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Studies in the protein content of normal avian blood

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Studies in Protein Content of Normal Avian Blood

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MASSACHUSETTS AGRICULTURAL COLLEGE

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Memorandum

Dept. Chemistry Date, May 15, 1930.

To: The Director of the Graduate School.

Subject: Thesis for Master's Degree.

The thesis of Mr. G. Chapman Crooks entitled "Studies in Protein Content of Normal Avian Blood" has been examined by the committee appointed by the Director of the Graduate School. A conference has been held with the candidate, and the undersigned committee herewith approves and accepts the thesis as in part fulfilling the requirement for the degree of Master of Science.

Joseph S Chamberlain
Leon A. Bradley
Wallace F. Powers } Comm

Signed:

STUDIES IN THE PROTEIN CONTENT OF NORMAL AVIAN BLOOD

G. Chapman Crooks

Thesis submitted for

the degree of

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TABLE OF CONTENTS

PURPOSE OF THE INVESTIGATION

During recent years it has come to be believed that certain constituents of normal blood can vary over only very limited ranges. At the same time it has been learned that others may vary to some extent even while the individual is perfectly normal in every other way. The proteins of the blood serum are among these variable substances.

The purpose of this work is to study the variation in the serum proteins of normal avian blood under varying conditions. To do this a number of hens were selected at random from a flock of healthy Rhode Island Reds, all approximately sixteen months old at the beginning of the tests. All of the birds were trapnested. Some of them were bled on July 8, and August 26, only. Others were bled once each week, and the remaining birds three times each week between these two dates. The blood samples were all analyzed for total non-protein material, serum globulin, serum albumin, and total proteins. The birds were housed under normal living conditions and fed a balanced poultry ration.

Thus the purpose of the problem may be said to be two-fold.

1. To observe the relationship between serum proteins and egg production.

2. To observe the effect of continued bleeding and the speed of regeneration of serum proteins.

REVIEW OF LITERATURE

In 1905 T. Brailsford Robertson (17) started a series of studies in the chemistry of the "Ion-Proteid" compounds. The first three of these, "Ueber den Einfluss von Elektrolyten auf die Frequens des Herzschlag"(17), "On the Influence of Electrolytes upon the Staining of Tissues by Iodine-Eosin and Methyl Green" (18), and "On the Influence of Electrolytes upon the Toxicity of Alkaloids", (19) have little direct bearing upon this present work, but do materially prepare the way for the fourth of his series, "On Some Chemical Properties of Casein and their Possible Relation to the Chemical Behavior of Other Protein Bodies with Especial Reference to the Hydrolysis of Casein by Trypsin", (20). That article, in turn, prepares the way for this present work. In his early article he pointed out the difficulty, in studying the proteins, due to the lack of accurate quantitative methods of dealing with them, and the large amount of time involved in such methods of measurement as were available. Gravimetric methods involved either considerable loss of material in the process of thoroughly freeing the protein from water or, in other cases, what appeared to be considerable inaccuracy due to undertain hydration of the protein material during the analysis.

In 1909 the same investigator (21) found that "the difference between the refractive indices of two solutions is proportional to the difference between the percentages of casein which they contain". This was a significant fact and the following

year, in three more publications, he elaborated his work by studying the refractive indices of solutions of ovomucoid and ovovitellin, (22) the paranucleins, (23) and serum-globulin, (24). This last article (24) reports the refractive indices of solutions of "insoluble" globulin. The material was prepared by Robertson by the precipitation of two fractions of globulin from ox blood. He believed it to be the same as that which Reiss (16) had obtained by precipitation with solutions of 32 to 36 per cent and 36 to 39 per cent saturations, respectively, of ammonium sulphate, and referred to as Pseudoglobulin I and Pseudoglobulin II. The changes in the refractive indices of salt solutions which resulted from the additions of one per cent of these "pseudoglobulins" were found to be .00224 and .00230, figures which checked within the value of experimental error with the figures as given by Reiss, (16).

Subsequent work (25)(26) by the same authority developed the method of analysis and showed the relationship between the sera of the horse, rabbit, rat, and ox, while this same work was extended by Woolsey (35) to cover the sera of the sheep, hog, goat, dog, cat and quinea pig. Later Thompson (32) and Briggs (3) followed similar methods to compare the sera of the hen, turkey, duck, goose; and pigeon, rooster and quinea fowl, respectively.

Wells (34) in 1913, using the methods of Robertson (25) determined the percentage of total protein in the blood serum of rabbits of various ages. He found that although age had little effect on the relative amounts of "soluble" globulins, "insoluble" globulins, and albumin, there was a slight increase in the per cent

of total proteins in the serum of animals between the ages of 21 and 140 days. On the other hand he found fully adult animals to show a slightly lower total protein than did younger ones between the ages of 100 and 150 days of age. The same work showed that the rabbits fed entirely on a milk diet had a slightly increased amount of serum protein when compared with those fed on a mixed diet of grain and alfalfa.

In 1915 Robertson (27) published a method which, although a development of the method used in previous work, made it possible to determine by refractometric methods, the percentages of albumin, globulin, total proteins, and non-protein materials using, in all, only about 1.5 cubic centimeters of serum.

Due to the undesirable feature of having ammonium salts present in the serum for further work on the same samples, Howe (9) modified this last method slightly by using sodium sulphate in place of ammonium sulphate as the precipitant. This was not an entirely new procedure, having been used as early as 1901 by Pinkus (14).

The next few years were marked by great activity in the development of new and the refinement of the older methods for the measurement of serum proteins. Two articles were published, the first in 1923 by Berger and Petschacher (2) and the second in 1926, by Petschacher, Berger and Schretter, (13), both dealing with the relationship between the viscosity of the serum proteins and the refractometric methods of measurement. The method used in this work was a combination of a micro-Kjeldahl and a simplified viscometric method.

Between these dates Mozai (11) had found that the refractive indices for constant mixtures of albumin and globulin were constant, while the viscosity varied with the relative proportion of the two. At the same time Starlinger and Hartl (31) were doing similar work, although differing in some respects from the results reported by Petschacher (12) in 1926.

Other workers were still developing methods for the precipitation of the serum proteins and in 1927 Lorber (10) found that not only certain acids but also the salts of the heavy metals could be used.

The same year Vila and Ancelle (33) separated the proteins of the serum by means of acetone. Then by the determination of the sulphur and phosphorus in the fractions, and the composition of the soluble and insoluble ash, identified them as two absolutely separate individuals.

With this much information concerning the methods of analysis, actual studies of various types of sera were undertaken by many workers. Arnd and Hafner (1) by a study of the refraction of samples which had been treated with ammonium sulphate and sodium sulphate, showed that the two serum proteins were really chemically distinct.

The following year Recknagel (15) reported that variations among individuals and even certain fluctuations in the serum of a single person were shown in the specific refraction of the total protein. He went so far as to claim that increases in specific refraction followed the same course as did the specific viscosity,

"both, apparently, being closely associated with the colloidal state of the proteins at a given time".

Brocq-Rousseu (4), working with eight horses, found that in samples taken each week there was a slight but steady decrease in the per cent of serum proteins for nine consecutive weeks. From the tenth through the thirteenth weeks the amounts were variable.

Similar work by Endres (6) reported that in cases of severe loss of blood the total salt concentration was not markedly altered but single electrolytes showed some alteration in concentration. He also observed some variation in the behavior of the serum proteins.

Among the recent applications of serum-protein investigations has been that of Schoch (30) who found that in pneumonia the serum-protein at first deminished but later showed a definite increase.

Another pathological application was that of Hanns and Chaumerliac (7). Using refractometer methods they found a direct relationship between albuminurea and a variation in the albumin content of the blood serum.

Cassinis (5) reported an apparent increase of 0.38 to 1.01 per cent in the serum protein of eight subjects following a run of 600 meters and a march of 4800 meters. He claimed, however, that this increase was only apparent. He explained it on the basis of the loss of water from the blood during the exercise, producing this apparent increase of protein by changing the relative amounts of protein and water.

The speed of regeneration of blood after heavy losses was found by Rozanskii (28) to be very rapid. Following a severe loss, the amount of fibrin was found to have increased 60 to 80 per cent, but returned to normal within two or three weeks.

Hayden and Fish (8) in 1929 published the results of an investigation of the blood of various domesticated animals including the cow, horse, dog, chicken and goat. Although doing much work on the inorganic constituents of the blood they also did some on the serum proteins. This phase of their work will be mentioned in more detail in the following pages.

While this present work was in progress Schneider (29) published his findings concerning the various common methods for determining serum proteins. He found the gravimetric and Kjeldahl methods to be in the closest agreement, but the refractometric method very close. Due to its relative accuracy, but even more because of its speed, he considered it to be the valuable method where large numbers of samples were to be handled.

