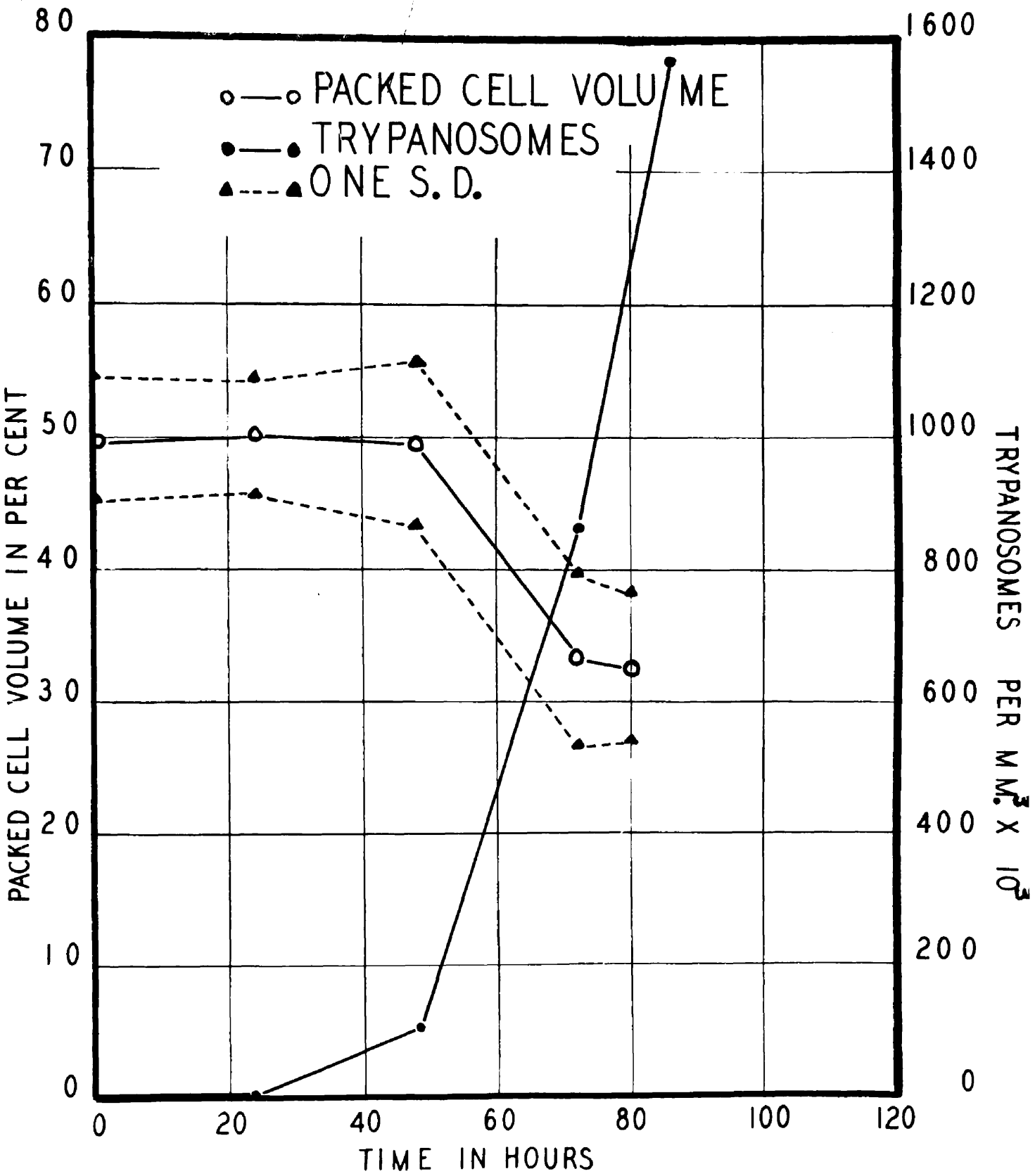

Figure 7.

SEDIMENTATION RATE DURING INFECTION

The mean change in the sedimentation rate in the adult albino rat infected with Trypanosoma equiperdum is given in Tables 28, 29, 30, 31 and 32. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 7, page 73

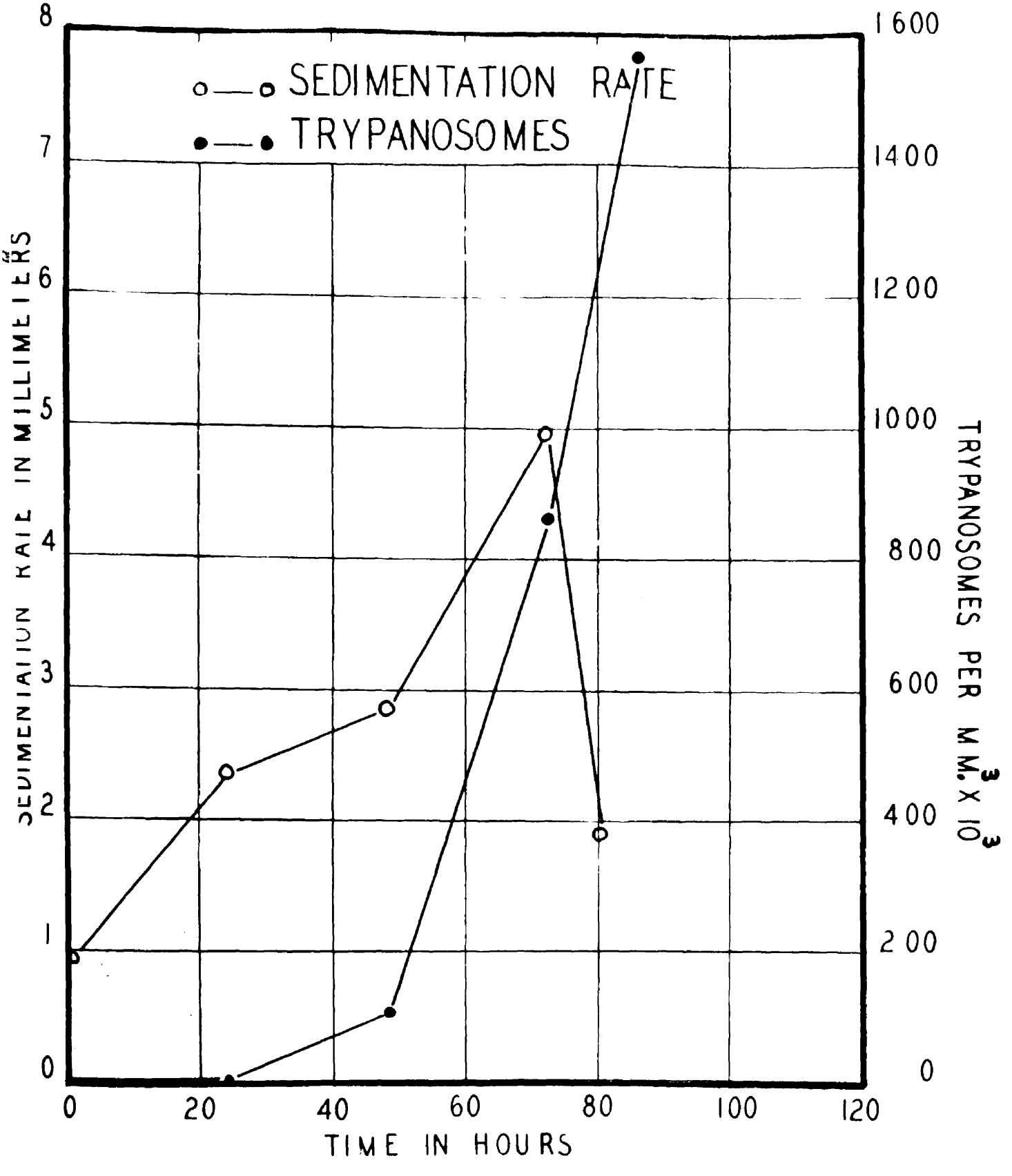

Figure 8.

COAGULATION TIME DURING INFECTION

The mean change in the coagulation time of the blood in the adult albino rat infected with Trypanosoma equiperdum is given in Tables 33, 34, 35, 36 and 37. The trypanosome growth curve (Figure 3) is superimposed for reference.

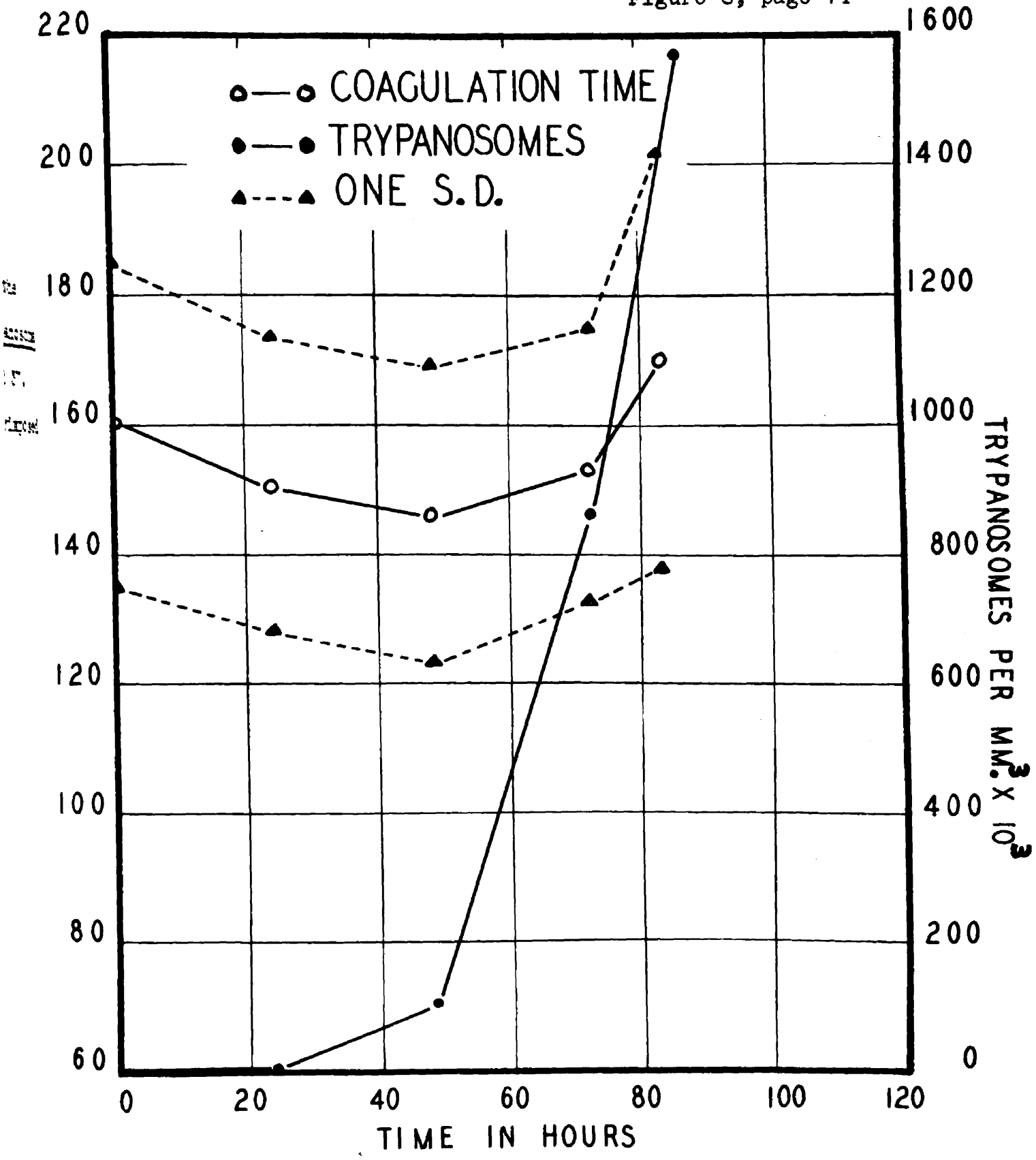
COAGULATION TIME
TRYPANOSOMES
ONE S.D.
220
200
180
160
140
120
100
80
60
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120
TIME IN HOURS
TRYPANOSOMES PER MM.³ X 10³

Figure 9.

PLATELET COUNT DURING INFECTION

The mean change in the platelet count of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 38, 39, 40, 41 and 42. The trypanosome growth curve (Figure 3) is superimposed for reference.

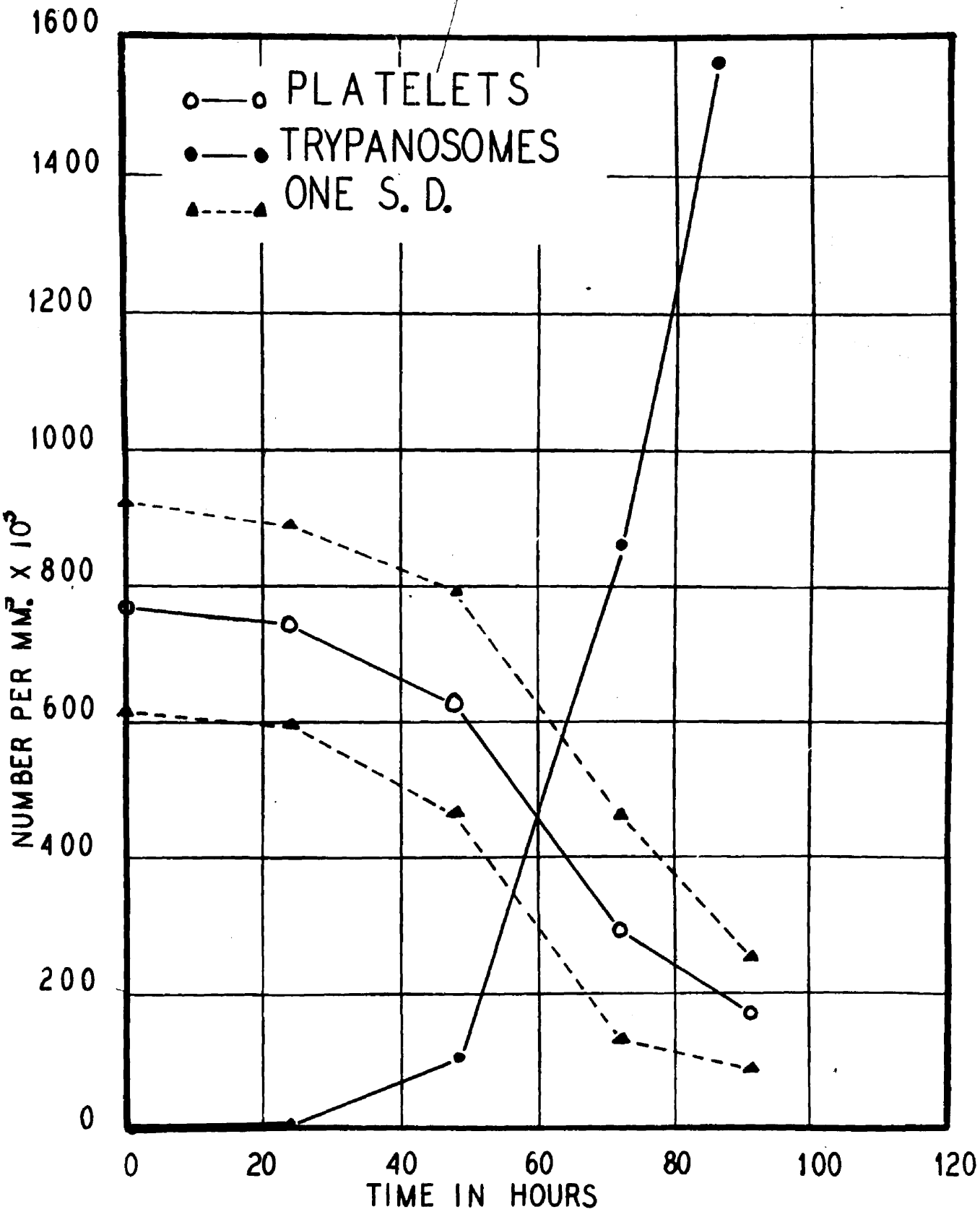
PLATELETS
TRYPANOSOMES
ONE S. D.
1600
1400
1200
1000
800
600
400
200
0
NUMBER PER MM.³ X 10³
0
20
40
60
80
100
120
TIME IN HOURS

Figure 10.