EXPERIMENTAL PROCEDURE

For this work thirty hens were picked at random from a flock of healthy Rhode Island Reds of average size and reputation as egg producers. They were all about sixteen months old at the time of starting the tests and the previous fall had been certified, according to the Massachusetts State tests, as being free of B. W. D.+

These birds were divided into three groups or pens, and numbered pens seven, eight and nine. Each group was housed in a well ventilated coop about fourteen feet square, with a southern exposure. This arrangement was made in an attempt to study the birds under as nearly normal living conditions as possible and thus eliminate the objection so often raised that when birds are confined in small metabolism cages and deprived of their normal exercise, abnormal conditions exist.

Food was available to the birds at all times. A supply of fresh water and oyster shells was also kept in each pen.

The egg production of each bird was easily obtained by the use of trap nests. The record seems to be quite accurate except in the case of one bird, #9454, which was discovered to be eating its eggs.

The blood samples were taken on the stated days, between the hours of eight and nine in the morning. This was done in order

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+ B. W. D. is the common representation of Bacillary White Diarrhea or, referred to in some states as, Pullorum.

that any possible daily fluctuation, due to habits of eating or exercise, might be as nearly the same for each day as possible. Also any discomfort that the birds might have suffered during the warmer parts of the day was eliminated by working with then at the relatively early hours.

The samples of blood were collected by puncturing the brachial vessel. This required only a small incision and, by taking samples from alternate wings, no serious scar tissue resulted which might have interfered with future sampling.

The samples were drawn directly into hard glass tubes, having a capacity of about 11 cubic centimeters. These had been carefully cleaned and rinsed several times with distilled water, dried in a steam oven, and closed at once with paraffined cork stoppers.

At each bleeding a sample of about 10 cubic centimeters was taken, although only a part of the serum from this was used. This whole blood was allowed to stand for two hours at a temperature of 20 to 25° C.+ At this temperature and in this time a firm clot formed and often sufficient serum issued from the clot to be used in the tests. The usual procedure, however, was to break up the clot with a piece of platinum wire and allow it to again stand for about an hour. Centrifuging for 15 minutes at a speed of 1400 revolutions per minute then gave a very clear serum. This work was done in an ordinary centrifuge having an eight inch, eight cup wheel. Controlling the factors of temperature and time seemed to improve the quality

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+ The usual room temperature where the samples were taken was 20 to 25°C., during the months that this work was being done.

of the serum to some extent, while this speed in the centrifuge seemed to completely throw out the clot in a minimum time.

The actual chemical analysis of the samples followed the method of Robertson (27) with only such modifications as seemed to facilitate the work under the existing conditions and with the apparatus used in this laboratory.

Five-tenths of a cubic centimeter of the clear serum was run into a tube, sealed at one end, about 15 centimeters long and one centimeter in diameter. To this was then added an equal volume of N/25 acetic acid. A short piece of platinum wire, two or three centimeters long, was dropped into the tube, the top sealed off, and the tube shaken. The purpose of the platinum wire was merely to insure thorough mixing, while a common bacteriological pipette graduated to .01 of a cubic centimeter was used to measure the liquids.

The tube was placed in warm water which was then slowly brought to a boil. Robertson (27) suggested boiling "for one or two minutes", but for the sake of uniformity all samples in this work were heated by allowing the water to boil slowly, but evenly, for two minutes. The tube was then removed and allowed to cool.

Shaking vigorously the short piece of platinum wire in the tube served to break up the coagulated mass of protein material.

After this the tube was cut about five centimeters from the top. This was high enough not to interfere with the coagulum, and at the same time left a tube about ten centimeters long which could be cleaned and used in a later part of the analysis. The tube

after being closed with a small paraffined stopper was centrifuged for ten minutes at a speed of about 1000 revolutions per minute.

The refractive index of the resulting clear liquid was determined with an Abbe refractometer. This liquid was a mixture of N/25 acetic acid and Serum A. Serum A was protein free, the protein material having been precipitated by the action of heat in the presence of the dilute acid.

At the same time the refractive index was found for a solution of N/50 acetic acid. This would be the strength of the liquid examined above, due to the fact that the N/25 acid had been mixed with an equal volume of the original serum. "By determining the refractive indices of the mixture and of the N/50 acetic acid simultaneously the necessity of regulating the temperature at which the readings were made was obviated." This fact was given by Robertson (27) in his work. These two sets of figures are represented in the following tables in columns II and III respectively.

The difference between these two figures, i.e., the refractive index of the protein-free serum plus the N.25 acid, and the refractive index of the N/50 acetic acid, multiplied by two represents the refractive index of the non-protein constituents of the serum. This latter value, given in the tables in column IV, when divided by the factor 0.00160 gives the per cent of non-protein material present.

The next step was to determine the amount of albumin in the sample. To do this Robertson (27) directed the use of 0.5 cubic

centimeter of serum; but due to some delay in the precipitation of the globulin in some samples, it was found convenient to have an excess of liquid in the precipitating tube. Thus in this work one cubic centimeter of saturated ammonium sulphate solution was placed in a tube about 10 cubic centimeters long and one centimeter in diameter, and an equal volume of serum added. As in the case of the non-protein determination, a small piece of platinum wire was introduced. The tube was then stoppered and shaken at once. The mixture was centrifuged for 15 minutee at a 1000 revolutions a minute. Of the supernatent liquid .25 of a cubic centimeter was then removed and added to an equal volume of distilled water. After being stoppered and thoroughly shaken the tube was centfifuged for 10 minutes at 1000 revolutions per minute. The refractive index of the resulting clear liquid was determined and also that of a one-fourth saturated ammonium sulphate solution. The difference between these two readings, recorded in columns VI ahd VII of the tables, is multiplied by four, as given in column VIII. This last figure less the refractive index of the non-protein material, gives the refractive index of the albumin in the serum. The per cent of albumin may be found by dividing by the factor 0.00177.

Following the determination of the refractive indices of the whole serum and distilled water at the same temperature as that used for the above determinations, the globulin content of the sample may be calculated. That is, the refractive index of the serum less that of the water leaves the refractive index of the total protein and non-protein material. As the refractive indices of the non-protein material and of the albumin have been determined, the index

of refraction of the globulin may be found by simple subtraction. This figure divided by 0.00229 gives the per cent of globulin in the sample. This per cent is shown on the following tables in column XVI. The total protein of the sample is then found by adding the per cents of albumin and globulin.

RESULT OF SERUM ANALYSES

In the following tables (I - XXX) are given the actual determinations made during the course of this research problem. These complete tables have been thus arranged for convenience and future reference. Summaries of them will appear in the following pages in connection with the discussion of the various points considered.

Table I Bird #9338

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3645	1.3620	.0100
15	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
22	1.3460	1.3450	.0020	1.3	1.3665	1.3650	.0060
29	1.3435	1.3425	.0020	1.3	1.3665	1.3650	.0060
8/5	1.3450	1.3440	.0020	1.3	1.3660	1.3645	.0060
12	1.3450	1.3440	.0020	1.3	1.3655	1.3640	.0060
19	1.3460	1.3450	.0020	1.3	1.3670	1.3655	.0060
26	1.3455	1.3445	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table II Bird #9379

I	II	III	IV	V	VI	VII	VIII
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
29	1.3435	1.3425	.0020	1.3	1.3665	1.3650	.0060
8/5	1.3450	1.3440	.0020	1.3	1.3665	1.3645	.0080
12	1.3450	1.3440	.0020	1.3	1.3675	1.3640	.0140
19	1.3460	1.3450	.0020	1.3	1.3690	1.3655	.0140
26	1.3455	1.3445	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table I (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0080	4.5	1.3611	1.3457	.0134	6.9	.0054	2.4
.0100	5.6	1.3628	1.3450	.0158	8.1	.0058	2.5
.0040	2.3	1.3590	1.3445	.0125	6.0	.0085	3.7
.0040	2.3	1.3590	1.3440	.0130	6.2	.0090	3.9
.0040	2.3	1.3580	1.3450	.0110	5.4	.0070	3.1
.0040	2.3	1.3590	1.3440	.0130	6.2	.0090	3.9
.0040	2.3	1.3605	1.3450	.0135	6.4	.0095	4.1
.0080	4.5	1.3560	1.3420	.0120	6.2	.0040	1.7
	3.26				6.31		3.16

Table II (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
.0060	3.4	1.3595	1.3457	.0118	6.9	.0058	2.5
.0100	5.6	1.3600	1.3450	.0130	6.9	.0030	1.3
.0100	5.6	1.3600	1.3445	.0135	7.1	.0035	1.5
.0040	2.3	1.3565	1.3440	.0105	5.1	.0065	2.8
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
.0120	6.8	1.3590	1.3440	.0130	7.2	.0010	0.4
.0120	6.8	1.3605	1.3450	.0135	7.5	.0015	0.7
.0080	4.5	1.3585	1.3420	.0145	7.3	.0065	2.8
	4.80				6.70		1.77