PLASMA SPECIFIC GRAVITY DURING INFECTION

The mean change in the plasma specific gravity of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 43, 44, 45, 46 and 47. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 10, page 76

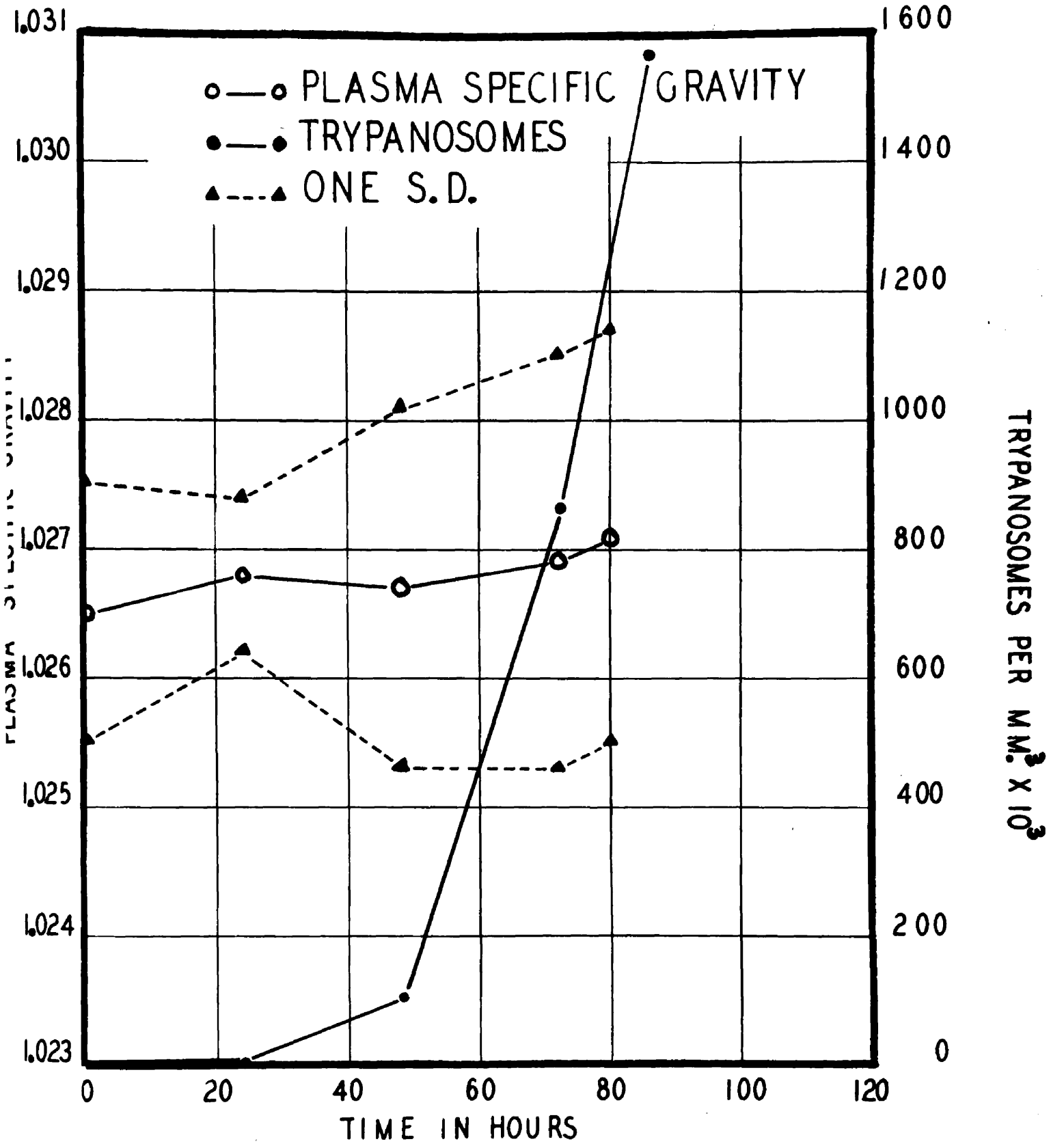

Figure 11.

TOTAL PLASMA PROTEINS DURING INFECTION

The mean change in the total plasma proteins of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 48, 49, 50, 51 and 52. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 11, page 77

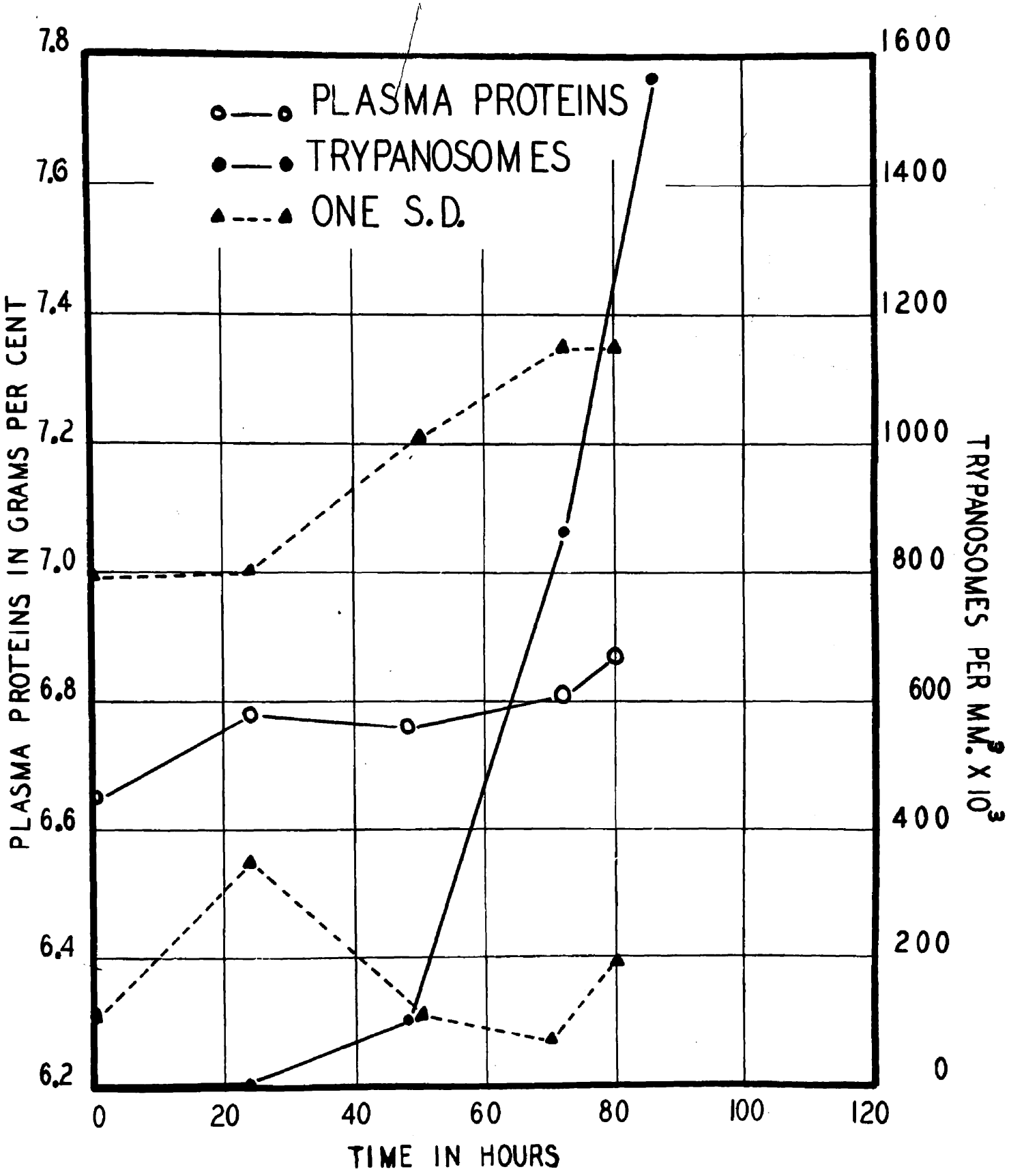

Figure 12.

TOTAL SERUM AND PLASMA PROTEINS DURING INFECTION

Comparison of the change in the total serum proteins with the total plasma proteins in the adult albino rat infected with Trypanosoma equiperdum. The mean change in the total serum proteins is given in Tables 53, 54, 55, 56 and 57. The mean change in the total plasma proteins is given in Tables 48, 49, 50, 51 and 52. The trypanosome growth curve (Figure 3) is superimposed for reference.

Figure 12, page 78

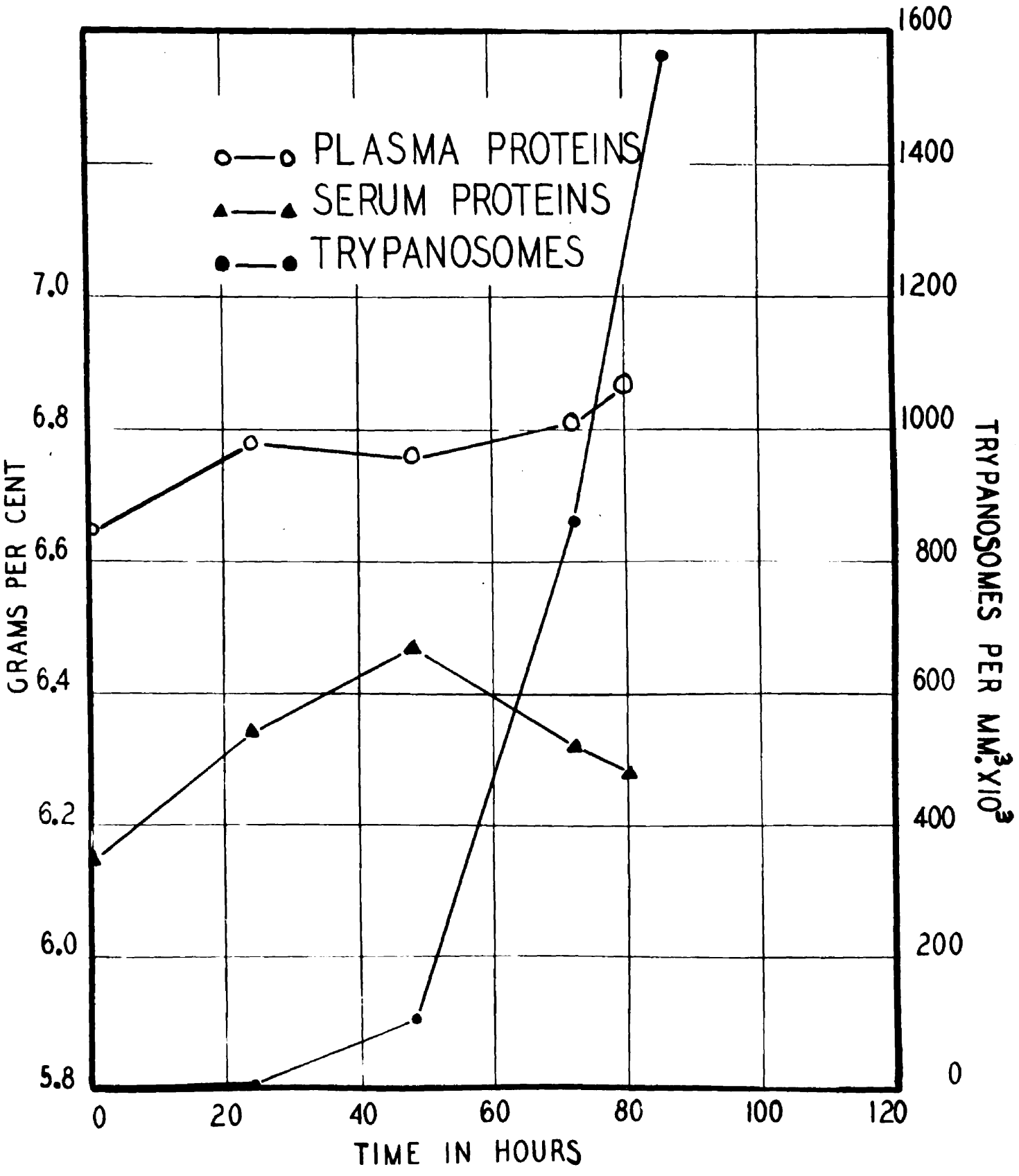

Figure 13.

BLOOD SUGAR DURING INFECTION

The mean change in the blood sugar of the adult albino rat infected with Trypanosoma equiperdum is given in Tables 60, 61, 62, 63 and 64. The trypanosome growth curve (Figure 3) is superimposed for reference.

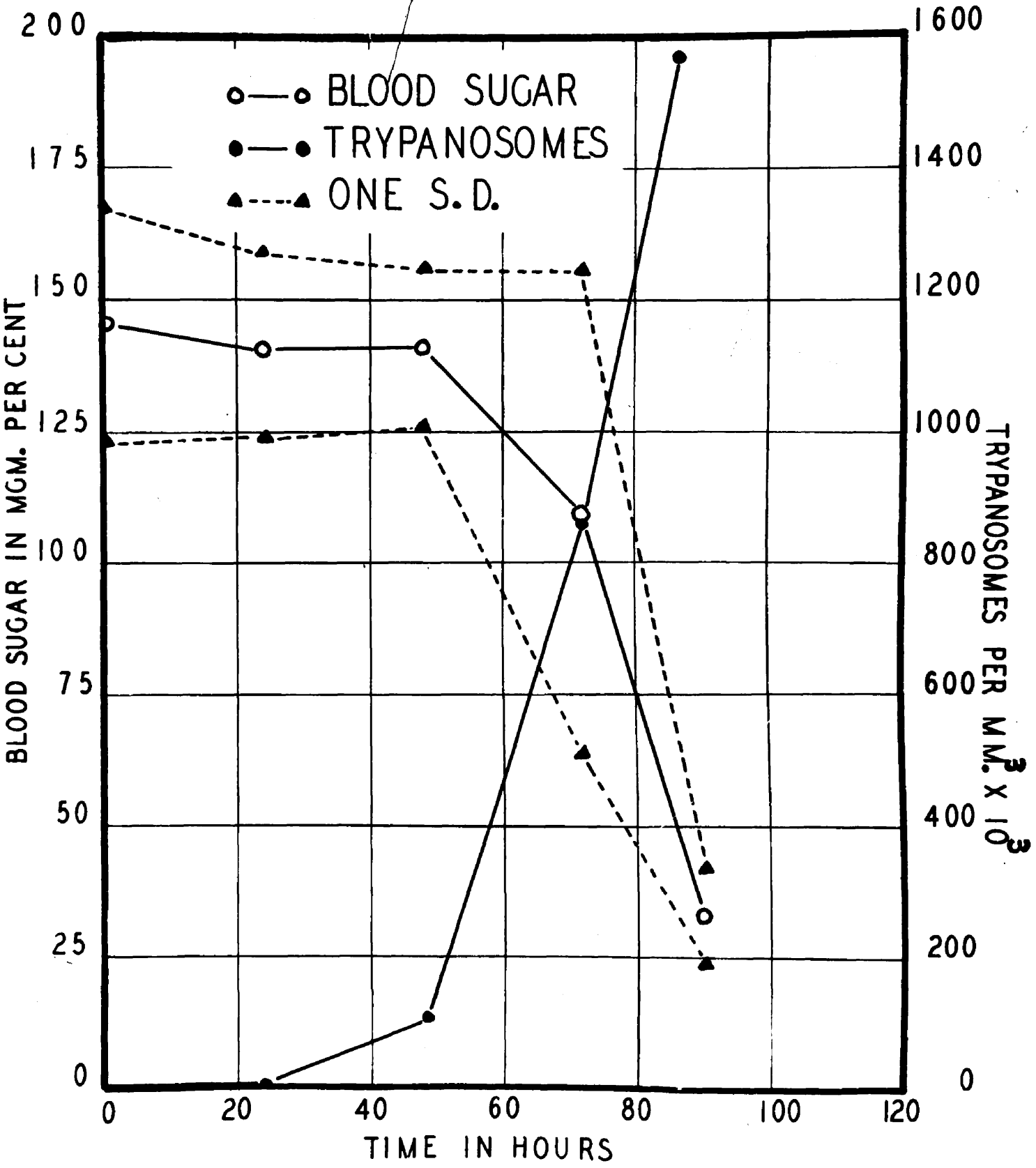
BLOOD SUGAR
TRYPANOSOMES
ONE S.D.
BLOOD SUGAR IN MGM. PER CENT
TRYPANOSOMES PER MM.³ X 10³
TIME IN HOURS
200
175
150
125
100
75
50
25
0
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120

Figure 14.

EFFECT OF GLUCOSE ON THE TRYPANOSOME COUNT

The effect of administration of 5 grams of glucose per kilogram body weight to the adult albino rat infected with Trypanosoma equiperdum is given in Table 65.

Figure 14, page 80

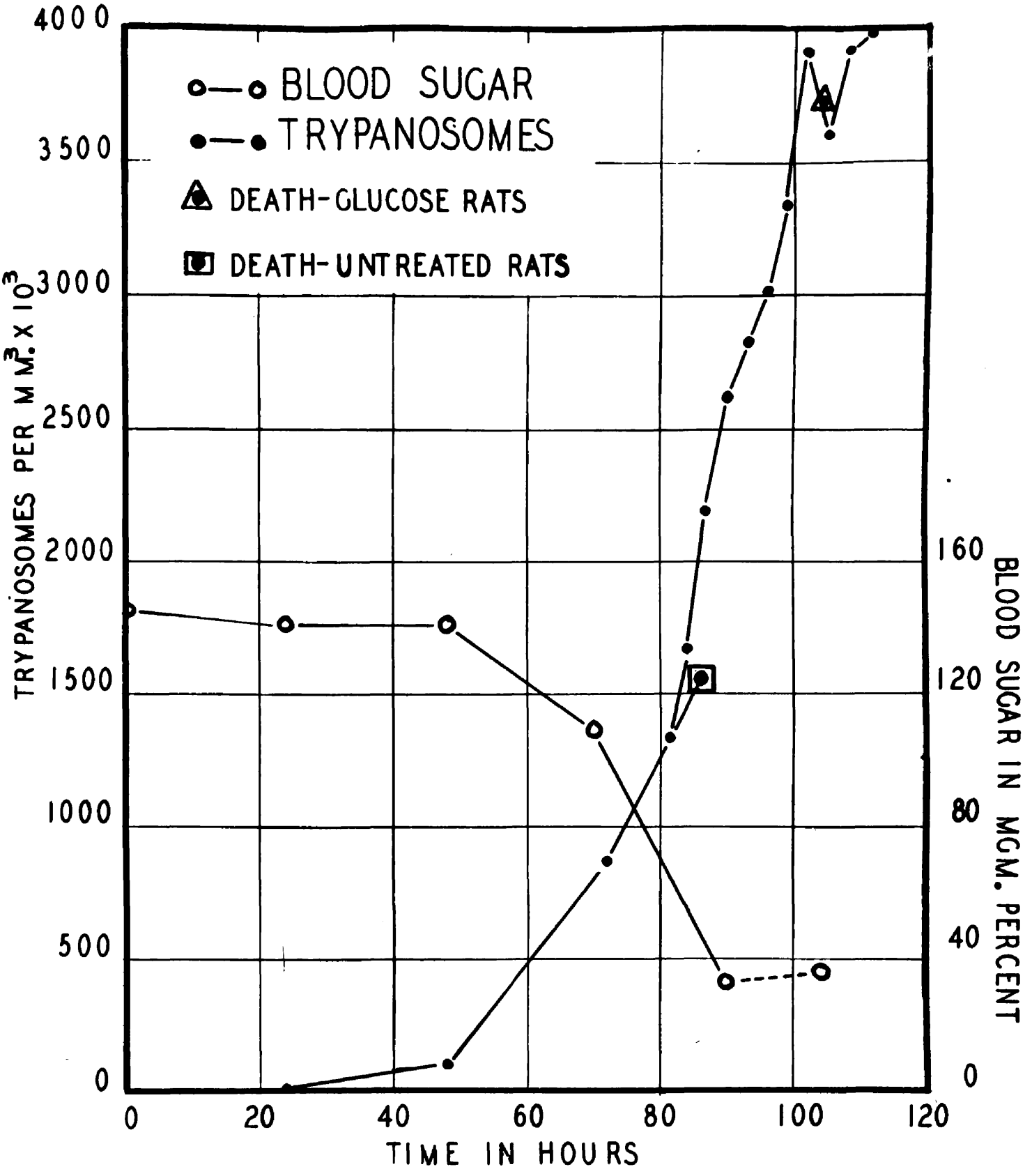

Figure 15.

BLOOD PICTURE FOLLOWING SPLENECTOMY

The effect of splenectomy on the blood of the normal adult albino rat is summarized in Table 69.

Figure 15, page 81

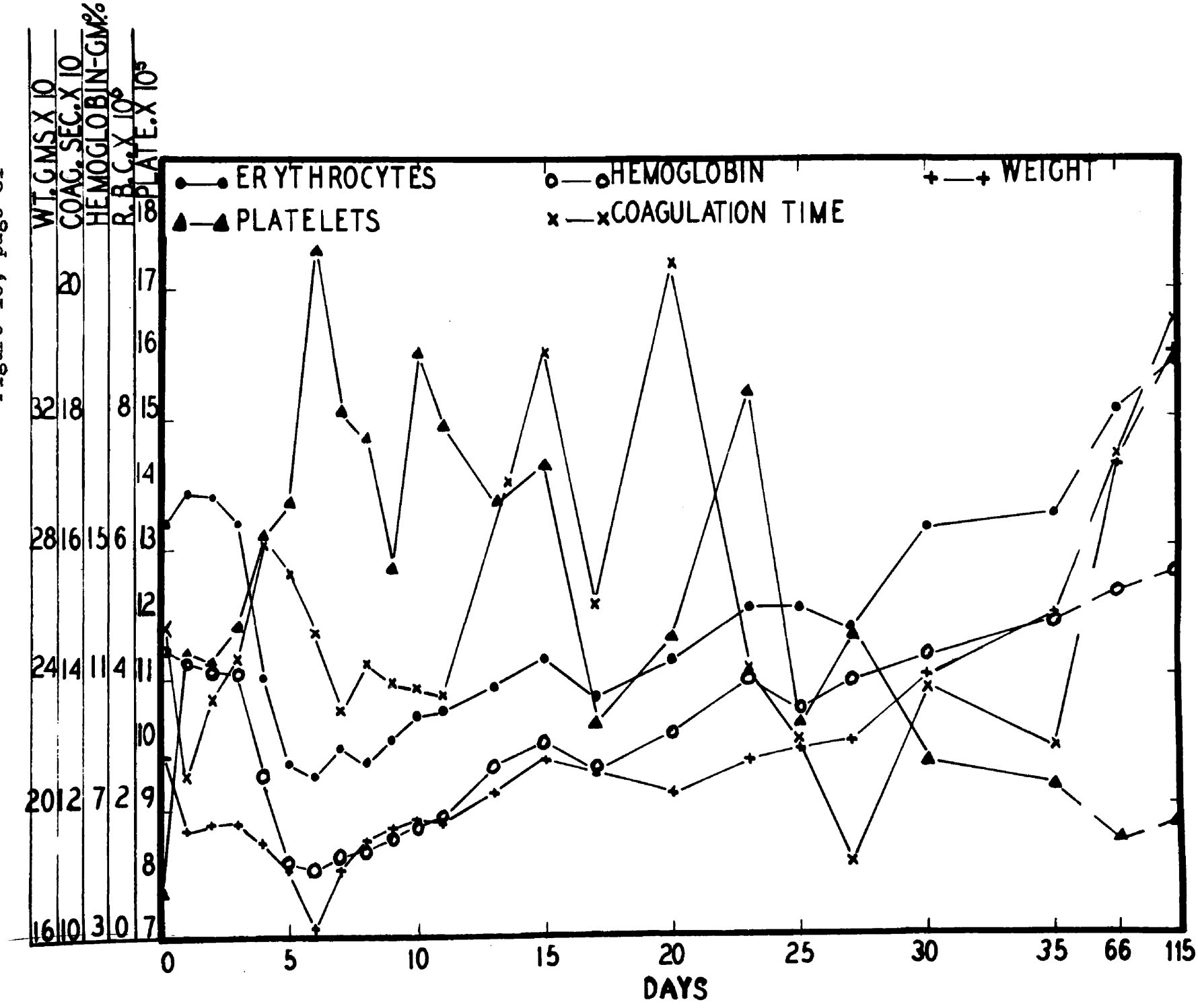

Figure 16.

BLOOD PICTURE FOLLOWING REPEATED HEMORRHAGE

The effect of repeated hemorrhage on the blood of the normal adult albino rat is summarized in Table 70.

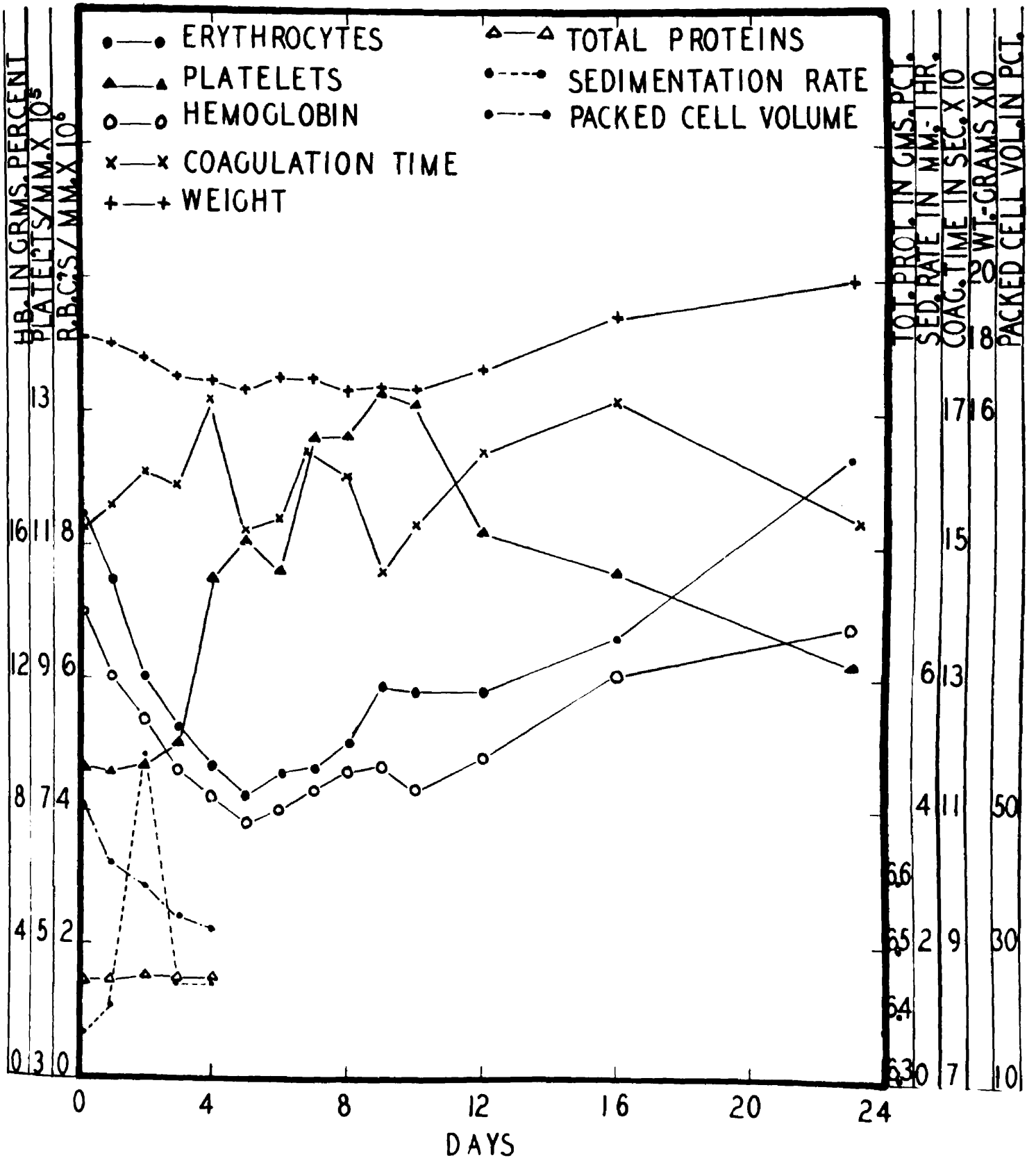
ERYTHROCYTES
PLATELETS
HEMOGLOBIN
COAGULATION TIME
WEIGHT
TOTAL PROTEINS
SEDIMENTATION RATE
PACKED CELL VOLUME
HB. IN GRMS. PERCENT
PLATELETS/MM.X 10⁵
R.B.C'S/MM.X 10⁶
TOT. PROT. IN GMS. PCT.
SED. RATE IN MM. 1 HR.
COAG. TIME IN SEC. X 10
WT.-GRAMS X 10
PACKED CELL VOL. IN PCT.
DAYS

TABLE 1

NUMBER OF ANIMALS USED IN EACH DETERMINATION

	BEFORE	DURING INFECTION			
	INFECTION	Time in hours after infection			
EXPERIMENT	Normals	24	48	72	Death
Erythrocytes*	100	--	--	--	--
Erythrocytes	40	40	40	40	32
Trypanosome Growth Curve	--	202	208	191	101
Body Weight	35	36	36	36	36
Hemoglobin	56	47	44	42	40
Packed Cell Volume	39	33	33	34	43
Sedimentation Rate	40	33	33	34	34
Coagulation Time	58	49	47	44	40
Platelets	46	88	83	81	40
Plasma Proteins and Specific Gravity	44	33	33	36	36
Serum Proteins	22	9	7	8	25
Fibrinogen	21	--	--	--	24
Blood Sugar	100	40	42	40	40
Smear Counts	--	20	20	20	--
Survival Time	--	--	--	--	314
Adding Glucose	--	--	--	--	38

* to establish normal count for use in smear method of counting trypanosomes.

TABLE 2.

TRYPANOSOME COUNT BY HEMOCYTOMETER AND SMEAR METHODS

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	HEMOCYTOMETER METHOD Tryps./cmm.	SMEAR METHOD Factor 8.48 x10^6 (Normal R.B.C.) Tryps./cmm.	SMEAR METHOD Factor 5.62 x10^6 (Death R.B.C.) Tryps./cmm.
31	10,000	34,000	22,500
34	4,000	8,480	5,620
35	4,000	76,500	50,500
36	14,000	17,000	11,200
37	4,000	4,240	2,810
38	2,000	4,240	2,810
48	2,000	2,120	1,410
49	8,000	8,480	5,620
52	14,000	68,000	45,000
53	2,000	25,500	16,800
54	2,000	4,240	2,810
55	12,000	34,000	22,500
56	28,000	68,000	45,000
57	44,000	68,000	45,000
58	26,000	34,000	22,500
59	2,000	4,240	2,810
60	2,000	4,240	2,810
61	2,000	4,240	2,810
62	4,000	8,480	5,620
63	2,000	8,480	5,620
Average:	9,400	24,320	16,087
Per cent increase over Hem.count:		258%	171%

TABLE 3.

TRYPANOSOME COUNT BY HEMOCYTOMETER AND SMEAR METHODS

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	HEMOCYTOMETER METHOD Tryps./cmm.	SMEAR METHOD Factor 8.48 x10^6 (Normal R.B.C.) Tryps./cmm.	SMEAR METHOD Factor 5.62 x10^6 (Death R.B.C.) Tryps./cmm.
31	248,000	324,000	215,000
34	200,000	475,000	314,000
35	264,000	440,000	292,000
36	56,000	210,000	135,000
37	12,000	42,500	28,000
38	126,000	212,000	140,000
48	30,000	19,000	12,000
49	308,000	780,000	491,000
52	374,000	485,000	320,000
53	116,000	119,000	78,400
54	40,000	102,000	67,400
55	480,000	882,000	584,500
56	232,000	535,000	354,000
57	490,000	835,000	550,000
58	220,000	535,000	354,000
59	12,000	34,000	22,400
60	4,000	34,000	22,400
61	6,000	25,500	16,800
62	12,000	17,000	11,200
63	68,000	80,000	45,000
Average:	164,900	309,000	202,600
Per cent incr. over Hem. count:		188%	123%

TABLE 4.

TRYPANOSOME COUNT BY HEMOCYTOMETER AND SMEAR METHODS

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	HEMOCYTOMETER METHOD Tryps./cmm.	SMEAR METHOD Factor 8.48 x10^6 (Normal R.B.C.) Tryps./cmm.	SMEAR METHOD Factor 5.62 x10^6 (Death R.B.C.) Tryps./cmm.
31	650,000	1,560,000	1,060,000
34	770,000	867,000	573,000
35	536,000	952,000	629,000
36	484,000	1,500,000	1,000,000
37	328,000	520,000	342,000
38	800,000	1,850,000	1,240,000
43	652,000	744,000	490,000
44	402,000	804,000	528,000
46	1,006,000	1,500,000	989,000
50	510,000	640,000	420,000
51	390,000	630,000	415,000
53	400,000	680,000	470,000
45	1,034,000	1,950,000	1,290,000
54	530,000	500,000	330,000
59	288,000	810,000	535,000
60	164,000	470,000	310,000
61	162,000	450,000	298,000
62	400,000	840,000	555,000
63	708,000	1,130,000	748,000
64	210,000	670,000	445,000
Average:	516,200	953,350	633,350
Per cent incr. over Hem. count:		185%	123%

TABLE 5.

CHANGE IN BODY WEIGHT OF NORMAL RATS OVER PERIOD EQUIVALENT TO DURATION OF TRYPANOSOME INFECTION

		BODY WEIGHT IN GRAMS Days				
Rat No.	Sex	0	1	2	3	4
527	M	197	194	196	198	200
528	M	202	207	210	212	210
529	M	178	182	180	184	186
530	M	210	211	217	220	222
531	M	200	205	207	210	211
532	M	187	195	201	202	205
533	M	204	209	210	210	213
534	M	210	213	210	213	214
535	M	208	207	208	210	212
536	M	210	212	214	220	223
537	M	204	209	214	211	212
538	M	191	197	190	193	195
539	M	190	188	191	193	193
540	M	218	221	216	220	224
541	M	205	212	212	214	212
542	M	190	198	198	200	202
543	M	220	228	224	222	225
544	M	179	182	187	186	188
545	M	189	193	194	196	197
546	M	173	173	176	178	180

TABLE 5. (continued)

Rat No.	Sex	0	1	2	3	4
547	M	199	198	201	201	201
548	M	178	185	181	185	183
549	M	156	160	161	162	163
550	M	182	176	182	186	187
551	M	191	191	194	196	200
552	M	199	199	199	199	201
553	M	166	167	172	176	178
554	M	191	192	194	196	198
555	M	175	178	183	185	186
556	M	174	178	181	182	184
557	M	196	197	199	207	207
558	M	204	202	204	206	204
559	M	234	235	234	232	233
560	M	185	189	184	185	187
561	M	191	194	193	194	195
Average weight=		194.0	196.4	197.6	199.5	200.9
Average gain =		--	2.4	1.2	1.9	1.4

Total Average gain = 1.7 grams per day

Number rats used = 35

TABLE 6.