Table III Bird #9395

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
29	1.3435	1.3425	.0020	1.3	1.3662	1.3650	.0048
8/5	1.3450	1.3440	.0020	1.3	1.3658	1.3645	.0052
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
19	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
26	1.3455	1.3445	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table IV Bird #9410

I	II	III	IV	V	VI	VII	VIII
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
22	1.3460	1.3450	.0020	1.3	1.3665	1.3650	.0060
29	1.3435	1.3425	.0020	1.3	1.3660	1.3650	.0040

Table III (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globlin	Globulin %
.0060	3.4	1.3576	1.3457	.0099	5.1	.0039	1.7
.0060	3.4	1.3590	1.3450	.0120	6.0	.0060	2.6
.0080	4.6	1.3585	1.3445	.0120	6.3	.0040	1.7
.0028	1.6	1.3570	1.3440	.0110	5.2	.0082	3.6
.0032	1.8	1.3570	1.3450	.0100	4.8	.0068	3.0
.0100	5.6	1.3580	1.3440	.0120	6.5	.0020	0.9
.0080	4.5	1.3575	1.3450	.0105	5.6	.0025	1.1
.0060	3.4	1.3565	1.3420	.0125	6.2	.0065	2.8
	3.53				5.71		2.17

Table IV (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
.0060	3.4	1.3573	1.3457	.0096	5.0	.0036	1.6
.0060	3.4	1.3555	1.3450	.0085	4.5	.0025	1.1
.0040	2.3	1.3550	1.3445	.0085	4.3	.0045	2.0
.0020	1.1	1.3545	1.3440	.0085	3.9	.0065	2.8

Table V Bird #9442

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
27	1.3435	1.3425	.0020	1.3	1.3665	1.3650	.0060
8/5	1.3450	1.3440	.0020	1.3	1.3675	1.3645	.0120
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
19	1.3460	1.3450	.0020	1.3	1.3690	1.3655	.0140
26	1.3455	1.3445	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table VI Bird #9454

I	II	III	IV	V	VI	VII	VIII
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
29	1.3435	1.3425	.0020	1.3	1.3665	1.3650	.0060
8/5	1.3450	1.3440	.0020	1.3	1.3662	1.3645	.0068
12	1.3450	1.3440	.0020	1.3	1.3660	1.3640	.0080
19	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
26	1.3455	1.3445	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table V (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0060	3.4	1.3583	1.3457	.0106	5.4	.0046	2.0
.0060	3.4	1.3590	1.3450	.0120	6.0	.0060	2.6
.0080	4.5	1.3600	1.3445	.0135	6.9	.0055	2.4
.0040	2.3	1.3575	1.3440	.0115	5.6	.0075	3.3
.0100	5.6	1.3610	1.3450	.0140	7.3	.0040	1.7
.0100	5.6	1.3595	1.3440	.0135	7.1	.0035	1.5
.0120	6.0	1.3630	1.3450	.0160	8.5	.0040	1.7
.0080	4.5	1.3570	1.3420	.0130	6.7	.0050	2.2
	4.51				6.68		2.17

Table VI (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
.0060	3.4	1.3591	1.3457	.0114	5.8	.0054	2.4
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
.0080	4.5	1.3600	1.3445	.0135	6.9	.0055	2.4
.0040	2.3	1.3580	1.3440	.0120	5.8	.0080	3.5
.0048	2.7	1.3580	1.3450	.0110	5.4	.0062	2.7
.0060	3.4	1.3570	1.3440	.0110	5.6	.0050	2.2
.0100	5.6	1.3590	1.3450	.0120	6.5	.0020	0.9
.0060	3.4	1.3555	1.3420	.0115	5.8	.0055	2.4
	3.59				5.92		2.34

Table VII Bird #9466

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3645	1.3620	.0100
15	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
27	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
8/5	1.3450	1.3440	.0020	1.3	1.3670	1.3645	.0100
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
17	1.3460	1.3450	.0020	1.3	1.3670	1.3655	.0060
26	1.3455	1.3445	.0020	1.3	1.3665	1.3650	.0060
Aver-age							

Table VIII Bird #9478

I	II	III	IV	V	VI	VII	VIII
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
8/5	1.3450	1.3440	.0020	1.3	1.3670	1.3645	.0100
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
19	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
26	1.3455	1.3445	.0020	1.3	1.3675	1.3650	.0100

Table VII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0080	4.5	1.3620	1.3457	.0143	7.3	.0063	2.8
.0100	5.6	1.3610	1.3450	.0140	7.3	.0040	1.7
.0100	5.6	1.3615	1.3445	.0150	7.8	.0050	2.2
.0060	3.4	1.3590	1.3440	.0130	6.5	.0070	3.6
.0080	4.5	1.3580	1.3450	.0110	5.8	.0030	1.3
.0100	5.6	1.3600	1.3440	.0140	7.3	.0040	1.7
.0040	2.3	1.3590	1.3450	.0120	5.8	.0080	3.5
.0040	2.3	1.3555	1.3420	.0115	5.6	.0075	3.3
	4.23				6.68		2.45

Table VIII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
,0060	3.4	1.3605	1.3457	.0128	6.4	.0068	3.0
.0100	5.6	1.3615	1.3450	.0145	7.6	.0045	2.0
.0080	4.5	1.3595	1.3445	.0130	6.7	.0050	2.2
.0060	3.4	1.3595	1.3440	.0135	6.7	.0075	3.3
.0080	4.5	1.3605	1.3450	.0135	6.9	.0055	2.4
.0100	5.6	1.3600	1.3440	.0140	7.3	.0040	1.7
.0100	5.6	1.3630	1.3450	.0160	8.2	.0060	2.6
.0080	4.5	1.3570	1.3420	.0130	6.7	.0050	2.2
	4.64				7.01		2.43

Table IX Bird #9484

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd	(VI-VII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3635	1.3620	.0060
15	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
8/5	1.3450	1.3440	.0020	1.3	1.3670	1.3645	.0100
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
19	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
26	1.3455	1.3445	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table X Bird #9552

I	II	III	IV	V	VI	VII	VIII
7/8	1.3430	1.3420	.0020	1.3	1.3640	1.3620	.0080
15	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
8/5	1.3450	1.3440	.0020	1.3	1.3670	1.3645	.0100
12	1.3450	1.3440	.0020	1.3	1.3670	1.3640	.0120
19	1.3460	1.3450	.0020	1.3	1.3690	1.3655	.0140
26	1.3455	1.3445	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table IX (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0040	2.3	1.3580	1.3457	.0103	5.1	.0063	2.8
.0100	5.6	1.3590	1.3450	.0120	6.5	.0020	0.9
.0100	5.6	1.3595	1.3450	.0125	6.7	.0025	1.1
.0060	3.4	1.3565	1.3440	.0105	5.4	.0045	2.0
.0080	4.5	1.3585	1.3450	.0115	6.0	.0035	1.5
.0100	5.6	1.3585	1.3440	.0125	6.7	.0025	1.1
.0080	4.5	1.3580	1.3450	.0110	5.8	.0030	1.3
.0100	5.6	1.3560	1.3420	.0120	6.5	.0020	0.9
	4.64				6.10		1.45

Table X (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
.0060	3.4	1.3588	1.3457	.0111	5.2	.0041	1.8
.0060	3.4	1.3590	1.3450	.0120	6.0	.0060	2.6
.0100	5.6	1.3605	1.3450	.0135	7.1	.0035	1.5
.0060	3.4	1.3575	1.3440	.0115	5.8	.0055	2.4
.0080	4.5	1.3585	1.3450	.0115	6.0	.0035	1.5
.0100	5.6	1.3600	1.3440	.0140	7.3	.0040	1.7
.0120	6.8	1.3620	1.3450	.0150	8.1	.0030	1.3
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
	4.80				6.60		1.81