CHANGE IN BODY WEIGHT OF RATS INFECTED

WITH TRYPANOSOMA EQUIPERDUM

Rat No.	Sex	BODY WEIGHT IN GRAMS Time in hours after infection 0	24	48	72	77
38	M	238	238	242	240	240
63	M	172	172	178	170	170
72	M	154	154	156	150	150
74	M	192	192	186	188	188
76	M	188	188	196	190	190
77	M	230	230	226	230	230
71	M	178	182	182	182	178
82	M	190	206	204	190	190
250	M	168	168	170	168	168
248	M	188	188	185	186	182
249	M	192	192	184	182	180
251	M	216	216	211	207	207
253	M	244	244	244	242	242
260	M	132	132	130	134	134
261	M	198	198	200	198	198
263	M	187	187	190	198	198
264	M	172	172	174	174	174
270	M	174	174	182	184	184
272	M	200	200	202	203	203
273	M	220	220	224	219	219

TABLE 6. (continued)

Rat No.	Sex	0	24	48	72	77
276	M	188	188	181	182	182
277	M	218	218	226	227	227
279	M	185	185	192	188	188
280	M	184	184	194	188	188
281	M	206	206	228	231	231
290	M	176	176	177	168	168
295	M	212	212	212	208	208
298	M	202	202	200	200	200
299	M	206	206	202	199	199
349	M	196	196	202	195	195
350	M	180	180	183	170	170
351	M	164	164	174	177	177
355	M	156	156	165	164	164
359	M	220	220	220	220	220
364	M	180	182	182	168	168
368	M	220	220	220	212	212
Average weight=		192.4	193.0	195.1	192.5	192.3
Average change=			0.6	2.1	-2.6	-0.2

Number rats used = 36

TABLE 7.

NUMBER OF TRYPANOSOMES PER CUBIC MILLIMETER OF BLOOD

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
48	262	2	62	168	4	84	158	2
49	214	8	63	172	2	98	260	2
51	220	0	64	194	2	99	233	2
52	256	14	65	212	4	102	222	4
53	210	2	66	184	2	103	285	8
45	234	0	67	140	2	107	176	2
31	300	10	68	150	2	108	230	2
34	228	4	69	250	2	144	170	10
35	292	4	70	196	2	149	150	2
36	224	14	72	154	10	150	186	6
37	298	4	73	202	2	155	172	2
38	238	2	74	192	6	156	184	2
54	176	2	75	198	2	157	173	2
55	180	12	76	188	2	161	176	2
56	194	28	77	230	6	162	178	14
57	196	44	79	203	6	167	168	4
58	170	26	80	156	2	169	188	0
59	206	2	81	225	2	170	152	8
60	188	2	82	206	6	177	172	2
61	190	2	83	172	2	179	140	0

TABLE 7. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
180	138	18	239	162	2	272	200	12
182	156	6	240	212	8	273	220	10
189	170	2	241	218	14	274	216	2
190	160	2	242	186	14	275	178	2
194	132	2	245	206	0	276	188	6
195	140	8	246	212	0	277	218	8
200	154	4	247	172	8	278	188	0
202	164	4	248	188	0	279	185	6
208	196	2	249	192	4	280	184	10
209	198	2	250	168	0	281	206	0
213	186	2	251	216	0	282	206	10
214	144	2	252	192	0	283	170	0
215	176	2	253	244	2	284	182	6
216	156	10	260	132	2	285	130	4
217	174	2	261	198	0	286	189	10
218	174	2	262	177	0	287	167	0
219	184	0	263	187	4	288	190	0
220	350	0	264	172	0	289	225	10
221	181	2	265	178	0	290	176	20
224	169	10	266	186	0	291	186	0
226	175	10	267	224	0	292	184	6
228	202	26	268	177	0	293	231	0
229	202	8	269	226	0	294	208	0
231	200	0	270	174	2	295	212	8
234	202	4	271	206	0	296	207	10

TABLE 7. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
297	214	6	322	196	0	350	180	0
298	202	30	323	211	0	351	164	10
299	206	4	324	204	0	356	172	6
300	315	0	325	186	2	357	140	10
301	230	0	326	212	2	358	186	2
302	288	2	327	227	2	359	220	4
303	252	0	328	193	2	360	203	0
304	209	8	329	170	0	363	180	4
305	224	2	330	206	4	364	182	2
306	268	2	331	219	0	369	186	10
307	230	0	332	150	0	370	193	10
308	198	4	333	222	2	371	232	4
309	216	8	334	234	4	376	200	0
310	214	2	335	186	0	377	213	2
311	268	0	336	210	2	379	218	2
312	196	0	337	203	4	394	186	2
313	272	2	338	172	2	395	171	10
314	234	6	339	213	0	Ave.=	197.6	4.4
315	212	0	340	190	6	No. Rats...		202
316	175	12	341	192	6	Mean.....		4.4
317	192	2	342	146	0	σ		5.89
318	154	0	345	181	2	σ in %.....		134
319	210	12	346	174	0	ϵ		0.415
320	214	0	347	232	2	ϵ in %.....		9.45
321	218	4	349	196	10			

TABLE 8.

NUMBER OF TRYPANOSOMES PER CUBIC MILLIMETER OF BLOOD

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
43	236	250	63	178	68	102	210	190
44	250	56	64	200	68	103	278	82
48	260	30	65	218	64	107	168	4
49	220	308	66	184	12	108	222	32
51	220	44	67	140	32	144	170	142
52	240	374	68	154	16	149	150	88
53	190	116	69	246	22	150	186	24
45	214	260	70	196	2	155	150	32
31	300	248	72	156	24	156	182	6
34	220	200	73	202	16	157	166	32
35	284	264	74	186	68	161	176	180
36	228	56	75	195	4	162	178	130
37	284	12	76	196	64	167	178	80
38	242	126	77	226	124	169	190	120
54	178	40	79	198	110	171	160	170
56	194	232	80	156	140	172	240	210
58	170	220	81	232	98	177	174	50
59	202	12	82	204	44	178	140	2
60	184	4	83	174	8	179	138	22
61	190	6	98	258	26	180	142	310
62	175	12	99	228	28	182	155	40

TABLE 8. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
184	134	60	243	198	30	278	184	0
189	174	16	244	206	30	279	192	130
190	164	20	248	185	140	280	194	220
194	126	32	249	184	64	281	228	260
195	140	166	250	170	98	282	196	230
200	174	42	251	211	100	283	174	0
201	142	30	252	192	0	284	178	110
202	163	60	253	244	70	285	133	180
208	194	30	260	130	100	286	186	110
209	202	30	261	200	80	287	174	230
213	184	50	262	176	0	288	191	0
215	176	22	263	190	90	289	220	90
216	160	230	264	174	120	290	177	190
217	184	18	265	182	0	291	184	0
218	171	26	266	186	80	292	192	72
219	185	24	267	220	80	293	240	90
220	342	20	268	171	190	294	205	0
222	160	18	269	216	10	295	212	200
223	168	28	270	182	130	296	216	100
228	204	41	271	218	0	297	218	90
231	195	419	272	202	130	300	318	10
235	174	196	273	224	250	301	228	38
239	156	154	274	224	20	302	282	36
240	210	140	275	183	40	303	238	16
241	198	160	276	181	180	304	206	60
242	182	540	277	226	130	305	220	50

TABLE 8. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
306	226	4	333	212	68	367	212	520
307	262	60	334	224	48	368	220	220
308	196	144	335	181	52	369	190	222
309	204	90	336	210	86	370	194	300
310	210	150	337	196	68	371	232	108
311	260	170	338	156	48	374	246	260
312	183	90	339	210	116	375	202	12
313	265	50	340	174	124	376	200	130
314	216	60	341	171	300	377	210	100
315	210	4	342	146	10	379	214	204
316	170	226	345	170	110	381	221	76
317	179	192	346	173	62	382	236	50
318	158	0	347	220	60	394	183	206
319	214	130	349	202	84	396	205	70
320	204	46	350	183	90	397	220	108
321	218	50	351	174	90	Ave.=	197	104
322	194	0	354	169	300	No. Rats...	208	
323	211	20	355	165	250	Mean.....	104	
324	180	0	356	174	320	σ.....	103	
325	166	50	357	144	430	σ in %.....	99	
326	190	60	361	212	112	ϵ.....	7.22	
327	223	70	362	191	60	ϵ in %.....	6.94	
328	194	20	363	182	146			
330	200	100	364	182	130			
331	217	20	365	176	370			
332	148	0	366	212	504			

TABLE 9.

NUMBER OF TRYPANOSOMES PER CUBIC MILLIMETER OF BLOOD

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
43	230	652	21	250	780	98	252	264
44	250	402	22	210	435	99	228	442
46	172	1,006	24	200	828	103	275	940
50	318	510	30	214	100	107	170	126
51	216	390	41	200	576	108	228	402
53	200	400	42	230	472	144	146	1,384
45	210	1,034	65	214	430	149	150	840
31	296	650	66	182	410	150	182	920
34	216	770	67	140	630	156	182	300
35	274	536	68	154	590	157	166	420
36	220	484	69	246	654	161	176	1,050
37	278	328	72	150	1,080	162	178	910
38	240	800	73	192	460	167	176	1,250
54	174	530	74	188	920	169	182	1,030
59	200	288	75	190	144	170	152	650
60	184	164	76	190	600	171	164	1,000
61	194	162	77	230	806	172	230	1,060
62	178	400	79	198	640	177	176	340
63	170	708	80	150	490	178	149	340
64	200	210	81	238	590	179	136	500

TABLE 9. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
180	132	1,540	235	172	1,660	277	227	1,630
184	138	686	241	218	1,210	278	182	0
189	174	290	242	186	1,500	279	188	1,750
190	160	502	248	182	900	280	188	1,490
194	128	760	249	180	800	281	231	1,660
195	136	1,100	250	168	1,200	283	177	0
200	168	1,050	251	207	900	284	182	760
201	140	560	252	196	0	285	132	1,330
202	160	850	253	242	980	286	181	1,740
208	198	1,120	260	134	890	287	166	1,120
209	202	690	261	198	910	288	190	0
213	184	750	262	180	0	289	214	1,460
215	174	700	263	198	990	290	168	1,060
216	158	1,090	264	174	1,300	291	189	0
217	186	530	265	182	10	292	183	990
218	172	630	266	190	960	293	238	1,090
219	190	350	267	233	720	294	216	0
220	338	220	269	226	410	295	208	1,400
221	185	360	270	184	1,610	298	200	1,540
222	158	310	271	218	90	299	199	1,830
224	156	1,690	272	203	1,570	300	296	380
226	178	1,690	273	219	1,480	301	211	790
229	194	660	274	226	880	302	278	430
231	198	980	275	192	470	303	224	310
234	206	450	276	182	2,000	304	202	960

TABLE 9. (continued)

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
305	215	1,460	333	192	1,300	373	177	20
306	222	80	334	208	1,300	374	237	1,620
307	250	800	335	158	1,450	375	207	140
308	178	430	336	206	1,830	376	192	1,000
309	189	1,380	337	190	1,010	377	209	900
310	202	1,560	338	156	1,650	379	205	1,800
311	253	1,100	339	203	1,450	Ave.=	196	860
312	184	1,060	340	188	1,250	No. Rats...		191
313	258	1,850	341	186	1,770	Mean.....		860
314	212	1,430	346	170	1,420	σ.....		556
315	214	350	347	220	1,230	σ in %.....		64.8
316	162	1,430	349	195	1,730	ϵ.....		62.2
317	172	1,320	350	170	1,500	ϵ in %.....		7.24
318	158	10	351	177	2,100			
319	206	1,740	352	194	8			
321	210	900	353	170	0			
322	190	8	355	164	1,980			
323	208	110	359	220	1,140			
324	180	0	360	204	0			
325	160	810	361	202	2,200			
326	192	740	362	190	1,970			
327	209	890	364	168	1,740			
328	187	1,070	368	212	1,950			
330	188	1,300	371	232	1,700			
331	196	390	372	210	0			

TABLE 10.

NUMBER OF TRYPANOSOMES PER CUBIC MILLIMETER OF BLOOD AT DEATH - EIGHTY SIX HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000	Rat No.	Weight in Gm.	Tryps. x1000
46	172	1,006	189	163	1,400	264	174	1,300
45	210	1,034	214	140	1,210	252	190	1,980
71	178	1,240	216	156	1,750	270	184	1,610
72	150	1,080	222	151	1,650	272	203	1,570
85	176	1,600	224	156	1,690	273	219	1,480
98	244	1,370	226	178	1,690	276	182	2,000
100	246	1,116	235	172	1,660	277	227	1,630
107	162	1,192	233	178	970	279	188	1,750
132	152	1,740	149	146	1,980	280	188	1,490
134	156	1,540	242	186	1,500	281	231	1,660
135	155	1,670	246	188	1,700	290	168	1,290
137	158	968	250	168	1,900	295	208	1,400
144	146	1,384	263	198	1,890	298	200	1,540
156	175	1,130	248	182	1,550	299	199	1,830
163	170	1,540	249	180	1,100	300	289	1,650
176	178	1,984	251	207	1,250	303	214	1,980
178	146	1,740	253	242	1,340	305	215	1,460
145	170	1,290	260	134	1,310	310	202	1,560
179	134	1,780	261	198	910	313	258	1,850
180	132	1,540	245	194	1,530	314	212	1,430

TABLE 10. (continued)

Rat No.	Weight in Gm.	Tryps. x1000
315	204	1,680
316	162	1,430
317	172	1,320
319	206	1,740
323	192	1,580
328	158	2,010
331	180	1,610
333	192	1,300
334	208	1,300
335	158	1,450
336	206	1,830
337	190	1,010
338	156	1,650
339	203	1,450
341	186	1,770
342	130	1,170
346	170	1,420
347	220	1,230
349	188	1,800
350	170	1,500
351	177	2,100
355	164	1,980
359	220	1,490
361	202	2,200
362	190	1,970
360	216	1,730
364	168	1,740
368	212	1,950
371	216	1,700
374	237	1,620
373	169	1,630
375	194	1,900
372	228	1,450
376	192	1,710
377	209	1,670
379	205	1,800
381	218	1,890
382	228	1,760
380	192	1,560
394	156	1,960
395	165	1,790
Ave.=	187	1,566
No. Rats...		101
Mean.....		1,566
σ.....		287
σ in %.....		18.3
ϵ.....		28.7
ϵ in %.....		1.83

TABLE 11.

AVERAGE SURVIVAL TIME IN HOURS OF ALBINO RATS

INFECTED WITH TRYPANOSOMA EQUIPERDUM

Rat No.	Hours	Rat No.	Hours	Rat No.	Hours	Rat No.	Hours	Rat No.	Hours
5	80	25	92	31	72	67	75	85	72
6	80	26	80	45	72	68	83	86	92
7	90	27	80	34	72	69	76	87	113
8	90	28	80	35	72	70	110	88	114
10	46	29	98	36	80	71	96	89	120
9	80	30	98	37	80	72	72	90	99
11	82	39	96	38	76	73	80	91	112
12	82	40	96	54	73	74	72	92	112
13	80	41	75	55	60	75	100	93	89
14	80	42	75	56	60	76	80	94	92
15	105	43	72	57	60	77	74	95	108
16	99	44	80	58	60	78	156	98	96
17	80	46	68	59	80	79	80	99	93
18	80	47	60	60	80	80	80	102	70
19	80	48	80	61	100	81	72	103	76
20	80	49	80	62	80	82	76	107	96
21	80	50	80	63	69	83	108	108	89
22	80	51	72	64	83	84	96	111	86
23	70	52	60	65	84	86	75	115	80
24	75	53	72	66	94	88	72	116	79

TABLE 11. (continued)

Rat No.	Hours	Rat No.	Hours	Rat No.	Hours	Rat No.	Hours	Rat No.	Hours
119	88	166	66	202	90	236	160	268	65
120	88	167	82	207	207	237	160	269	80
123	78	169	87	208	84	239	80	270	76
124	78	170	77	209	93	240	80	271	110
127	98	171	86	213	90	241	80	272	78
128	98	172	86	214	145	242	68	273	75
129	80	173	86	215	90	243	80	274	80
130	78	174	102	216	79	244	80	275	80
131	135	175	108	217	84	245	121	276	74
132	126	176	120	218	100	246	97	277	77
133	80	177	80	219	80	247	90	278	132
134	48	178	96	220	80	248	82	279	78
135	72	179	86	221	93	249	82	280	77
136	100	180	72	222	96	250	81	281	77
137	72	181	96	223	90	251	83	282	74
138	102	182	84	224	72	252	144	283	348
139	74	183	186	225	168	253	82	284	82
144	78	184	84	229	90	260	83	285	82
149	100	188	432	231	90	261	83	286	82
150	88	189	96	226	76	262	160	287	94
151	124	190	92	227	160	263	78	288	145
156	98	194	95	228	68	264	71	289	82
157	95	195	89	233	145	265	132	290	79
161	90	200	78	234	80	266	80	291	252
162	90	201	92	235	73	267	80	292	84

TABLE 11. (continued)

Rat No.	Hours	Rat No.	Hours	Rat No.	Hours	Rat No.	Hours
293	84	318	110	347	74	372	142
294	160	319	75	348	160	373	101
295	75	321	82	349	77	374	72
296	80	322	135	350	71	375	100
297	80	323	95	351	71	376	82
298	72	324	140	352	130	377	82
299	72	325	80	353	130	379	73
300	97	326	80	354	70	380	144
301	86	327	81	355	71	381	74
302	90	328	95	356	71	382	74
303	97	330	90	357	71	394	100
304	84	331	95	358	112	395	72
305	72	332	110	359	72	396	80
306	72	333	73	360	148	397	80
307	84	334	73	361	71		
308	90	335	74	362	71		
309	90	336	75	363	70		
310	72	337	78	364	73		
311	90	338	77	365	70		
312	90	339	74	366	70		
313	73	340	80	367	70		
314	73	341	72	368	72		
315	96	342	96	369	72		
316	75	345	73	370	72		
317	73	346	73	371	72		

Ave.= 90.65

No. Rats... 314

Mean..... 90.65

σ..... 34.00

σ in %..... 37.50

ϵ 1.96

ϵ in %..... 2.16

TABLE 12.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD

IN THE NORMAL ADULT ALBINO RAT

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
1	180	9.08	13	240	8.60	18	190	8.81
2	170	8.63	14	200	9.29	19	250	9.05
3	190	9.40	15	220	8.79	20	220	7.60
4	190	9.45	9	220	8.82	19	248	8.08
5	190	9.46	10	190	9.13	20	208	7.70
6	210	8.26	9	220	8.62	22	200	9.00
7	210	9.06	10	190	7.57	22	200	7.99
8	210	7.96	13	190	9.29	23	244	8.85
9	200	8.59	14	170	9.40	24	200	8.71
10	200	8.47	13	230	8.98	25	190	7.03
1	180	8.58	14	190	8.98	22	200	7.62
2	170	8.96	15	230	8.57	23	250	9.44
3	190	7.95	15	230	8.60	24	200	8.68
4	190	8.77	15	235	8.83	23	254	9.78
5	190	7.35	17	260	7.46	24	204	8.74
6	210	8.60	18	200	7.63	25	196	7.50
9	200	8.59	19	250	8.48	26	238	7.05
10	200	9.38	19	250	9.44	27	214	8.21
11	230	9.88	20	210	7.99	28	210	8.53
12	240	9.87	17	252	8.08	25	200	7.07

TABLE 12. (continued)

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
26	230	8.32	32	232	9.22	42	230	8.42
27	216	8.69	29	180	7.24	39	258	7.06
28	212	8.19	30	212	8.28	40	260	7.52
26	242	8.33	39	256	7.72	41	218	8.68
26	242	8.56	29	184	7.85	42	228	8.93
27	210	8.07	30	220	7.86	43	230	7.85
28	220	8.48	31	296	8.88	44	240	8.00
31	296	8.68	32	228	8.98	46	194	8.41
33	234	7.82	33	240	7.53	Ave.=	220	8.48
34	216	8.23	34	218	9.04	No. Rats...	100	
35	270	8.74	35	270	8.75	Mean.....		8.48
36	212	9.10	36	220	9.39	σ.....		0.679
37	230	9.35	38	246	9.02	σ in %.....		8.006
38	236	8.33	37	278	8.17	ϵ		0.0679
27	222	7.30	40	260	7.84	ϵ in %.....		0.800
28	222	9.00	41	200	8.11			

TABLE 13.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
17	256	7.77	60	188	7.75	81	238	8.63
24	204	8.71	61	194	8.62	82	190	9.49
29	180	7.08	62	175	8.53	Ave.=	208	8.22
30	214	8.16	63	172	7.40	No. Rats...		40
39	256	7.25	64	194	8.01	Mean.....		8.220
40	260	7.40	65	214	9.53	σ.....		0.672
43	230	8.03	66	184	8.72	σ in %.....		8.200
44	240	8.38	67	140	6.68	ϵ.....		0.106
46	194	7.88	68	154	8.92	ϵ in %.....		1.290
53	196	8.87	69	246	8.13			
45	200	7.94	70	196	8.32			
31	288	8.80	72	156	7.63			
34	218	8.79	73	205	8.15			
35	266	8.82	74	200	7.72			
36	220	8.83	75	190	8.39			
37	278	8.17	76	190	8.46			
38	240	8.67	77	230	6.94			
54	174	8.23	79	198	8.78			
59	206	7.19	80	150	8.99			

TABLE 14.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
17	260	7.10	60	188	6.24	81	235	8.10
24	200	8.62	61	190	7.65	82	196	7.46
29	190	7.92	62	175	7.90	Ave.=	210	7.93
30	218	8.20	63	172	8.60	No. Rats...	40	
39	264	7.42	64	194	10.00	Mean.....		7.930
40	270	7.50	65	212	7.32	σ.....		0.796
43	244	7.78	66	184	7.78	σ in %.....		10.500
44	252	7.64	67	140	6.49	ϵ		0.126
46	188	8.08	68	158	8.44	ϵ in %.....		1.590
53	200	8.33	69	244	6.95			
45	200	6.94	70	196	9.02			
31	288	7.50	72	154	8.41			
34	222	9.04	73	202	9.23			
35	270	8.22	74	200	7.25			
36	224	9.19	75	198	8.66			
37	278	6.85	76	188	7.52			
38	238	8.38	77	230	7.35			
54	176	8.06	79	203	8.50			
59	206	6.88	80	156	8.65			

TABLE 15.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
17	260	7.52	60	184	6.38	81	238	7.41
24	202	6.82	61	190	6.43	82	198	6.91
29	190	7.48	62	175	9.01	Ave.=	210.2	7.38
30	214	7.67	63	178	6.49	No. Rats...		40
39	264	7.81	64	195	8.44	Mean.....		7.380
40	270	7.11	65	218	8.57	σ.....		1.060
43	236	7.93	66	184	7.81	σ in %.....		14.400
44	250	8.15	67	140	5.49	ϵ.....		0.168
46	190	6.80	68	150	8.88	ϵ in %.....		2.280
53	202	5.62	69	246	5.93			
45	201	4.56	70	196	9.53			
31	292	8.11	72	156	7.95			
34	220	7.50	73	202	9.44			
35	268	6.23	74	202	7.39			
36	228	6.61	75	195	8.60			
37	278	7.71	76	196	8.09			
38	242	7.44	77	226	6.96			
54	178	6.89	79	198	7.36			
59	202	6.69	80	156	7.58			

TABLE 16.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6	Rat No.	Weight in Gm.	R.B.C. x 10^6
17	260	7.95	60	184	5.87	81	238	6.29
24	200	6.00	61	194	6.94	82	190	3.13
29	188	7.54	62	178	8.49	Ave.=	207.5	6.23
30	224	6.35	63	170	6.20	No. Rats...		40
39	266	6.63	64	190	6.65	Mean.....		6.230
40	265	7.45	65	214	7.56	σ.....		1.160
43	230	5.96	66	182	7.27	σ in %.....		18.600
44	240	6.58	67	140	5.12	ϵ		0.183
46	172	4.47	68	154	6.02	ϵ in %.....		2.950
53	195	5.06	69	246	4.69			
45	198	4.71	70	200	8.19			
31	290	6.92	72	150	5.66			
34	218	7.86	73	192	6.90			
35	265	5.05	74	200	7.41			
36	220	6.15	75	190	6.33			
37	275	6.62	76	190	4.39			
38	240	5.88	77	230	4.45			
54	174	6.47	79	198	6.13			
59	200	6.31	80	150	5.73			

TABLE 17.

NUMBER OF RED BLOOD CELLS PER CUBIC MILLIMETER OF BLOOD IN THE RAT AT DEATH - EIGHTY ONE HOURS AFTER INFECTION

Rat No.	Weight in Gm.	R. B. C. x 10^6	Rat No.	Weight in Gm.	R. B. C. x 10^6
41	228	6.19	364	168	5.19
42	230	6.14	368	212	5.37
46	172	4.47	371	216	5.23
45	210	4.71	374	237	6.16
38	240	5.88	373	169	5.78
63	170	6.20	375	194	6.42
71	178	6.47	372	228	5.24
72	150	5.66	376	192	5.57
74	188	7.41	377	209	6.18
76	190	4.39	379	205	5.58
77	230	4.45	381	218	5.10
84	156	5.38	382	228	5.03
349	188	5.86	Ave.=	198.3	5.62
350	170	3.78	No. Rats...	32	
351	177	5.37	Mean.....		5.620
355	164	5.96	σ.....		0.785
359	220	7.20	σ in %.....		14.000
361	202	5.41	ϵ.....		0.139
362	190	5.78	ϵ in %.....		2.47
360	216	6.39			

TABLE 18.

GRAMS OF HEMOGLOBIN PER 100 CC. OF BLOOD

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.
246	218	14.0	267	224	13.5	302	260	16.0
247	184	14.5	268	170	14.0	303	232	15.0
248	190	15.0	269	210	13.0	304	202	15.0
249	192	13.0	266	170	14.0	305	210	15.0
250	176	14.0	267	212	13.5	306	196	14.0
251	218	14.0	268	164	13.5	307	242	15.0
252	200	15.0	269	206	13.0	308	173	14.0
253	248	13.0	270	158	13.5	309	168	12.5
254	228	15.0	271	184	14.0	310	186	14.0
255	212	14.0	272	179	14.0	311	244	15.5
256	298	13.0	273	208	14.0	312	178	14.0
257	242	14.0	274	196	14.0	313	232	12.5
258	270	12.5	275	164	13.5	314	178	14.0
259	150	13.0	276	166	14.5	315	185	14.0
260	138	12.5	277	184	14.0	Ave.=	197.9	13.8
261	186	14.0	278	148	13.5	No. Rats...	56	
262	178	12.0	279	159	13.5	Mean.....	13.800	
263	184	13.0	280	171	14.0	σ.....	0.840	
264	174	13.0	281	202	14.0	σ in %.....	6.100	
265	164	12.5	300	282	15.0	ϵ	0.112	
266	184	13.0	301	206	14.0	ϵ in %.....	0.815	

TABLE 19.

GRAMS OF HEMOGLOBIN PER 100 CC. OF BLOOD IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.
236	180	8.5	268	177	10.5	292	184	15.0
237	170	13.0	269	226	13.5	293	231	15.0
239	162	12.0	270	174	13.0	295	212	14.0
240	212	10.0	271	206	14.5	296	207	14.0
241	218	11.0	272	200	14.5	297	214	14.0
242	186	12.0	273	220	13.5	298	202	14.0
245	206	14.0	274	216	13.5	299	206	14.0
246	212	11.0	275	178	10.0	Ave.=	194.3	13.0
247	172	12.0	276	188	11.5	No. Rats...		47
248	188	13.5	277	218	14.0	Mean.....		13.000
249	192	13.5	279	185	14.0	σ.....		1.570
250	168	13.0	280	184	14.0	σ in %.....		12.100
251	216	13.5	281	206	14.5	ϵ.....		0.229
253	244	13.0	282	206	14.5	ϵ in %.....		1.760
260	132	10.0	284	182	14.5			
261	198	13.0	285	130	12.0			
263	187	12.0	286	189	14.0			
264	172	10.5	287	167	15.0			
266	186	14.0	289	225	14.0			
267	224	14.0	290	176	14.0			

TABLE 20.

GRAMS OF HEMOGLOBIN PER 100 CC. OF BLOOD IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.
236	180	7.5	269	216	13.5	293	240	14.5
237	170	10.0	270	182	11.0	295	212	13.0
239	156	8.5	271	218	13.0	296	216	13.0
240	210	10.0	272	202	13.0	297	218	14.0
241	198	10.0	273	224	12.0	Ave.=	194.9	12.2
242	182	12.0	274	224	14.0	No. Rats...		44
243	198	9.0	275	183	10.5	Mean.....		12.200
244	206	10.0	276	181	13.0	σ.....		1.86
248	185	13.0	277	226	14.0	σin %.....		15.300
249	184	13.0	279	192	13.0	ϵ.....		0.281
250	170	13.0	280	194	13.5	ϵin %.....		2.300
251	211	13.0	281	228	13.5			
253	244	14.0	282	196	14.0			
260	130	11.5	284	178	13.0			
261	200	11.5	285	133	11.0			
263	190	12.5	286	186	14.0			
264	174	11.0	287	174	14.0			
266	186	13.0	289	220	13.0			
267	220	14.0	290	177	13.0			
268	171	8.0	292	192	13.5			

TABLE 21.

GRAMS OF HEMOGLOBIN PER 100 CC. OF BLOOD IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.
235	172	9.5	270	184	11.0	298	200	12.0
236	178	8.5	271	218	13.0	299	199	12.0
237	170	9.5	272	203	12.5	Ave.=	193	11.0
241	206	8.0	273	219	10.5	No. Rats...		42
242	180	9.0	274	226	13.5	Mean.....		11.000
245	206	12.5	275	192	10.5	σ.....		1.530
246	200	10.5	276	182	11.0	σ in %.....		13.900
247	170	12.0	277	227	12.0	ϵ		0.237
248	182	10.5	279	188	11.0	ϵ in %.....		2.150
249	180	11.5	280	188	8.5			
250	168	11.0	281	231	11.0			
251	207	12.5	284	182	12.0			
253	242	11.5	285	132	8.0			
260	134	7.5	286	181	12.0			
261	198	11.0	287	166	13.0			
263	198	9.5	289	176	12.0			
264	174	10.0	290	168	11.0			
266	190	12.0	292	183	12.0			
267	233	13.0	293	238	13.0			
269	226	12.5	295	208	11.0			

TABLE 22.

GRAMS OF HEMOGLOBIN PER 100 CC. OF BLOOD IN THE RAT

AT DEATH - EIGHTY THREE HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.	Rat No.	Weight in Gm.	Hb. in Gm.
235	172	9.5	277	227	12.0	374	237	11.0
233	178	6.5	279	188	11.0	373	169	11.0
242	180	9.0	280	188	8.5	Ave.=	192.8	10.4
246	188	9.0	281	231	11.0	No. Rats...		40
250	168	11.0	290	168	11.0	Mean.....		10.400
263	198	9.5	295	208	11.0	σ.....		1.320
248	182	10.5	298	200	12.0	σ in %.....		12.700
249	180	11.5	299	199	12.0	ϵ		0.208
251	207	12.5	349	188	11.0	ϵ in %.....		2.020
253	242	11.5	350	170	8.0			
260	134	7.5	351	177	10.0			
261	198	11.0	355	164	10.5			
245	194	9.0	359	220	10.5			
264	174	10.0	361	202	10.5			
252	190	9.5	362	190	9.5			
270	184	11.0	360	216	12.0			
272	203	12.5	364	168	10.0			
273	219	10.5	368	212	9.5			
276	182	11.0	371	216	10.0			

TABLE 23.

PACKED CELL VOLUME IN PER CENT PER 100 CC. OF BLOOD

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %
45	200	38	69	246	52	88	170	53
31	288	54	70	196	48	89	174	43
34	218	50	72	156	49	90	144	57
35	266	57	73	205	51	Ave.=	194.1	49.8
36	220	49	74	200	48	No. Rats...		39
37	278	52	75	190	48	Mean.....		49.800
38	240	41	76	190	55	σ.....		4.700
54	174	56	77	230	49	σ in %.....		9.400
59	206	39	79	198	47	ϵ.....		0.754
60	188	46	80	150	52	ϵ in %.....		1.600
61	194	43	81	238	48			
62	175	53	82	190	64			
63	172	55	78	180	52			
64	194	52	83	168	52			
65	214	46	84	150	49			
66	184	45	85	160	54			
67	140	45	86	170	49			
68	154	51	87	160	53			

TABLE 24.

PACKED CELL VOLUME IN PER CENT PER 100 CC. OF BLOOD

IN THE RAT TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %
300	315	54	317	192	52	332	150	40
301	230	51	318	154	40	333	222	51
302	288	48	319	210	50	335	186	48
303	252	55	320	214	54	Ave.=	216	50.1
304	209	54	321	218	48	No. Rats...		33
305	224	54	322	196	47	Mean.....		50.10
306	268	49	323	211	51	σ.....		4.30
307	230	52	324	204	57	σ in %.....		8.60
308	198	48	325	186	53	ϵ		0.75
309	216	45	326	212	55	ϵ in %.....		1.49
310	214	50	327	227	55			
311	268	44	328	193	54			
313	272	46	329	170	43			
315	212	54	330	206	51			
316	175	49	331	219	51			

TABLE 25.