Table XI Bird #9341

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
10	1.3430	1.3420	.0020	1.3	1.3650	1.3620	.0120
12	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
15	1.3440	1.3430	.0020	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
19	1.3465	1.3455	.0020	1.3	1.3680	1.3660	.0080
22	1.3460	1.3450	.0020	1.3	1.3695	1.3650	.0180
24	1.3470	1.3460	.0020	1.3	1.3690	1.3660	.0120
26	1.3440	1.3430	.0020	1.3	1.3655	1.3630	.0100
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
31	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3665	1.3645	.0080
5	1.3450	1.3440	.0020	1.3	1.3660	1.3650	.0040
7	1.3460	1.3450	.0020	1.3	1.3678	1.3653	.0100
9	1.3450	1.3440	.0020	1.3	1.3660	1.3635	.0100
12	1.3445	1.3435	.0020	1.3	1.3665	1.3640	.0100
14	1.3440	1.3430	.0020	1.3	1.3660	1.3640	.0080
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
21	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
23	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
26	1.3470	1.3460	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table XI (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0100	5.6	1.3600	1.3440	.0140	7.3	.0040	1.7
.0100	5.6	1.3600	1.3445	.0135	7.1	.0035	1.5
.0060	3.4	1.3605	1.3455	.0130	6.5	.0070	3.1
.0160	9.0	1.3635	1.3450	.0165	9.2	.0005	0.2
.0100	5.6	1.3595	1.3455	.0120	6.4	.0020	0.8
.0080	4.5	1.3570	1.3430	.0120	6.2	.0040	1.7
.0060	3.4	1.3575	1.3440	.0115	5.8	.0055	2.4
.0060	3.4	1.3570	1.3440	.0110	5.6	.0050	2.2
.0060	3.4	1.3565	1.3445	.0100	5.1	.0040	1.7
.0020	1.1	1.3570	1.3450	.0100	4.6	.0080	3.5
.0080	4.5	1.3580	1.3450	.0110	5.8	.0030	1.3
.0080	4.5	1.3590	1.3445	.0125	6.5	.0045	2.0
.0080	4.5	1.3580	1.3445	.0115	6.0	.0035	1.5
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
.0100	5.6	1.3590	1.3450	.0120	6.5	.0020	0.9
.0100	5.6	1.3600	1.3450	.0130	6.9	.0030	1.3
.0100	5.6	1.3580	1.3430	.0130	6.9	.0030	1.3
.0060	3.4	1.3575	1.3430	.0125	6.2	.0065	2.8
.0060	3.4	1.3560	1.3420	.0120	6.0	.0060	2.6
	4.65				6.46		1.8

Table XII Bird # 9382

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3431	1.3420	.0022	1.3	1.3650	1.3630	.0080
10	1.3431	1.3420	.0022	1.3	1.3640	1.3620	.0080
12	1.3431	1.3420	.0022	1.3	1.3655	1.3630	.0100
15	1.3441	1.3430	.0022	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
19	1.3465	1.3455	.0020	1.3	1.3690	1.3660	.0120
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
24	1.3470	1.3460	.0020	1.3	1.3685	1.3660	.0100
26	1.3440	1.3430	.0020	1.3	1.3650	1.3630	.0080
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
31	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3665	1.3645	.0080
5	1.3450	1.3440	.0020	1.3	1.3675	1.3650	.0100
7	1.3460	1.3450	.0020	1.3	1.3672	1.3653	.0076
9	1.3450	1.3440	.0020	1.3	1.3660	1.3635	.0100
12	1.3445	1.3435	.0020	1.3	1.3670	1.3640	.0120
14	1.3440	1.3430	.0020	1.3	1.3660	1.3640	.0080
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
21	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
23	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
26	1.3470	1.3460	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table XII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0058	3.3	1.3560	1.3420	.0118	5.9	.0060	2.6
.0058	3.3	1.3550	1.3420	.0108	5.5	.0050	2.2
.0078	4.2	1.3550	1.3420	.0108	5.5	.0030	1.3
.0098	5.5	1.3590	1.3440	.0128	6.8	.0030	1.3
.0100	5.7	1.3610	1.3445	.0145	7.7	.0045	2.0
.0100	5.6	1.3620	1.3455	.0145	7.6	.0045	2.0
.0080	4.5	1.3620	1.3450	.0150	7.6	.0070	3.1
.0080	4.5	1.3620	1.3455	.0145	7.3	.0065	2.8
.0060	3.4	1.3590	1.3430	.0140	6.9	.0080	3.5
.0060	3.4	1.3600	1.3440	.0140	6.9	.0080	3.5
.0060	3.4	1.3610	1.3440	.0150	7.3	.0090	3.9
.0060	3.4	1.3590	1.3445	.0125	6.2	.0065	2.8
.0080	4.5	1.3610	1.3450	.0140	7.1	.0060	2.6
.0056	3.2	1.3600	1.3450	.0130	6.4	.0074	3.2
.0080	4.5	1.3595	1.3445	.0130	6.5	.0050	2.2
.0100	5.6	1.3580	1.3445	.0115	6.2	.0015	0.6
.0060	3.4	1.3585	1.3450	.0115	5.8	.0055	2.4
.0100	5.6	1.3600	1.3450	.0130	6.9	.0030	1.3
.0080	4.5	1.3590	1.3450	.0120	6.2	.0040	1.7
.0100	5.6	1.3600	1.3430	.0150	7.8	.0050	2.2
.0100	5.6	1.3590	1.3430	.0140	7.3	.0040	1.7
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
	4.47				6.76		2.30

Table XIII Bird #9388

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
10	1.3430	1.3420	.0020	1.3	1.3650	1.3620	.0120
12	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
15	1.3440	1.3430	.0020	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0030	1.3	1.3680	1.3655	.0100
19	1.3465	1.3455	.0020	1.3	1.3690	1.3660	.0120
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3690	1.3660	.0120
26	1.3440	1.3430	.0020	1.3	1.3660	1.3630	.0120
29	1.3435	1.3425	.0020	1.3	1.3675	1.3650	.0100
31	1.3450	1.3440	.0020	1.3	1.3675	1.3650	.0100
8/2	1.3460	1.3450	.0020	1.3	1.3670	1.3645	.0100
5	1.3450	1.3440	.0020	1.3	1.3675	1.3650	.0100
7	1.3460	1.3450	.0020	1.3	1.3678	1.3653	.0100
9	1.3450	1.3440	.0020	1.3	1.3665	1.3635	.0120
12	1.3445	1.3435	.0020	1.3	1.3675	1.3640	.0140
14	1.3440	1.3430	.0020	1.3	1.3670	1.3640	.0120
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
21	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
23	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
26	1.3470	1.3460	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table XIII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0100	5.6	1.3565	1.3420	.0125	6.7	.0025	1.1
.0100	5.6	1.3565	1.3420	.0125	6.7	.0025	1.1
.0120	6.8	1.3570	1.3420	.0130	7.2	.0010	0.4
.0100	5.6	1.3590	1.3440	.0130	6.9	.0030	1.3
.0080	4.5	1.3595	1.3445	.0130	6.7	.0050	2.2
.0100	5.6	1.3605	1.3455	.0130	6.9	.0030	1.3
.0100	5.6	1.3610	1.3450	.0140	7.3	.0040	1.7
.0100	5.6	1.3595	1.3455	.0120	6.5	.0020	0.9
.0100	5.6	1.3570	1.3430	.0120	6.5	.0020	0.9
.0080	4.5	1.3590	1.3440	.0130	6.7	.0050	2.2
.0080	4.5	1.3490	1.3440	.0130	6.7	.0050	2.2
.0080	4.5	1.3580	1.3445	.0115	6.0	.0035	1.5
.0080	4.5	1.3635	1.3450	.0165	8.2	.0085	3.7
.0080	4.5	1.3590	1.3450	.0120	6.2	.0040	1.7
.0100	5.6	1.3590	1.3445	.0125	6.7	.0025	1.1
.0120	6.8	1.3600	1.3445	.0135	7.5	.0015	0.7
.0100	5.6	1.3585	1.3450	.0115	6.3	.0015	0.7
.0100	5.6	1.3590	1.3450	.0120	6.5	.0020	0.9
.0100	5.6	1.3610	1.3450	.0140	7.3	.0040	1.7
.0100	5.6	1.3590	1.3430	.0140	7.3	.0040	1.7
.0100	5.6	1.3590	1.3430	.0140	7.3	.0040	1.7
.0080	4.5	1.3585	1.3420	.0145	7.3	.0065	2.8
	5.36				6.88		1.45