PACKED CELL VOLUME IN PER CENT PER 100 CC. OF BLOOD

IN THE RAT FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %
300	318	53	315	210	48	333	212	58
301	228	43	316	170	49	334	224	57
302	282	48	317	179	50	335	181	53
303	238	44	318	158	43	Ave.=	214	49.5
304	206	47	319	214	48	No. Rats...		33
305	220	56	320	204	54	Mean.....		49.50
306	226	44	321	218	57	σ		6.42
307	262	43	322	194	50	σ in %.....		13.00
308	196	38	323	211	50	ϵ		1.12
309	204	41	325	166	61	ϵ in %.....		2.26
310	210	47	326	190	59			
311	260	47	327	223	53			
312	183	56	328	194	50			
313	265	57	330	200	51			
314	216	32	331	217	47			

TABLE 26.

PACKED CELL VOLUME IN PER CENT PER 100 CC. OF BLOOD

IN THE RAT SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %
300	296	38	315	214	41	336	206	29
301	211	31	316	162	42	337	190	28
302	278	33	317	172	19	340	188	33
303	224	32	319	206	28	341	186	34
304	202	41	321	210	29	Ave.=	206	33.2
305	215	32	323	208	50	No. Rats...		34
306	222	35	325	160	36	Mean.....		33.20
307	250	33	326	192	31	σ.....		6.64
308	178	23	327	209	30	σ in %.....		20.00
309	189	24	328	187	35	ϵ		1.14
310	202	36	330	188	35	ϵ in %.....		3.43
311	253	36	331	196	32			
312	184	36	333	192	45			
313	258	33	334	208	31			
314	212	19	335	158	41			

TABLE 27.

PACKED CELL VOLUME IN PER CENT PER 100 CC. OF BLOOD IN THE RAT AT DEATH - EIGHTY HOURS AFTER INFECTION

Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %	Rat No.	Weight in Gm.	P.C.V. in %
300	289	38	317	172	19	359	220	37
303	214	32	319	206	28	361	202	35
305	215	32	323	192	30	362	190	26
310	202	36	331	180	38	360	216	35
313	258	33	333	192	45	364	168	40
314	212	19	334	208	31	368	212	35
45	210	29	335	158	41	371	216	32
38	240	22	336	206	29	374	237	30
63	170	28	337	190	28	373	169	44
71	178	36	341	186	34	Ave.=	195.5	32.6
72	150	36	346	170	32	No. Rats...		43
74	188	35	347	220	34	Mean.....		32.60
76	190	25	349	188	36	σ.....		5.57
77	230	32	342	130	34	σ in %.....		17.10
84	156	28	350	170	30	ϵ		0.85
315	204	31	351	177	38	ϵ in %.....		2.61
316	162	42	355	164	28			

TABLE 28.

SEDIMENTATION RATE IN MILLIMETERS PER HOUR

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour
63	172	1.0	81	238	1.0	308	200	2.0
64	194	0.5	82	190	0.5	309	210	0.5
65	214	1.0	71	182	3.0	310	224	0.5
66	184	3.5	78	192	0.5	311	282	1.0
67	140	3.0	90	172	0.5	312	193	0.5
68	154	1.0	89	231	2.0	313	280	0.5
69	246	1.0	88	186	0.5	314	221	1.0
70	196	0.5	87	170	0.5	315	212	0.5
72	156	1.0	86	166	0.5	Ave.=	192	0.95
73	205	0.5	85	166	0.5	No. Rats...		40
74	200	1.0	84	160	2.0	Mean.....		0.950
75	190	1.0	83	168	0.5	σ		0.765
76	190	0.5	304	218	1.0	σ in %.....		80.500
77	230	0.5	305	234	0.5	ϵ		0.121
79	198	0.5	306	231	0.5	ϵ in %.....		12.750
80	150	0.5	307	274	0.5			

TABLE 29.

SEDIMENTATION RATE IN MILLIMETERS PER HOUR IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour
300	315	0.5	317	192	0.5	332	150	11.0
301	230	4.0	318	194	1.0	333	222	1.0
302	288	6.0	319	210	1.0	335	186	0.5
303	252	0.5	320	214	0.5	Ave.	216	2.36
304	209	0.5	321	218	4.0	No. Rats... 33		
305	224	0.5	322	196	1.5	Mean.....		2.360
306	268	2.0	323	211	1.5	σ.....		3.540
307	230	1.0	324	204	0.5	σ in %....		150.000
308	198	3.5	325	186	1.0	ϵ.....		0.616
309	216	5.0	326	212	0.5	ϵ in %....		26.100
310	214	1.0	327	227	1.0			
311	268	1.0	328	193	1.0			
313	272	3.0	329	170	18.0			
315	212	0.5	330	206	1.0			
316	175	3.0	331	219	0.5			

TABLE 30.

SEDIMENTATION RATE IN MILLIMETERS PER HOUR IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour
300	318	1.0	315	210	1.5	333	212	0.5
301	228	7.0	316	170	1.0	334	224	1.0
302	282	3.5	317	179	2.0	335	181	0.5
303	238	11.5	318	158	0.5	Ave.=	214	2.85
304	206	1.0	319	214	1.0	No. Rats...		33
305	220	0.5	320	204	2.5	Mean.....		2.850
306	226	3.0	321	218	0.5	σ.....		4.550
307	262	4.0	322	194	2.0	σ in %.....		159.500
308	196	1.0	323	211	2.0	ϵ.....		0.794
309	204	12.0	325	166	0.5	ϵ in %.....		27.800
310	210	1.0	326	190	5.0			
311	260	1.0	327	223	1.0			
312	183	1.0	328	200	1.0			
313	265	0.5	330	217	1.0			
314	216	21.0	331	150	1.5			

TABLE 31.

SEDIMENTATION RATE IN MILLIMETERS PER HOUR IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour
300	296	1.0	315	214	3.0	336	206	0.5
301	211	12.0	316	162	1.0	337	190	0.5
302	278	2.0	317	172	15.0	340	188	0.5
303	224	1.0	319	206	0.5	341	186	0.5
304	202	1.0	321	210	0.5	Ave.=	206	4.94
305	215	1.0	323	208	2.0	No. Rats...		34
306	222	4.5	325	160	8.0	Mean.....		4.94
307	250	10.5	326	192	13.0	σ.....		8.05
308	178	1.0	327	209	20.0	σ in %.....162.50		
309	189	2.0	328	187	1.0	ϵ		1.38
310	202	1.0	330	188	0.5	ϵ in %.....		28.00
311	253	1.0	331	196	34.0			
312	184	1.0	333	192	0.5			
313	258	1.0	334	208	1.0			
314	212	25.0	335	158	1.0			

TABLE 32.

SEDIMENTATION RATE IN MILLIMETERS PER HOUR IN THE RAT

AT DEATH - EIGHTY HOURS AFTER INFECTION

Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour	Rat No.	Weight in Gm.	mm. in 1 hour
300	289	0.5	336	206	0.5	368	212	0.5
303	214	1.0	337	190	0.5	371	216	1.0
305	215	1.0	341	186	0.5	374	237	1.0
310	202	1.0	346	170	0.5	373	169	2.0
313	258	1.0	347	220	1.0	Ave.=	197	1.9
314	212	25.0	349	188	1.0	No. Rats...		34
315	204	0.5	342	130	0.5	Mean.....		1.900
316	162	1.0	350	170	0.5	σ.....		4.750
317	172	15.0	351	177	0.5	σ in %.....250.000		
319	206	0.5	355	164	1.0	ϵ		0.815
323	192	0.5	359	220	1.0	ϵ in %.....		43.000
331	180	0.5	361	202	0.5			
333	192	0.5	362	190	2.0			
334	208	1.0	360	216	0.5			
335	158	1.0	364	168	0.5			

TABLE 33.

COAGULATION TIME IN SECONDS IN THE ADULT

ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.
234	208	120	266	184	129	302	260	174
235	172	120	227	224	174	303	232	166
236	184	90	268	170	164	304	202	172
234	207	180	269	210	163	305	210	170
235	178	124	266	170	165	306	196	140
236	190	190	267	212	210	307	242	175
237	150	150	268	164	200	308	173	148
239	166	180	269	202	201	309	168	147
240	227	135	270	158	182	310	186	164
241	214	175	271	184	172	311	244	163
242	192	160	272	179	174	312	178	167
243	216	165	273	208	160	313	232	139
244	212	150	274	196	148	314	178	211
245	214	120	275	164	145	315	185	186
246	216	150	276	166	185	Ave.=	193.8	160.1
247	178	150	277	184	166	No. Rats...	58	
248	186	150	278	148	169	Mean.....	160.10	
249	183	135	279	159	170	σ.....	24.80	
250	166	120	280	171	164	σ in %.....	15.50	
251	202	170	281	202	125	ϵ.....	3.26	
252	186	150	300	282	177	ϵ in %.....	2.06	
265	164	165	301	206	175			

TABLE 34.

COAGULATION TIME IN SECONDS IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.
233	182	120	266	186	150	289	225	181
234	202	145	267	224	144	290	176	169
236	180	130	268	177	200	292	184	150
237	170	100	269	226	121	293	231	165
239	162	180	270	174	112	295	212	135
240	212	170	271	206	134	296	207	141
241	218	160	272	200	133	297	214	152
242	186	153	273	220	147	298	202	153
245	206	130	274	216	130	299	206	126
246	212	153	275	178	127	Ave.=	194.2	151
247	172	155	276	188	143	No. Rats...		49
248	188	179	277	218	119	Mean.....		151.00
249	192	210	279	185	125	σ.....		22.80
250	168	175	280	184	152	σ in %.....		15.10
251	216	167	281	206	149	ϵ.....		3.25
253	244	174	282	206	153	ϵ in %.....		2.15
260	132	140	284	182	165			
261	198	175	285	130	155			
263	187	160	286	189	194			
264	172	150	287	167	156			

TABLE 35.

COAGULATION TIME IN SECONDS IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.
231	195	120	266	186	127	289	220	153
233	182	165	267	220	120	290	177	146
235	174	175	268	171	141	292	192	154
236	180	120	269	216	124	293	240	165
237	170	120	270	182	124	295	212	146
239	156	162	271	218	135	296	216	130
240	210	162	272	202	135	297	218	151
241	198	198	273	224	133	Ave.=	194.2	146
242	182	150	274	224	127	No. Rats...	47	
243	198	120	275	183	119	Mean.....	146.00	
244	206	194	276	181	132	σ.....	22.60	
248	185	171	277	226	111	σ in %.....	15.50	
249	184	170	279	192	117	ϵ	3.30	
250	170	124	280	194	137	ϵ in %.....	2.25	
251	211	150	281	228	154			
253	244	180	282	196	123			
260	130	130	284	178	165			
261	200	150	285	133	198			
263	190	175	286	186	163			
264	174	143	287	174	163			

TABLE 36.

COAGULATION TIME IN SECONDS IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.
229	194	150	264	174	130	287	166	169
231	195	145	266	190	150	289	214	147
235	174	165	267	233	126	290	168	127
236	178	150	269	226	115	292	183	125
237	170	199	270	184	116	293	238	161
241	206	160	271	218	149	295	208	131
242	180	160	272	203	170	298	200	177
245	206	150	273	219	129	298	199	155
246	200	163	274	226	142	Ave.=	194	153.5
247	170	174	275	192	143	No. Rats...		44
248	182	195	276	182	110	Mean.....		153.50
249	180	189	277	227	137	σ.....		21.20
250	168	153	279	188	164	σ in %.....		13.80
251	207	187	280	188	156	ϵ		3.18
253	242	168	281	231	187	ϵ in %.....		2.07
260	134	147	284	182	153			
261	198	156	285	132	155			
263	198	175	286	181	156			

TABLE 37.

COAGULATION TIME IN SECONDS IN THE RAT AT DEATH -

EIGHTY THREE HOURS AFTER INFECTION

Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.	Rat No.	Weight in Gm.	time in sec.
235	174	165	276	182	110	368	212	236
233	182	250	277	227	137	371	216	175
242	180	160	279	188	164	374	237	218
246	188	208	280	188	156	373	169	211
250	168	153	281	231	187	Ave.=	193.1	170
263	198	175	290	168	195	No. Rats...		40
248	182	195	295	208	131	Mean.....		170.00
249	180	189	298	200	177	σ.....		32.00
251	207	187	299	199	155	σ in %.....		18.80
253	242	168	349	195	146	ϵ		5.06
260	134	147	350	170	187	ϵ in %.....		2.97
261	198	156	351	177	167			
245	194	200	355	164	120			
264	174	130	359	220	180			
252	190	130	361	202	150			
270	184	116	362	190	173			
272	203	170	360	216	195			
273	219	129	364	168	200			

TABLE 38.

NUMBER OF PLATELETS PER CUBIC MILLIMETER OF BLOOD

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
226	176	970	245	204	690	306	196	660
260	148	590	246	288	700	307	242	990
227	188	630	247	232	840	308	173	970
228	208	760	248	266	750	309	168	780
229	200	999	249	142	460	310	186	580
230	170	740	254	220	690	311	244	1,010
260	162	710	255	204	690	312	178	700
261	174	660	256	288	700	313	232	600
232	194	450	257	232	840	314	178	750
234	207	650	258	266	750	315	185	1,040
235	178	810	259	142	660	Ave.=	196.5	772.4
236	183	970	260	132	850	No. Rats...		46
238	168	900	300	282	740	Mean.....		772.40
239	150	920	301	206	780	σ.....		152.70
240	216	890	302	232	860	σ in %....		19.80
241	202	500	303	260	740	ϵ		22.50
243	204	840	304	202	1,030	ϵ in %....		2.92
244	220	690	305	210	1,000			

TABLE 39.

NUMBER OF PLATELETS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
144	146	400	189	170	780	224	169	1,100
149	150	554	190	160	738	226	176	740
150	186	646	194	132	850	228	208	630
156	178	730	195	140	670	229	202	940
157	160	862	200	186	690	231	200	640
161	174	800	201	138	810	233	182	580
162	176	672	202	164	710	234	202	570
167	176	340	208	196	790	239	162	830
169	188	440	209	198	710	240	212	510
170	148	550	213	186	700	241	218	620
174	126	672	215	177	800	242	186	660
175	116	1,116	216	156	770	245	206	900
176	188	800	217	174	480	246	212	680
177	172	820	218	174	640	247	172	700
179	140	660	219	184	760	248	188	800
180	138	570	220	350	920	249	192	850
181	124	686	221	185	590	250	168	720
182	156	906	223	172	680	251	216	890

TABLE 39. (continued)

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
253	244	780	276	188	700	296	207	900
260	132	920	277	218	910	297	214	840
261	198	900	279	185	720	298	202	960
263	187	890	280	184	770	299	206	820
264	172	860	281	206	770	Ave.=	173.9	742.6
266	186	720	282	206	840	No. Rats...		88
267	224	890	284	182	600	Mean.....		742.60
268	177	620	285	130	600	σ		147.00
269	226	1,050	286	189	670	σ in %....		19.80
270	174	480	287	167	650	ϵ		15.70
271	206	800	289	225	750	ϵ in %....		2.12
272	200	930	290	176	580			
273	220	710	292	184	750			
274	216	900	293	231	820			
275	178	680	295	212	890			

TABLE 40.

NUMBER OF PLATELETS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
144	170	410	184	112	760	223	168	670
149	146	460	189	140	740	228	204	310
150	170	640	190	150	750	229	198	660
156	152	700	194	120	650	231	195	620
157	140	800	195	140	470	235	174	630
161	170	460	200	174	560	239	156	510
162	160	500	201	142	650	240	210	370
167	158	500	202	163	550	241	198	620
169	182	450	208	194	570	242	182	720
171	160	410	209	202	800	243	198	740
172	240	540	213	184	610	244	206	980
174	126	702	215	176	550	248	185	580
175	120	770	216	160	790	249	184	650
177	172	970	217	184	420	250	170	420
179	140	644	218	171	760	251	211	610
180	130	330	219	185	590	253	244	640
181	120	860	220	342	1,107	260	130	840
182	155	650	222	160	1,050	261	200	640

TABLE 40. (continued)

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
263	190	720	277	226	720	295	212	670
264	174	490	279	192	560	296	216	790
266	186	700	280	194	480	297	218	730
267	220	840	281	228	520	Ave.=	145.8	630.16
268	171	350	282	196	620	No. Rats...	83	
269	216	780	284	178	760	Mean.....	630.16	
270	182	370	285	133	440	σ	163.30	
271	218	840	286	186	710	σ in %....	26.00	
272	202	550	287	174	590	ϵ	17.90	
273	224	350	289	220	500	ϵ in %....	2.84	
274	224	660	290	177	350			
275	183	680	292	192	750			
276	181	560	293	240	840			

TABLE 41.