Table XIV Bird #9433

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
10	1.3430	1.3420	.0020	1.3	1.3655	1.3620	.0140
12	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
15	1.3440	1.3430	.0020	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
19	1.3465	1.3455	.0020	1.3	1.3680	1.3660	.0080
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3685	1.3660	.0100
26	1.3440	1.3430	.0020	1.3	1.3655	1.3630	.0100
29	1.3435	1.3425	.0020	1.3	1.3675	1.3650	.0100
31	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3670	1.3645	.0100
5	1.3450	1.3440	.0020	1.3	1.3680	1.3650	.0120
7	1.3460	1.3450	.0020	1.3	1.3670	1.3653	.0068
9	1.3450	1.3440	.0020	1.3	1.3653	1.3635	.0072
12	1.3445	1.3435	.0020	1.3	1.3670	1.3640	.0120
14	1.3440	1.3430	.0020	1.3	1.3670	1.3640	.0120
16	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
19	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
21	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
23	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
26	1.3470	1.3460	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table XIV (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0120	6.8	1.3588	1.3420	.0148	8.0	.0028	1.2
.0120	6.8	1.3582	1.3420	.0142	7.9	.0022	1.1
.0060	3.4	1.2560	1.3420	.0120	6.0	.0060	2.6
.0100	5.6	1.3590	1.3440	.0130	6.9	.0030	1.3
.0080	4.5	1.3595	1.3445	.0130	6.7	.0050	2.2
.0060	3.4	1.3585	1.3455	.0110	5.6	.0050	2.2
.0100	5.6	1.3595	1.3450	.0120	6.5	.0020	0.9
.0080	4.5	1.3600	1.3455	.0125	6.5	.0045	2.0
.0080	4.5	1.3560	1.3430	.0110	5.8	.0030	1.3
.0080	4.5	1.3565	1.3440	.0105	5.6	.0025	1.1
.0060	3.4	1.3580	1.3440	.0120	6.0	.0060	2.6
.0080	4.5	1.3590	1.3445	.0125	6.5	.0045	2.0
.0100	5.6	1.3595	1.3450	.0125	6.7	.0025	1.1
.0048	2.7	1.3590	1.3450	.0120	5.8	.0072	3.1
.0052	2.9	1.3610	1.3445	.0145	6.9	.0093	4.0
.0100	5.6	1.3575	1.3445	.0110	6.1	.0010	0.5
.0100	5.6	1.3575	1.3450	.0105	6.1	.0005	0.5
.0080	4.5	1.3575	1.3450	.0105	5.6	.0025	1.1
.0080	4.5	1.3575	1.3450	.0105	5.6	.0025	1.1
.0060	3.4	1.3570	1.3430	.0120	6.0	.0060	2.6
.0060	3.4	1.3570	1.3430	.0120	6.0	.0060	2.6
.0080	4.5	1.3580	1.3420	.0140	7.1	.0060	2.6
	4.55				6.36		1.81

Table XV Bird #9435

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
10	1.3430	1.3420	.0020	1.3	1.3650	1.3620	.0120
12	1.3430	1.3420	.0020	1.3	1.3655	1.3630	.0100
15	1.3440	1.3430	.0020	1.3	1.3700	1.3650	.0200
17	1.3460	1.3450	.0020	1.3	1.3695	1.3655	.0160
19	1.3465	1.3455	.0020	1.3	1.3690	1.3660	.0120
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3695	1.3660	.0140
26	1.3440	1.3430	.0020	1.3	1.3650	1.3630	.0080
29	1.3435	1.3425	.0020	1.3	1.3665	1.3650	.0060
31	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3660	1.3645	.0060
5	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
7	1.3460	1.3450	.0020	1.3	1.3678	1.2653	.0100
9	1.3450	1.3440	.0020	1.3	1.3655	1.3635	.0080
12	1.3445	1.3435	.0020	1.3	1.3670	1.3640	.0120
14	1.3440	1.3430	.0020	1.3	1.3675	1.2640	.0140
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3682	1.3655	.0108
21	1.3445	1.2435	.0020	1.3	1.3655	1.3630	.0100
23	1.3445	1.3435	.0020	1.3	1.3655	1.3630	.0100
26	1.3470	1.3460	.0020	1.3	1.3685	1.3650	.0140
Aver-age							

Table XV (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0080	4.5	1.3600	1.3420	.0160	8.0	.0080	3.5
.0180	10.6	1.3670	1.3440	.0210	11.8	.0030	1.2
.0140	7.9	1.3640	1.3445	.0175	9.2	.0035	1.3
.0100	5.6	1.3620	1.3455	.0145	7.6	.0045	2.0
.0100	5.6	1.2630	1.3450	.0160	8.2	.0060	2.6
.0120	6.8	1.3620	1.3455	.0145	7.9	.0025	1.1
.0060	3.4	1.3560	1.3430	.0110	5.6	.0050	2.2
.0040	2.3	1.3580	1.3440	.0120	5.8	.0080	3.5
.0060	3.4	1.3580	1.3440	.0120	6.0	.0060	2.6
.0040	2.3	1.3530	1.3445	.0065	3.4	.0025	1.1
.0060	3.4	1.3595	1.3450	.0125	6.2	.0065	2.8
.0080	4.5	1.3598	1.3450	.0128	6.6	.0048	2.1
.0060	3.4	1.3580	1.3445	.0115	5.8	.0055	2.4
.0100	5.6	1.3590	1.3445	.0125	6.7	.0025	1.1
.0120	6.8	1.3620	1.3450	.0150	8.0	.0030	1.2
.0100	5.6	1.3580	1.3450	.0110	6.0	.0010	0.4
.0088	5.0	1.3615	1.3450	.0145	7.5	.0057	2.5
.0080	4.5	1.3590	1.3430	.0140	7.1	.0060	2.6
.0080	4.5	1.3590	1.3430	.0140	7.1	.0060	2.6
.0120	6.8	1.3630	1.3420	.0190	9.9	.0070	3.1
	5.17				7.23		2.06

Table XVI Bird #9448

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
10	1.3430	1.3420	.0020	1.3	1.3655	1.3620	.0140
12	1.3430	1.3420	.0020	1.3	1.3670	1.3630	.0160
15	1.3440	1.3430	.0020	1.3	1.3690	1.3650	.0160
17	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
19	1.3465	1.3455	.0020	1.3	1.3685	1.3660	.0100
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3692	1.3660	.0128
26	1.3440	1.3430	.0020	1.3	1.3655	1.3630	.0100
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
31	1.3450	1.3440	.0020	1.3	1.3670	1.3650	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3665	1.3645	.0080
5	1.3450	1.3440	.0020	1.3	1.3672	1.3650	.0088
7	1.3460	1.3450	.0020	1.3	1.3668	1.3653	.0060
9	1.3450	1.3440	.0020	1.3	1.3662	1.3635	.0108
12	1.3445	1.3435	.0020	1.3	1.3665	1.3640	.0100
14	1.3440	1.3430	.0020	1.3	1.3675	1.3640	.0120
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
21	1.3445	1.3435	.0020	1.3	1.3665	1.3630	.0140
23	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
26	1.3470	1.3460	.0020	1.3	1.3685	1.3650	.0140
Aver-age							

Table XVI (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0120	6.8	1.3600	1.3420	.0160	8.5	.0040	1.7
.0120	6.8	1.3600	1.3420	.0160	8.5	.0040	1.7
.0140	7.9	1.3595	1.3420	.0155	8.6	.0015	0.7
.0140	7.7	1.3625	1.3440	.0165	9.0	.0025	1.1
.0100	5.6	1.3615	1.3445	.0150	7.8	.0050	2.2
.0080	4.5	1.3625	1.3455	.0150	7.6	.0070	3.1
.0100	5.6	1.3630	1.3450	.0160	8.2	.0060	2.6
.0108	6.1	1.2645	1.3455	.0170	8.8	.0062	2.7
.0080	4.5	1.3580	1.3430	.0130	6.7	.0050	2.2
.0060	3.4	1.3600	1.3440	.0140	6.9	.0080	3.5
.0060	3.4	1.3600	1.3440	.0140	6.9	.0080	3.5
.0060	3.4	1.3580	1.3445	.0115	5.8	.0055	2.4
.0068	3.8	1.3590	1.3450	.0120	6.1	.0052	2.3
.0040	2.3	1.3560	1.3450	.0090	4.5	.0050	2.2
.0088	5.0	1.3575	1.3445	.0110	5.1	.0002	0.1
.0080	4.5	1.3610	1.3445	.0145	7.3	.0065	2.8
.0100	5.6	1.3615	1.3450	.0145	7.6	.0045	2.0
.0100	5.6	1.3600	1.3450	.0130	6.9	.0030	1.3
.0080	4.5	1.3610	1.3450	.0140	7.1	.0060	2.6
.0120	6.8	1.3595	1.3430	.0145	7.9	.0025	1.1
.0100	5.6	1.3605	1.3430	.0155	8.0	.0055	2.4
.0120	6.8	1.3620	1.3420	.0180	9.4	.0060	2.6
	5.29				7.42		2.13

Table XVII Bird #9451

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"				Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Non-Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
10	1.3430	1.3420	.0020	1.3	1.3655	1.3620	.0140
12	1.3430	1.3420	.0020	1.3	1.3660	1.2630	.0120
15	1.3440.	1.3430	.0020	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0020	1.3	1.3690	1.3655	.0140
19	1.3465	1.3455	.0020	1.3	1.3685	1.3660	.0100
22	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3690	1.3660	.0120
26	1.3440	1.3430	.0020	1.3	1.3660	1.3630	.0120
29	1.3435	1.3425	.0020	1.3	1.3680	1.3650	.0120
31	1.3450	1.3440	.0020	1.3	1.3650	1.3620	.0120
8/2	1.3460	1.3450	.0020	1.3	1.3680	1.3645	.0140
5	1.3450	1.3440	.0020	1.3	1.3675	1.3650	.0100
7	1.3460	1.3450	.0020	1.3	1.3678	1.3653	.0100
9	1.3450	1.3440	.0020	1.3	1.3670	1.3635	.0100
12	1.3445	1.3435	.0020	1.3	1.3665	1.3640	.0100
14	1.3440	1.3430	.0020	1.3	1.3670	1.3640	.0120
16	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
19	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
21	1.3445	1.3435	.0020	1.3	1.3665	1.3630	.0140
23	1.3445	1.3435	.0020	1.3	1.3670	1.3635	.0140
26	1.3470	1.3460	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table XVII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Dist. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0120	6.8	1.3598	1.3420	.0158	8.5	.0038	1.7
.0120	6.8	1.3598	1.3420	.0158	8.5	.0038	1.7
.0100	5.6	1.3580	1.3420	.0140	7.3	.0040	1.7
.0100	5.6	1.3615	1.3440	.0155	8.0	.0055	2.4
.0120	6.8	1.3630	1.3445	.0165	8.8	.0045	2.0
.0080	4.5	1.3635	1.3455	.0160	8.0	.0080	3.5
.0100	5.6	1.3620	1.3450	.0150	7.8	.0050	2.2
.0100	5.6	1.3610	1.3455	.0135	7.1	.0035	1.5
.0100	5.6	1.3595	1.3430	.0145	7.6	.0045	2.0
.0100	5.6	1.3620	1.3440	.0160	8.2	.0060	2.6
.0100	5.6	1.3610	1.3440	.0150	7.8	.0050	2.2
.0120	6.8	1.3610	1.3445	.0145	7.9	.0025	1.1
.0080	4.5	1.3600	1.3450	.0130	6.7	.0050	2.2
.0080	4.5	1.3600	1.3450	.0130	6.7	.0050	2.2
.0080	4.5	1.3590	1.3445	.0125	6.5	.0045	2.0
.0080	4.5	1.3580	1.3445	.0115	6.0	.0035	1.5
.0100	5.6	1.3610	1.3450	.0140	7.3	.0040	1.7
.0080	4.5	1.3600	1.3450	.0130	6.7	.0050	2.2
.0100	5.6	1.3620	1.3450	.0150	7.8	.0050	2.2
.0120	6.8	1.3630	1.3430	.0180	9.4	.0060	2.6
.0120	6.8	1.3630	1.3430	.0180	9.4	.0060	2.6
.0100	5.6	1.3605	1.3420	.0165	8.4	.0065	2.8
	5.63				7.75		2.12

Table XVIII Bird #9459

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid+ Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3645	1.3630	.0060
10	1.3430	1.3420	.0020	1.3	1.3635	1.3620	.0060
12	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
15	1.3441	1.3430	.0020	1.3	1.3680	1.3650	.0120
17	1.3460	1.3450	.0020	1.3	1.3685	1.3655	.0120
19	1.3465	1.3455	.0020	1.3	1.3685	1.3660	.0100
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
24	1.3470	1.3460	.0020	1.3	1.3685	1.3660	.0100
26	1.3440	1.3430	.0020	1.3	1.3650	1.3630	.0080
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
31	1.3450	1.3440	.0020	1.3	1.3640	1.3620	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3665	1.3645	.0080
5	1.3450	1.3440	.0020	1.3	1.3660	1.3650	.0040
7	1.3460	1.3450	.0020	1.3	1.3670	1.3653	.0068
9	1.3450	1.3440	.0020	1.3	1.3655	1.3635	.0080
12	1.3445	1.3435	.0020	1.3	1.3660	1.3640	.0080
14	1.3440	1.3430	.0020	1.3	1.3660	1.3640	.0080
16	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
19	1.3460	1.3450	.0020	1.3	1.3675	1.3655	.0080
21	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
23	1.3445	1.3435	.0020	1.3	1.3645	1.3630	.0060
26	1.3470	1.3460	.0020	1.3	1.3665	1.3650	.0060
Aver-age							

Table XVIII (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Dist. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0040	2.3	1.3540	1.3420	.0100	4.9	.0060	2.6
.0040	2.3	1.3540	1.3420	.0100	4.9	.0060	2.6
.0060	3.4	1.3550	1.3420	.0110	5.6	.0050	2.2
.0100	5.6	1.3630	1.3440	.0170	8.7	.0070	3.1
.0100	5.6	1.3630	1.3445	.0165	8.4	.0065	2.8
.0080	4.5	1.3600	1.3455	.0125	6.5	.0045	2.0
.0080	4.5	1.3585	1.3450	.0115	6.0	.0035	1.5
.0080	4.5	1.3590	1.3455	.0115	6.0	.0035	1.5
.0060	3.4	1.3555	1.3430	.0105	5.4	.0045	2.0
.0060	3.4	1.3560	1.3440	.0100	5.1	.0040	1.7
.0060	3.4	1.3550	1.3440	.0090	4.7	.0030	1.3
.0060	3.4	1.3550	1.3445	.0085	4.5	.0025	1.1
.0020	1.1	1.3540	1.3450	.0070	3.4	.0050	2.3
.0018	2.7	1.3575	1.3450	.0105	5.2	.0057	2.5
.0060	3.4	1.3580	1.3445	.0115	5.8	.0055	2.4
.0060	3.4	1.3555	1.3445	.0090	4.7	.0030	1.3
.0060	3.4	1.3560	1.3450	.0090	4.7	.0030	1.3
.0060	3.4	1.3550	1.3450	.0080	4.3	.0020	0.9
.0060	3.4	1.3570	1.3450	.0100	5.1	.0040	1.7
.0060	3.4	1.3445	1.3430	.0095	4.9	.0035	1.5
.0040	2.3	1.3550	1.3430	.0100	4.9	.0060	2.6
.0040	2.3	1.3560	1.3420	.0120	5.8	.0080	3.5
	3.41				5.43		2.02

Table XIX Bird #9485

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"				Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Non-Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
10	1.3430	1.3420	.0020	1.3	1.3650	1.3620	.0120
12	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
15	1.3441	1.3430	.0020	1.3	1.3685	1.3650	.0140
17	1.3460	1.3450	.0020	1.3	1.3680	1.3655	.0100
19	1.3465	1.3455	.0020	1.3	1.3680	1.3660	.0080
22	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
24	1.3470	1.3460	.0020	1.3	1.3675	1.3660	.0060
26	1.3440	1.3430	.0020	1.3	1.3670	1.3630	.0080
29	1.3435	1.3425	.0020	1.3	1.3670	1.3650	.0080
31	1.3450	1.3440	.0020	1.3	1.3640	1.3620	.0080
8/2	1.3460	1.3450	.0020	1.3	1.3675	1.3645	.0120
5	1.3450	1.3440	.0020	1.3	1.3675	1.3650	.0100
7	1.3460	1.3450	.0020	1.3	1.3675	1.3653	.0088
9	1.3450	1.3440	.0020	1.3	1.3660	1.3635	.0100
12	1.3445	1.3435	.0020	1.3	1.3665	1.3640	.0100
14	1.3440	1.3430	.0020	1.3	1.3665	1.3640	.0100
16	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
19	1.3460	1.3450	.0020	1.3	1.3670	1.3655	.0060
21	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
23	1.3445	1.3435	.0020	1.3	1.3650	1.3630	.0080
26	1.3470	1.3460	.0020	1.3	1.3665	1.3650	.0060
Aver-age							

Table XIX (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Dist. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0100	5.6	1.3600	1.3420	.0160	8.2	.0060	2.6
.0100	5.6	1.3600	1.3420	.0160	8.2	.0060	2.6
.0120	6.8	1.3570	1.3420	.0130	7.2	.0010	0.4
.0120	6.8	1.3590	1.3440	.0130	7.2	.0010	0.4
.0080	4.5	1.3585	1.3445	.0120	6.2	.0040	1.7
.0060	3.4	1.3600	1.3455	.0125	6.2	.0065	2.8
.0080	4.5	1.3600	1.3450	.0130	6.7	.0050	2.2
.0040	2.3	1.3575	1.3455	.0100	4.9	.0060	2.6
.0060	3.4	1.3565	1.3430	.0115	5.8	.0055	2.4
.0060	3.4	1.3575	1.3440	.0115	5.8	.0055	2.4
.0060	3.4	1.3570	1.3440	.0110	5.6	.0050	2.2
.0100	5.6	1.3600	1.3445	.0135	7.1	.0035	1.5
.0080	4.5	1.3605	1.3450	.0135	6.9	.0055	2.4
.0058	3.8	1.3605	1.3450	.0135	6.7	.0067	2.9
.0080	4.5	1.3600	1.3445	.0135	6.9	.0055	2.4
.0080	4.5	1.3575	1.3445	.0110	5.8	.0030	1.3
.0080	4.5	1.3570	1.3450	.0100	5.4	.0020	0.9
.0060	3.4	1.3570	1.3450	.0100	5.1	.0040	1.7
.0040	2.3	1.3560	1.3450	.0090	4.5	.0050	2.2
.0060	3.4	1.3550	1.3430	.0100	5.1	.0040	1.7
.0060	3.4	1.3560	1.3430	.0110	5.6	.0050	2.2
.0040	2.3	1.3560	1.3420	.0120	5.8	.0080	3.5
	4.18				6.22		2.05