NUMBER OF PLATELETS PER CUBIC MILLIMETER OF BLOOD

IN THE RAT SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
144	170	240	189	174	400	224	156	130
149	154	230	190	160	230	226	178	160
150	182	300	194	128	400	229	194	650
156	182	320	195	136	140	231	198	290
157	166	250	200	168	180	234	206	220
161	176	250	201	140	270	235	172	190
162	178	170	202	160	240	241	206	230
167	176	90	208	198	180	242	180	200
169	188	180	209	202	490	245	206	810
170	148	30	213	184	360	246	200	180
171	164	110	215	174	290	247	170	600
172	230	330	216	158	140	248	182	270
177	176	500	217	186	530	249	180	160
178	149	510	218	172	300	250	168	180
179	136	250	219	190	470	251	207	170
180	132	120	220	338	500	253	242	130
181	128	482	221	185	520	260	134	150
184	138	230	222	158	540	261	198	350

TABLE 41. (continued)

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
263	198	180	277	227	320	295	208	240
264	174	220	279	188	320	298	200	340
266	190	310	280	188	330	299	199	120
267	233	300	281	231	230	Ave.=	181.6	296.7
269	226	730	284	182	290	No. Rats...	81	
270	184	210	285	132	270	Mean.....	296.70	
271	218	800	286	181	120	σ.....	164.00	
272	203	270	287	166	280	σ in %....	55.20	
273	219	220	289	214	150	ϵ	18.20	
274	226	580	290	168	110	ϵ in %....	6.15	
275	192	520	292	183	280			
276	182	230	293	238	220			

TABLE 42.

NUMBER OF PLATELETS PER CUBIC MILLIMETER OF BLOOD IN THE RAT AT DEATH - NINETY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000	Rat No.	Weight in Gm.	Plate. x1000
149	146	60	251	207	170	145	170	130
156	175	40	253	242	130	163	170	40
176	178	40	260	134	150	214	140	190
178	146	200	261	198	350	233	178	70
179	134	150	245	194	190	Ave.=	178.7	171.8
180	132	120	264	174	220	No. Rats... 40		
189	163	50	252	190	70	Mean..... 171.8		
216	156	150	270	184	210	σ..... 82.5		
222	151	130	272	203	270	σ in %.... 48.0		
224	156	130	273	219	220	ϵ..... 13.0		
226	178	130	276	182	230	ϵ in %.... 7.6		
235	172	190	279	188	320			
242	180	200	280	188	330			
246	188	150	281	231	230			
250	168	180	290	168	120			
263	198	180	295	208	240			
248	182	270	298	200	340			
249	180	160	299	199	120			

TABLE 43.

PLASMA SPECIFIC GRAVITY IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.
332	153	1.0259	366	206	1.0267	386	194	1.0256
333	222	1.0264	367	202	1.0266	387	205	1.0249
334	235	1.0266	368	201	1.0262	388	185	1.0244
335	188	1.0279	369	182	1.0282	389	210	1.0257
336	215	1.0273	370	192	1.0256	390	181	1.0281
337	210	1.0267	371	212	1.0266	391	195	1.0259
338	176	1.0287	372	183	1.0262	392	167	1.0249
339	224	1.0279	373	162	1.0266	393	167	1.0262
340	204	1.0273	374	222	1.0257	Ave.=	189	1.0265
341	201	1.0267	375	188	1.0275	No. Rats...		44
342	142	1.0273	376	170	1.0247	Mean.....		1.02650
345	170	1.0266	377	182	1.0265	σ.....		0.00100
346	170	1.0259	379	178	1.0262	σ in %.....		0.09750
361	200	1.0257	380	182	1.0262	ϵ.....		0.00015
362	191	1.0266	381	188	1.0257	ϵ in %.....		0.01460
363	180	1.0275	382	192	1.0259			
364	184	1.0252	384	174	1.0257			
365	170	1.0282	385	158	1.0274			

TABLE 44.

PLASMA SPECIFIC GRAVITY IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.
300	315	1.0268	317	192	1.0259	332	150	1.0278
301	230	1.0268	318	154	1.0256	333	222	1.0261
302	288	1.0274	319	210	1.0276	335	186	1.0267
303	252	1.0267	320	210	1.0275	Ave.=	216	1.0268
304	209	1.0266	321	218	1.0276	No. Rats...	33	
305	224	1.0286	322	196	1.0266	Mean.....		1.02680
306	268	1.0266	323	211	1.0268	σ.....		0.00060
307	230	1.0266	324	204	1.0271	σ in %.....		0.05840
308	198	1.0272	325	186	1.0259	ϵ		0.00011
309	216	1.0275	326	212	1.0267	ϵ in %.....		0.01020
310	214	1.0277	327	227	1.0267			
311	268	1.0261	328	193	1.0259			
313	272	1.0276	329	170	1.0258			
315	212	1.0266	330	206	1.0270			
316	175	1.0264	331	219	1.0267			

TABLE 45.

PLASMA SPECIFIC GRAVITY IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.
300	318	1.0256	315	210	1.0281	333	212	1.0274
301	228	1.0236	316	170	1.0266	334	224	1.0287
302	282	1.0256	317	179	1.0259	335	181	1.0289
303	238	1.0216	318	158	1.0267	Ave.=	214	1.0267
304	206	1.0272	319	214	1.0278	No. Rats...		33
305	220	1.0282	320	204	1.0276	Mean.....		1.02670
306	226	1.0267	321	218	1.0259	σ.....		0.00140
307	262	1.0272	322	194	1.0268	σ in %.....		0.13600
308	196	1.0246	323	211	1.0266	ϵ		0.00024
309	204	1.0256	325	166	1.0276	ϵ in %.....		0.02300
310	210	1.0264	326	190	1.0278			
311	260	1.0266	327	223	1.0266			
312	183	1.0286	328	194	1.0271			
313	265	1.0271	330	200	1.0277			
314	216	1.0271	331	217	1.0271			

TABLE 46.

PLASMA SPECIFIC GRAVITY IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.
300	296	1.0295	315	214	1.0267	336	206	1.0275
301	211	1.0257	316	162	1.0261	337	190	1.0276
302	278	1.0267	317	172	1.0214	338	156	1.0265
303	224	1.0277	319	206	1.0276	339	203	1.0265
304	202	1.0274	321	210	1.0267	340	188	1.0261
305	215	1.0241	323	208	1.0267	341	186	1.0272
306	222	1.0276	325	160	1.0271	Ave.=	204	1.0269
307	250	1.0261	326	192	1.0267	No. Rats...		36
308	178	1.0271	327	209	1.0243	Mean.....		1.026900
309	189	1.0256	328	187	1.0285	σ.....		0.001600
310	202	1.0268	330	188	1.0265	σ in %.....		0.156000
311	253	1.0261	331	196	1.0298	ϵ		0.000267
312	184	1.0288	333	192	1.0302	ϵ in %.....		0.026000
313	258	1.0266	334	208	1.0280			
314	212	1.0275	335	158	1.0283			

TABLE 47.

PLASMA SPECIFIC GRAVITY IN THE RAT AT DEATH -

EIGHTY HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.	Rat No.	Weight in Gm.	Sp. Gr.
300	289	1.0286	336	206	1.0275	364	168	1.0283
303	214	1.0274	337	190	1.0276	360	216	1.0299
305	215	1.0241	338	156	1.0265	368	212	1.0280
310	202	1.0268	339	203	1.0265	371	216	1.0268
313	258	1.0266	341	186	1.0272	374	237	1.0251
314	212	1.0275	342	130	1.0262	373	169	1.0266
315	204	1.0296	346	170	1.0275	Ave.=	196.1	1.0271
316	162	1.0261	347	220	1.0277	No. Rats...		36
317	172	1.0214	349	195	1.0270	Mean.....		1.027100
319	206	1.0276	350	170	1.0263	σ		0.001600
323	192	1.0278	351	177	1.0280	σ in %.....		0.155000
331	180	1.0282	355	164	1.0272	ϵ		0.000267
333	192	1.0302	359	220	1.0254	ϵ in %.....		0.025900
334	208	1.0280	361	202	1.0272			
335	158	1.0283	362	190	1.0243			

TABLE 48.

TOTAL PLASMA PROTEINS IN GRAMS PER 100 CC. IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
332	153	6.46	366	206	6.73	386	194	6.36
333	222	6.63	367	202	6.70	387	205	6.12
334	235	6.70	368	201	6.56	388	185	5.95
335	188	7.14	369	182	7.24	389	210	6.39
336	215	6.94	370	192	6.36	390	181	7.21
337	210	6.73	371	212	6.70	391	195	6.46
338	176	7.41	372	183	6.56	392	167	6.12
339	224	7.14	373	162	6.70	393	167	6.56
340	204	6.94	374	222	6.40	Ave.=	189	6.65
341	201	6.73	375	188	7.00	No. Rats...	44	
342	142	6.94	376	170	6.05	Mean.....		6.6500
345	170	6.70	377	182	6.66	σ		0.3430
346	170	6.46	379	178	6.56	σ in %.....		5.1500
361	200	6.40	380	182	6.56	ϵ		0.0518
362	191	6.70	381	188	6.40	ϵ in %.....		0.7800
363	180	7.00	382	192	6.46			
364	184	6.22	384	174	6.39			
365	170	7.24	385	158	6.97			

TABLE 49.

TOTAL PLASMA PROTEINS IN GRAMS PER 100 CC. IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
300	315	6.77	317	192	6.46	332	150	7.11
301	230	6.77	318	154	6.36	333	222	6.53
302	288	6.97	319	210	7.04	335	186	6.73
303	252	6.74	320	210	7.00	Ave.=	216	6.78
304	209	6.70	321	218	7.04	No. Rats...		33
305	224	7.38	322	196	6.70	Mean.....		6.780
306	268	6.70	323	211	6.77	σ		0.233
307	230	6.70	324	204	6.87	σ in %.....		3.000
308	198	6.90	325	186	6.46	ϵ		0.040
309	216	7.00	326	212	6.73	ϵ in %.....		0.600
310	214	7.07	327	227	6.73			
311	268	6.53	328	193	6.46			
313	272	7.04	329	170	6.43			
315	212	6.70	330	206	6.84			
316	175	6.63	331	219	6.73			

TABLE 50.

TOTAL PLASMA PROTEINS IN GRAMS PER 100 CC. IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
300	318	6.36	316	170	6.70	335	181	7.48
301	228	5.68	317	179	6.46	Ave.=	214	6.76
302	282	6.36	318	158	6.73	No. Rats...		33
303	238	5.34	319	214	7.11	Mean.....		6.760
304	206	6.90	320	204	7.04	σ		0.453
305	220	7.24	321	218	6.46	σ in %.....		6.700
306	226	6.73	322	194	6.77	ϵ		0.079
307	262	6.90	323	211	6.70	ϵ in %.....		1.170
308	196	6.02	325	166	7.04			
309	204	6.36	326	190	7.11			
310	210	6.63	327	223	6.70			
311	260	6.70	328	194	6.87			
312	183	7.38	330	200	7.07			
313	265	6.87	331	217	6.87			
314	216	6.87	333	212	6.97			
315	210	7.21	334	224	7.41			

TABLE 51.

TOTAL PLASMA PROTEINS IN GRAMS PER 100 CC. IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
300	296	7.68	315	214	6.73	336	206	7.01
301	211	6.40	316	162	6.54	337	190	7.04
302	278	6.73	317	172	4.93	338	156	6.80
303	224	7.07	319	206	7.04	339	203	6.80
304	202	6.97	321	210	6.73	340	188	6.53
305	215	5.85	323	208	6.73	341	186	6.90
306	222	7.04	325	160	6.87	Ave.=	204	6.81
307	250	6.53	326	192	6.73	No. Rats...		36
308	178	6.87	327	209	5.92	Mean.....		6.810
309	189	6.36	328	187	7.35	σ.....		0.544
310	202	6.76	330	188	6.66	σ in %.....		8.000
311	253	6.53	331	196	7.78	ϵ		0.090
312	184	7.45	333	192	7.89	ϵ in %.....		1.330
313	258	6.70	334	208	7.18			
314	212	7.00	335	158	7.23			

TABLE 52.

TOTAL PLASMA PROTEINS IN GRAMS PER 100 CC. IN THE RAT

AT DEATH - EIGHTY HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
300	289	7.38	336	206	7.01	364	168	7.28
303	214	6.97	337	190	7.04	360	216	7.82
305	215	5.85	338	156	6.80	368	212	7.18
310	202	6.76	339	203	6.80	371	216	6.77
313	258	6.70	341	186	6.90	374	237	6.19
314	212	7.00	342	130	6.56	373	169	6.70
315	204	7.72	346	170	7.00	Ave.=	196.1	6.87
316	162	6.54	347	220	7.07	No. Rats...		36
317	172	4.93	349	195	6.83	Mean.....		6.87
319	206	7.04	350	170	6.60	σ.....		0.48
323	192	7.11	351	177	7.18	σ in %.....		7.00
331	180	7.23	355	164	6.90	ϵ		0.08
333	192	7.89	359	220	6.29	ϵ in %.....		1.16
334	208	7.18	361	202	6.90			
335	158	7.23	362	190	5.92			

TABLE 53.

TOTAL SERUM PROTEINS IN GRAMS PER 100 CC. IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
361	200	6.05	372	183	6.30
362	191	6.40	373	162	6.40
363	180	6.57	374	222	6.09
364	184	5.98	375	188	6.33
365	170	6.61	376	170	5.50
366	206	6.23	377	182	6.40
367	202	6.40	378	200	4.66
368	201	6.23	379	178	6.09
369	182	6.50	380	182	6.09
370	192	6.05	381	188	5.88
371	212	6.61	382	192	6.09
			Ave.=	193.5	6.15

TABLE 54.

TOTAL SERUM PROTEINS IN GRAMS PER 100 CC. IN THE RAT

TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.
336	210	6.96
337	203	6.96
338	172	5.53
339	213	6.49
340	190	6.33
341	192	6.43
342	146	5.48
346	174	6.16
347	232	6.78
Ave.=	193	6.34

TABLE 55.

TOTAL SERUM PROTEINS IN GRAMS PER 100 CC. IN THE RAT

FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.
336	210	6.59
337	196	6.49
338	156	6.58
339	210	6.16
340	174	6.99
341	171	7.20
342	146	5.31
Ave.=	181	6.47

TABLE 56.

TOTAL SERUM PROTEINS IN GRAMS PER 100 CC. IN THE RAT

SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.
333	192	6.82
335	158	6.40
336	206	6.36
337	190	6.36
338	156	6.40
339	203	6.36
340	188	6.12
341	186	6.78
Ave.=	185	6.32

TABLE 57.

TOTAL SERUM PROTEINS IN GRAMS PER 100 CC. IN THE RAT AT DEATH - EIGHTY HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Prot. in Gm.	Rat No.	Weight in Gm.	Prot. in Gm.
328	158	5.71	350	170	6.05
331	180	6.75	351	177	6.18
333	192	6.82	355	164	6.61
335	158	6.40	359	220	5.95
336	206	6.36	361	202	5.88
337	190	6.36	362	190	4.97
338	156	6.40	360	216	7.21
339	203	6.36	364	168	6.36
341	186	6.78	368	212	6.85
342	130	6.02	371	216	5.88
346	170	6.23	373	169	5.95
347	220	6.56	374	237	5.94
349	195	6.40	Ave.=	188	6.28

TABLE 58.

FIBRINOGEN IN GRAMS PER 100 CC. OF PLASMA

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	Plas. Prot.	Ser. Prot.	Fib'gn. in Gm.	Rat No.	Weight in Gm.	Plas. Prot.	Ser. Prot.	Fib'gn. in Gm.
361	200	6.40	6.05	0.35	372	183	6.56	6.30	0.26
362	191	6.70	6.40	0.30	373	162	6.70	6.40	0.30
363	180	7.00	6.57	0.43	374	222	6.40	6.09	0.31
364	184	6.22	5.98	0.24	375	188	7.00	6.33	0.67
365	170	7.24	6.61	0.63	376	170	6.05	5.50	0.55
366	206	6.73	6.23	0.50	377	182	6.66	6.40	0.26
367	202	6.70	6.40	0.30	379	178	6.56	6.09	0.47
368	201	6.56	6.23	0.33	380	182	6.56	6.09	0.47
369	182	7.24	6.50	0.74	381	188	6.40	5.88	0.52
370	192	6.36	6.05	0.31	382	192	6.46	6.09	0.37
371	212	6.70	6.61	0.09	Ave.=189				0.40

TABLE 59.

FIBRINOGEN IN GRAMS PER 100 CC. OF PLASMA IN THE RAT

AT DEATH - SEVENTY NINE HOURS AFTER INFECTION

Rat No.	Weight in Gm.	Plas. Prot.	Ser. Prot.	Fib'gn. in Gm.	Rat No.	Weight in Gm.	Plas. Prot.	Ser. Prot.	Fib'gn. in Gm.
331	180	7.23	6.75	0.48	350	170	6.60	6.05	0.55
333	192	7.89	6.82	1.07	351	177	7.18	6.18	1.00
335	158	7.23	6.40	0.83	355	164	6.90	6.61	0.29
336	206	7.01	6.36	0.65	359	220	6.29	5.95	0.34
337	190	7.04	6.36	0.68	361	202	6.90	5.88	1.02
338	156	6.80	6.40	0.40	362	190	5.92	4.97	0.95
339	203	6.80	6.36	0.54	364	168	7.28	6.36	0.92
341	186	6.90	6.78	0.12	360	216	7.82	7.21	0.61
342	130	6.56	6.02	0.54	368	212	7.18	6.85	0.33
346	170	7.00	6.23	0.77	371	216	6.77	5.88	0.89
347	220	7.07	6.56	0.51	374	237	6.19	5.94	0.25
349	195	6.83	6.40	0.43	373	169	6.70	5.95	0.75
					Ave.=189				0.62

TABLE 60.