Table XX Bird #9520

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non-	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3665	1.3630	.0140
10	1.3430	1.3420	.0020	1.3	1.3655	1.3620	.0140
12	1.3430	1.3420	.0020	1.3	1.3670	1.3630	.0160
15	1.3440	1.3430	.0020	1.3	1.3690	1.3650	.0160
17	1.3460	1.3450	.0020	1.3	1.3695	1.3655	.0160
19	1.3465	1.3455	.0020	1.3	1.3695	1.3660	.0140
22	1.3460	1.3450	.0020	1.3	1.3690	1.3650	.0120
24	1.3470	1.3460	.0020	1.3	1.3700	1.3660	.0160
26	1.3440	1.3430	.0020	1.3	1.3670	1.3630	.0160
27	1.3435	1.3425	.0020	1.3	1.3675	1.3650	.0100
31	1.3450	1.3440	.0020	1.3	1.3650	1.3620	.0120
8/2	1.3460	1.3450	.0020	1.3	1.3670	1.3645	.0100
5	1.3450	1.3440	.0020	1.3	1.3685	1.3650	.0140
7	1.3460	1.3450	.0020	1.3	1.3688	1.3653	.0140
9	1.3450	1.3440	.0020	1.3	1.3670	1.3635	.0140
12	1.3445	1.3435	.0020	1.3	1.3685	1.3640	.0180
14	1.3440	1.3430	.0020	1.3	1.3675	1.3640	.0140
16	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
19	1.3460	1.3450	.0020	1.3	1.3695	1.3655	.0160
21	1.3445	1.3435	.0020	1.3	1.3670	1.3630	.0160
23	1.3445	1.3435	.0020	1.3	1.3660	1.3630	.0120
26	1.3470	1.3460	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table XX (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Dist. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0120	6.8	1.3595	1.3420	.0155	8.3	.0035	1.5
.0120	6.8	1.3600	1.3420	.0160	8.5	.0040	1.7
.0140	7.9	1.3600	1.3420	.0160	8.8	.0020	0.9
.0140	7.9	1.3650	1.3440	.0190	10.1	.0050	2.2
.0140	7.9	1.3650	1.3445	.0185	9.9	.0045	2.0
.0120	6.8	1.3650	1.3455	.0175	9.2	.0055	2.4
.0100	5.6	1.3650	1.3450	.0180	9.1	.0080	3.5
.0140	7.9	1.3660	1.3455	.0185	9.9	.0045	2.0
.0140	7.9	1.3610	1.3430	.0160	8.8	.0020	0.9
.0080	4.5	1.3600	1.3440	.0140	7.1	.0060	2.6
.0100	5.6	1.3600	1.3440	.0140	7.3	.0040	1.7
.0080	4.5	1.3650	1.3445	.0185	9.1	.0105	4.6
.0120	6.8	1.3615	1.3450	.0145	7.9	.0025	1.1
.0120	6.8	1.3620	1.3450	.0150	8.1	.0030	1.3
.0120	6.8	1.3615	1.3445	.0150	8.1	.0030	1.3
.0160	9.0	1.3640	1.3445	.0175	9.7	.0015	0.7
.0120	6.8	1.3625	1.3450	.0155	8.3	.0035	1.5
.0100	5.6	1.3620	1.3450	.0150	7.8	.0050	2.2
.0140	7.9	1.3670	1.3450	.0200	10.5	.0060	2.6
.0140	7.9	1.3645	1.3430	.0195	10.3	.0055	2.4
.0100	5.6	1.3580	1.3430	.0130	6.9	.0030	1.3
.0080	4.5	1.3590	1.3420	.0150	7.6	.0070	3.1
	6.72				8.70		1.98

Table XXI Bird #9334

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0020	1.3	1.3655	1.3630	.0100
8/26	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table XXII Bird #9344

7/8	1.3430	1.3420	.0020	1.3	1.3660	1.3630	.0120
8/26	1.3460	1.3450	.0020	1.3	1.3675	1.3650	.0100
Aver-age							

Table XXIII Bird #9358

7/8	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
8/26	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table XXIV Bird #9387

7/8	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
8/26	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table XXV Bird #9390

7/8	1.3430	1.3420	.0018	1.3	1.3655	1.3630	.0100
8/26	1.3462	1.3450	.0024	1.5	1.3670	1.3650	.0080
Aver-age							

Table #XXI (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2O	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0080	4.5	1.3588	1.3420	.0148	7.5	.0068	3.0
.0100	5.6	1.3580	1.3450	.0110	6.0	.0010	0.4
	5.05				6.75		1.7

Table XXII (Cont.)

.0100	5.6	1.3610	1.3420	.0170	8.7	.0070	3.1
.0080	4.5	1.3580	1.3450	.0110	5.8	.0030	1.3
	5.05				7.25		2.2

Table XXIII (Cont.)

.0060	3.4	1.3550	1.3420	.0110	5.6	.0050	2.2
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
	3.4				5.6		2.2

Table XXIV (Cont.)

.0060	3.4	1.3585	1.3420	.0145	7.1	.0085	3.7
.0100	5.6	1.3620	1.3450	.0150	7.8	.0050	2.2
	4.5				7.95		2.95

Table XXV (Cont.)

.0080	4.5	1.3565	1.3420	.0125	6.5	.0045	2.0
.0060	3.4	1.3570	1.3450	.0096	5.0	.0036	1.6
	3.95				5.75		1.8

Table XXVI Bird #9414

I	II	III	IV	V	VI	VII	VIII
	Refractive Index "n"			Non	Refractive Index "n"		
Date	Acid + Serum A	N/50 Acid	(II-III) x2	Protein %	Globulin-Free Serum	$(NH_4)_2SO_4$ 1/4 Satd.	(VI-VIII) x4
7/8	1.3430	1.3420	.0018	1.3	1.3660	1.3630	.0120
8/26	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table XXVII Bird #9425

7/8	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
8/26	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table XXVIII Bird #9481

7/8	1.3430	1.3420	.0020	1.3	1.3650	1.3630	.0080
8/26	1.3460	1.3450	.0020	1.3	1.3670	1.3650	.0080
Aver-age							

Table XXIX Bird #9495

7/8	1.3430	1.3420	.0018	1.3	1.3660	1.3630	.0120
8/26	1.3460	1.3450	.0020	1.3	1.3685	1.3650	.0140
Aver-age							

Table XXX Bird #9538

7/8	1.3430	1.3420	.0020	1.3	1.3652	1.3630	.0088
8/26	1.3460	1.3450	.0020	1.3	1.3680	1.3650	.0120
Aver-age							

Table XXVI (Cont.)

IX	X	XI	XII	XIII	XIV	XV	XVI
"n" Albumin	Albumin %	Refractive Index "n" Serum	Distd. H_2S	Total Protein	Total Protein %	"n" Globulin	Globulin %
.0100	5.6	1.3600	1.3420	.0160	8.2	.0060	2.6
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
	4.5				6.9		2.4

Table XXVII (Cont.)

.0060	3.4	1.3545	1.3420	.0105	5.4	.0045	2.0
.0060	3.4	1.3560	1.3450	.0090	4.7	.0030	1.3
	3.4				5.05		1.65

Table XXVIII (Cont.)

.0060	3.4	1.3570	1.3420	.0130	6.5	.0070	3.1
.0060	3.4	1.3580	1.3450	.0110	5.6	.0050	2.2
	3.4				6.05		2.65

Table XXIX (Cont.)

.0100	5.6	1.3600	1.3420	.0160	8.2	.0060	2.6
.0120	6.8	1.3630	1.3450	.0160	8.5	.0040	1.7
	6.2				8.35		2.15

Table XXX (Cont.)

.0068	3.8	1.3590	1.3420	.0150	7.4	.0082	3.6
.0100	5.6	1.3640	1.3450	.0170	8.7	.0070	3.1
	4.7				8.05		3.35

DISCUSSION OF RESULTS

Part I

Relation Between Serum Proteins and Egg Production.

In this part of the work the egg production of each bird on the test was kept from July 1, to September 9, or a period of 71 days. The period is a bit longer than that over which the blood tests were made, but was so arranged that any lag due either to the effect of egg production on the serum or of the serum on egg production would not cause any variation between the different birds.