BLOOD SUGAR IN MILLIGRAMS PER 100 CC. OF BLOOD

IN THE ADULT ALBINO RAT BEFORE INFECTION

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
91	198	178	140	160	135	158	150	137
92	208	154	141	162	160	159	142	132
98	248	160	142	158	142	160	160	132
99	230	246	143	156	181	161	170	250
100	250	132	144	140	144	168	172	142
101	264	168	145	156	149	169	182	142
102	226	190	146	136	141	170	148	119
103	263	137	147	150	151	171	160	135
104	228	168	148	136	132	180	130	150
105	238	130	149	146	150	181	120	142
106	235	137	150	170	151	183	138	135
107	152	168	151	162	210	184	112	142
108	202	133	152	152	135	185	136	135
109	142	132	153	148	142	186	146	137
110	156	149	154	204	146	187	116	132
137	156	144	155	130	142	188	126	149
138	132	142	156	152	142	189	140	137
139	140	146	157	140	146	190	150	142

TABLE 60. (continued)

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
191	162	146	211	142	142	236	183	164
192	148	146	212	184	142	237	173	142
193	154	132	213	180	132	238	170	135
194	120	128	215	172	137	239	166	137
196	148	144	216	152	132	240	226	149
197	148	135	217	174	144	241	214	135
198	136	111	218	166	151	242	190	135
199	186	128	219	160	137	243	206	142
200	170	137	220	134	132	244	204	137
201	128	135	221	130	142	245	210	142
202	155	132	222	104	149	Ave.=	168.3	145.6
203	149	132	214	144	146	No. Rats...		100
204	212	142	230	170	137	Mean.....		145.600
206	165	132	231	200	144	σ.....		21.800
207	162	132	232	194	177	σ in %.....		14.950
208	188	168	233	186	144	ϵ.....		2.180
209	180	142	234	207	140	ϵ in %.....		1.495
210	178	135	235	178	150			

TABLE 61.

BLOOD SUGAR IN MILLIGRAMS PER 100 CC. OF BLOOD

IN THE RAT TWENTY FOUR HOURS AFTER INFECTION

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
95	178	137	162	160	142	244	204	142
98	248	135	167	158	144	245	210	142
99	230	132	168	172	144	246	212	151
102	226	115	181	120	137	247	172	144
103	263	141	194	120	123	Ave.=	177.1	141
107	152	137	196	148	142	No. Rats...	40	
108	202	150	200	170	151	Mean.....	141.000	
137	156	144	201	128	144	σ.....	8.600	
138	132	142	229	202	140	σ in %....	6.100	
143	156	142	231	200	142	ϵ	1.360	
144	140	135	233	186	144	ϵ in %....	0.965	
145	156	135	234	207	140			
150	170	144	236	183	168			
151	162	140	237	173	140			
155	130	128	239	166	150			
156	152	132	240	226	151			
157	140	146	241	218	151			
161	170	142	242	186	137			

TABLE 62.

BLOOD SUGAR IN MILLIGRAMS PER 100 CC. OF BLOOD

IN THE RAT FORTY EIGHT HOURS AFTER INFECTION

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
87	180	137	144	140	142	190	150	137
88	210	137	145	156	135	194	120	132
89	266	137	150	170	146	228	204	151
90	196	115	151	162	132	229	202	155
91	186	130	155	130	150	231	200	142
92	204	181	156	152	140	233	186	142
93	172	168	157	140	150	Ave.=	176.7	141.4
94	192	167	161	170	142	No. Rats...		42
95	178	123	162	160	135	Mean.....		141.40
98	248	141	163	156	146	σ.....		14.70
99	230	150	167	158	142	σ in %....		10.40
102	226	150	169	182	142	ϵ		2.28
103	263	172	171	160	94	ϵ in %....		1.61
107	152	142	172	240	139			
108	202	123	180	130	142			
137	156	142	182	156	135			
138	132	132	188	126	135			
139	140	137	189	140	151			

TABLE 63.

BLOOD SUGAR IN MILLIGRAMS PER 100 CC. OF BLOOD

IN THE RAT SEVENTY TWO HOURS AFTER INFECTION

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
85	166	46	150	170	64	242	190	34
86	190	70	156	152	144	245	206	137
87	180	140	157	140	142	246	200	151
88	210	137	161	170	50	247	170	132
89	266	150	162	160	57	Ave.=	180.2	109.6
90	196	144	170	148	103	No. Rats...		40
91	186	141	180	130	28	Mean.....		109.60
92	204	178	181	120	132	σ.....		45.60
95	178	148	188	126	142	σ in %....		41.60
98	248	142	189	140	142	ϵ.....		7.22
99	230	142	190	150	120	ϵ in %....		6.58
103	263	51	229	202	137			
107	152	168	231	200	58			
108	202	150	234	207	132			
137	156	113	235	178	32			
138	132	160	239	166	62			
144	140	38	240	226	43			
149	146	120	241	214	103			

TABLE 64.

BLOOD SUGAR IN MILLIGRAMS PER 100 CC. OF BLOOD IN THE RAT AT DEATH - NINETY ONE HOURS AFTER INFECTION

Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.	Rat No.	Weight in Gm.	B.S. mg%.
85	166	46	180	130	28	290	168	36
87	180	20	178	146	23	295	208	35
88	210	20	179	134	23	298	200	36
89	266	23	222	151	37	299	199	37
94	192	23	235	178	32	Ave.=	188.6	32.8
98	260	20	242	190	34	No. Rats...		40
100	250	32	245	194	43	Mean.....		32.800
99	230	20	246	188	32	σ		9.150
103	263	51	263	198	36	σ in %.....		27.800
107	152	30	264	174	32	ϵ		1.445
132	152	36	270	184	28	ϵ in %.....		4.400
134	156	29	272	203	44			
135	154	52	273	219	23			
144	140	38	276	182	30			
156	152	26	277	227	39			
163	156	26	279	188	50			
165	200	22	281	231	50			
176	178	36	288	196	36			

TABLE 65.

EFFECT ON THE TRYPANOSOME COUNT OF ADMINISTERING FIVE GRAMS OF GLUCOSE PER KILOGRAM OF BODY WEIGHT TO THE INFECTED RAT EVERY THREE HOURS

		Time in Hours													
		0	3	6	9	12	15	18	21	24	27	30	Hours incr. in surv. time	Tryps. at death x1000	B.S. at death mg%.
Rat No.	Weight in Gm.	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000	Tryps. x1000			
411	146	1,540	1,830	980	1,910	2,930							12	2,930	37
414	166	2,160	2,730	2,300	3,340								10	-----	--
417	156	1,820	1,730	3,480	2,810	3,310							12	3,310	36
389	223	1,830	2,100	2,350	2,360	3,370							12	3,560	300
393	212	1,700	2,400	2,860	2,630	3,240							15	3,600	--
426	156	1,900	2,200	5,630	3,710								6	3,710	42
428	165	1,420	1,890	2,440	2,810	3,960	3,940	3,260					18	3,260	30
429	172	1,020	1,200	1,490	1,950	1,710	1,970						21	-----	--
430	166	1,300	1,800	2,060	1,980	2,140	1,930						21	-----	--
431	146	1,800	2,500	3,600	4,030	4,100							15	5,040	--
425	148	1,670	1,950			2,040	1,950	1,820					18	1,570	--
433	166	1,590	1,360	1,120	1,650	2,620	3,380	3,370					18	3,260	--
434	167	1,500	1,440	1,410	2,300	2,860	3,640						18	2,670	30
435	220	1,430	1,390	1,870	2,700	3,000	3,630	4,360	3,880	3,280			24	4,820	41
436	174	1,480	1,350	2,270	2,560	2,900	3,560	2,940	4,010	3,820	3,330	3,890	30	3,890	41
437	165	730	800	1,650	1,830	1,820	2,160	2,740	3,490				21	3,490	34
438	158	920	950	1,300	2,400	2,930	3,190	3,710	4,700				21	4,700	42
440	185	800	950	1,170	1,590	2,560			3,510				24	3,510	30
445	149	1,550	1,760	1,800	2,720	2,620	2,740						15	-----	--
447	152	580	900	1,010	1,450	1,160	1,610			3,830			24	3,830	45

TABLE 65. (continued)

Rat No.	Weight in Gm.	0 Tryps. x1000	3 Tryps. x1000	6 Tryps. x1000	9 Tryps. x1000	12 Tryps. x1000	15 Tryps. x1000	18 | 21 Trypsryps. x1000|1000	24 Tryps. x1000	27 Tryps. x1000	30 Tryps. x1000	Hours incr. in surv. time	Tryps. at death x1000	B.S. at death mg%.
448	178	1,570	1,970	2,600	3,860							9	3,860	45
450	132	1,450	1,860	2,310	3,260							9	3,260	40
451	148	1,300	1,600	2,800	3,590							9	3,590	30
452	138	1,540	2,010	2,730	3,210	3,210						12	3,210	45
454	143	1,070	1,980	2,250	3,670							9	3,670	32
455	164	1,430	1,650	2,670	2,910	2,820						12	2,820	32
456	128	1,510	1,710	1,930	2,420	2,360	2,110		2,770			24	2,770	300
444	134	1,270	1,810	2,440	2,940	3,690						12	3,690	71
446	156	770	900	1,090	1,960	2,350	2,610	2,780	3,990			24	3,990	22
453	178	1,650	1,790	2,110	1,720	3,190	4,010	5,050				18	5,050	36
457	238	900	1,460	1,920	2,560	2,990	3,070	3,420	3,960	3,160	3,890	30	3,920	300
458	176	1,040	1,890	2,730	2,670	2,170	2,920	3,040	3,330	5,250		27	5,250	300
459	201	1,140	1,320	1,590	2,300	2,710	2,810	2,600	4,380			24	4,550	34
460	168	1,320	1,670	1,900	2,760	3,660	3,860	4,040	3,620			24	3,620	37
461	172	1,050	1,720	1,850	2,420	2,940	3,010	2,930	3,020	3,950		27	3,950	34
462	195	1,280	2,010	2,710	2,930	3,100	3,520	3,900				18	3,900	42
463	187	1,110	1,980	2,600	2,950	3,740	4,840					15	4,840	26
464	174	910	1,430	1,980	2,020	2,050	2,920	3,550	3,610	3,980	4,230	30	4,230	36
Ave.=	169	1,343	1,660	2,189	2,618	2,821	3,016	3,343,918	3,601	3,934	4,003	18.1	3,744	37.3

TABLE 66.

EFFECT OF INSULIN ON BLOOD SUGAR OF

NORMAL ADULT ALBINO RATS

Rat No.	Weight in Gm.	Insulin U/Kg.	Hrs.after injection	B.S. mg%.	B.S.at death mg.%
510	150	700	5.0	40	
511	143	600	2.5		36
419	126	600	4.5		38
420	125	600	5.3		43
486	140	600	4.0	38	
481	172	500	4.0	66	
482	155	500	4.0	51	
483	163	500	3.0		25
484	171	500	4.0	62	
485	164	500	4.0		32
512	138	500	1.5		38
487	164	400	4.0	48	
488	160	400	4.0		23
524	163	400	3.0	43	
525	147	400	2.6	36	
489	143	300	4.0	46	
490	144	300	4.0	47	
491	160	100	4.0	60	
492	166	100	4.0	62	
Ave.=					33.6

TABLE 67.

EFFECT OF INSULIN ON BLOOD SUGAR OF

TRYPANOSOME INFECTED RAT

Rat No.	Weight in Gm.	Tryps. x1000	Insulin U/Kg.	Hrs.after injection	B.S. mg%.	B.S. at death mg%.
475	172	210	500	3.25		25
276	208	200	400	2.60		28
477	178	20	300	--		--
478	186	60	300	2.50		23
479	187	160	200	3.25		23
480	164	200	200	1.30		28
481	192	150	200	2.16		32
482	175	180	200	1.50		26
487	190	160	100	2.00		26
489	155	20	100	2.00		28
490	161	200	50	2.25		27
491	160	160	50	2.30		23
492	176	140	20	1.00		26
497	193	140	20	1.30		20
514	168	110	20	1.30		26
515	162	60	10	2.00		32
516	179	90	10	1.50		27
517	154	100	5	3.00	54	
518	156	100	1	3.00	86	
Ave.=						26.2

TABLE 68.

EFFECT OF SODIUM IODOACETATE ON THE TRYPANOSOME INFECTION IN THE RAT

Rat No.	Wt. gm.	Tryps. x1000	mg./ Kg.	Tryps. 2 hrs x1000	% Red.	Tryps. 18 hrs x1000	Tryps. 48 hrs x1000	Tryps. 72hrs x1000	Tryps. 96 hrs x1000
547	216	680	20	50	93	140	Dead		
556	204	510	20	20	94	50	900	Dead	
558	239	10	20	0	100	10	560	Dead	
560	223	120	20	50	47	840	Dead		
561	142	350	20	30	92	110	850	Dead	
562	187	1,210	20	40	98	110	920	Dead	
567	174	1,710	20	30	98	250	Dead		
569	176	1,420	20	640	55	1,330	Dead		
574	160	360	30	40	89	22	460	Dead	
575	191	300	30	20	93	50	730	Dead	
576	171	430	30	50	89	40	620	Dead	
577	165	330	40	30	91	10	420	Dead	
579	174	320	40	0	100	0	30	460	Dead
580	174	390	50	30	93	0	50	600	Dead
581	260	260	50	0	100	Dead			
584	165	Normal	20						Alive
585	160	Normal	20						Alive
586	170	Normal	30						Alive
587	170	Normal	30						Alive
588	172	Normal	40			Dead			
589	156	Normal	40						Alive
590	186	Normal	50						Dead
591	168	Normal	50						Alive

TABLE 69.

BLOOD PICTURE IN FIVE SPLENECTOMIZED ADULT ALBINO RATS

Days fr.op.	Wt. in gm.	Plate. x1000	R.B.C. x 10^6	Hb. Gm.%.	Coag.Time. in sec.
0	217	778	6.40	11.9	148
1	193	1,140	6.86	11.5	125
2	195	1,125	6.80	11.3	137
3	195	1,180	6.38	11.2	143
4	189	1,320	4.00	8.0	162
5	181	1,370	2.68	5.3	156
6	162	1,760	2.50	5.1	147
7	180	1,510	2.93	5.5	135
8	189	1,470	2.67	5.7	142
9	193	1,270	3.06	6.1	139
10	195	1,600	3.40	6.5	138
11	196	1,490	3.46	6.7	137
13	205	1,370	3.84	8.3	170
15	215	1,430	4.32	9.0	190
17	212	1,030	3.78	8.1	151
20	204	1,160	4.15	9.3	204
23	214	1,540	5.06	11.0	141
25	218	1,025	5.06	10.5	130
27	220	1,140	4.77	10.9	111
30	240	970	6.30	11.7	138
35	257	935	6.48	12.5	129
58	300	1,090	7.85	13.6	193
66	306	845	8.15	13.6	174
73	310	845	8.60	13.0	164
115	340	870	8.89	14.2	195

TABLE 70.

EFFECT OF HEMORRHAGE IN TEN ADULT ALBINO RATS BY WITHDRAWING 1.1 CC. OF BLOOD FROM THE HEART ON FIVE CONSECUTIVE DAYS

Days from 1st bldg	Wt. in gm.	R.B.C. x 10^6	Hb. Gm%.	Coag. sec.	Plate. x1000	Sed. mm/hr.	PCV %	Plas. Sp.Gr.	Plas. Tot.Pr.
0	183.6	8.53	14.0	153.6	766	0.65	51.5	1.0259	6.45
1	181.1	7.48	12.1	156.0	760	1.10	42.4	1.0259	6.45
2	176.3	6.04	10.8	161.8	768	4.85	39.3	1.0262	6.57
3	170.7	5.27	9.75	159.4	805	1.45	34.2	1.0261	6.54
4	169.0	4.76	8.50	172.0	1,048	1.40	32.6	1.0261	6.54
5	166.0	4.23	7.70	152.0	1,110				
6	170.0	4.60	8.06	154.0	1,060				
7	170.0	4.67	8.70	164.0	1,260				
8	165.0	5.03	9.23	160.0	1,260				
9	167.0	5.88	9.40	146.0	1,330				
10	166.0	5.80	8.75	153.0	1,310				
12	173.0	5.80	9.65	164.0	1,120				
16	189.0	6.60	12.10	172.0	1,060				
23	200.0	9.35	13.60	154.0	920				