For convenience a summary (Figure 1) has been prepared showing the average serum-albumin, serum-globulin, total protein, and egg production of each bird in Pen 7. These birds, it will be recalled, were bled once each week over a period of eight weeks. Figure 2 is merely a rearrangement of the same figures to show the relative values for the various serum constituents when the results are arranged according to ascending egg production of the birds. The relation between egg production and serum-albumin, although showing some irregulatiries, in general shows an appreciable increase. Bird #9395, for example, showed the lowest egg production of any in the pen, laying only six eggs during the entire period, while her average serum-albumin for the eight weeks was only 3.53 per cent of the total serum.

Figure 1

Summary Tables I - X

Bird Number	Albumin %	Globulin %	Total Protein %	Eggs Produced
9338	3.26	3.16	6.31	26
9379	4.80	1.77	6.70	27
9395	3.53	2.17	5.71	06
9410	----	----	----	-- *
9442	4.51	2.17	6.68	26
9454	3.59	2.34	5.92	-- **
9466	4.23	2.45	6.68	41
9478	4.64	2.43	7.01	33
9484	4.64	1.45	6.10	41
9552	4.80	1.81	6.60	37
Average	4.22	2.19	6.41	26.3

* The record for Bird #9410 is incomplete. On the night of August 4th she disappeared from the poultry plant and could never be located.

** Bird #9454 was of no value in this discussion of egg production because she was found to be eating her eggs in the nest.

Figure 2

Summary Tables I - X

Eggs Produced	Albumin %	Globulin %	Total Protein %	Bird Number
06	3.53	2.17	5.71	9395
26	3.26	3.16	6.31	9338
26	4.51	2.17	6.68	9442
27	4.80	1.77	6.70	9379
33	4.64	2.43	7.01	9478
37	4.80	1.81	6.60	9552
41	4.23	2.45	6.68	9466
41	4.64	1.45	6.10	9484

Figure 3

Summary Tables XI - XX

Bird Number	Albumin %	Globulin %	Total Protein %	Eggs Produced
9341	4.65	1.80	6.46	29
9382	4.47	2.30	6.76	30
9388	5.36	1.45	6.88	47
9433	4.55	1.81	6.36	44
9435	5.17	2.06	7.23	-- *
9448	5.29	2.13	7.42	47
9451	5.63	2.12	7.75	22
9459	3.41	2.02	5.43	16
9485	4.18	2.05	6.22	22
9520	6.72	1.98	8.70	43
Average	4.94	1.97	6.92	30

* Bird #9435 died on September 1st. Although all blood samples had been taken, her egg record was incomplete.

Figure 4

Summary Tables XI - XX

Eggs Produced	Albumin %	Globulin %	Total Protein %	Bird Number
16	3.41	2.02	5.43	9459
22	4.18	2.05	6.22	9485
22	5.63	2.12	7.75	9451
29	4.65	1.80	6.46	9341
30	4.47	2.30	6.76	9382
43	6.72	1.98	8.70	9520
44	4.55	1.81	6.36	9433
47	5.29	2.13	7.42	9448
47	5.36	1.45	6.88	9388

Figure 5

Summary Tables XXI - XXX

Bird Number	Albumin %	Globulin %	Total Protein %	Eggs Produced
9334	5.05	1.70	6.75	29
9344	5.05	2.20	7.25	30
9358	3.40	2.20	5.60	19
9387	4.50	2.95	7.95	01
9390	3.95	1.80	5.75	06 *
9414	4.50	2.40	6.90	42
9425	3.40	1.65	5.05	06
9481	3.40	2.65	6.05	45
9495	6.20	2.15	8.35	10
9538	4.70	3.35	8.05	47
Average	4.47	2.36	6.88	25.4

* Bird #9390 can not be consisdered of any value in these tests. About half way through the period she started to lose weight and her general appearence indicated abnormal conditions. An autopsy at the end of the tests showed the ovary to be non-functioning and the presence of a partially absorbed egg yolk in the abdorminal cavity.

Figure 6

Summary Tables XXI - XXX

Eggs Produced	Albumin %	Globulin %	Total Protein %	Bird Number
01	4.50	2.95	7.95	9387
06	3.40	1.65	5.05	9425
06	3.95	1.80	5.75	9390 *
10	6.20	2.15	8.35	9495
19	3.40	2.20	5.60	9358
29	5.05	1.70	6.75	9334
30	5.05	2.20	7.25	9344
42	4.50	2.40	6.90	9414
45	3.40	2.65	6.05	9481
47	4.70	3.35	8.05	9538

* See footnote Figure 5

In the case of the next two birds, #9338 and #9442, there is an apparent breaking down of the rule because there are two birds having exactly the same egg production but different serum-albumin contents. This would indicate that, although in general, an increased egg production is accompanied by an increase in the serum-albumin, certain individual characteristics in the birds, possibly hereditary, show individual variations.

In Figures 3 and 4 summaries are arranged in a similar manner, showing the observations of the birds in Pen 8. These being bled three times a week for eight consecutive weeks give enough more figures to make the averages a bit more significant. These not only show a more regular increase of serum-albumin in relation to egg production but the exceptions are less marked and the variations from the normal are smaller. In this case Birds #9451 and #9520 were the only serious exceptions.

The results for the birds in Pen 9, Figures 5 and 6, can hardly be considered in this discussion. They were kept primarily as controls for another part of the work and bled only at the beginning and end of the tests. This does not give a sufficiently large number of readings to give a fair average. The summary is given here merely to have it readily available for future discussion.

Attacking the problem of serum-globulin in relation to egg production, results almost the reverse of those in the case of albumin are found. In general, the relatively high egg producers show a relatively low serum-globulin content in the blood. Referring to Figure 2 the tendency can be noted. As in the case of the serum-albumin the

same criticism can be raised that there are irregularities, but the variations appear in the same birds as did those that showed in the consideration of serum-albumin. In the case of the birds bled three times a week (Figure 4) there are fewer irregularities than in those bled only once a week.

In both cases, however, the relation between the serum-globulins and the egg production seems to have less significance than does the relation between serum-albumin and egg production. In either case results would have been greatly improved had it been possible to perform the tests on a larger number of birds and for a longer period of time. Taken during the months of July and August when the birds are naturally not producing eggs as heavily as at other times of the year, while some are molting or brooding, although little difficulty was experienced from the last factor, many uncontrolled factors are bound to arise which under extended time would ajdust themselves to give graater agreement of data.

The relation between the per cent of total protein in the serum and egg production is even more interesting, and shows fewer irregularities than either the study of serum-albumin or of serum-globulin, in the same comparisons.

Considering Figure 2, there are no very low producers. For the months through which these tests were run a production of 25 to 30 eggs during the 71 days is very fair, while 35 is excellent. It will be noticed that with an increased total protein there is an increased egg production. The maximum is 7.01 per cent for 33 eggs. With further increase in eggs there is a decrease in serum proteins.

Figure 4 shows similar relative results, although the proteins are in all cases correspondingly higher. This fact will be discussed under the question of serum regeneration in the following pages.

Thus with the birds bled weekly, Figure 2, with the exception of Bird #9484, the serum protein for birds producing 26 eggs or over, during the tests, was between 6.31 and 7.01 per cent. Due to the question arising from the difference in the analysis of the blood of Birds #9338 and #9442 even though their egg production was the same, the range for the good layers may be even more narrow than that suggested above.

In the case of those bled three times a week,(Figure 4, birds producing 29 eggs or over during the 71 days showed a total protein content ranging from 6.36 to 7.42 per cent, with one exception jumping to 8.70 per cent.

Thus it may be seen that the larger producers had a total serum protein content of between 6.36 and 7.42 per cent. Those birds having total protein values either above or below these ranges were at that particular time, therefore, less valuable from the standpoint of egg production.

In every case there was closer agreement among the good producers than among the poorer ones. This may be explained on the basis that temporary disorders which effected egg production also effected the condition of the blood. While in many cases the weaker birds showed some fluctuation, the stronger ones were less subject to upsets in either egg laying or blood conditions.

Another interesting fact is shown by taking the averages of each of the quantities of serum proteins determined in each group of birds and arranging these results according to the number of times that the birds were bled. That is, Pen 9, was bled only twice, Pen 7, eight times and Pen 8, 22 times. In a similar way the average egg production per bird in each pen was found. By dividing the average total protein per bird in each pen by the egg production for the birds in that same pen, a factor referred to here as the Protein Egg Factor is obtained. This will be noted, decreases per egg in direct relation to the number of times the birds are bled. This would seem to indicate that there was a certain protein reserve in the blood serum that is reduced by excessive bleeding before egg production is effected.

Pen Number	Average Albumin	Average Globulin	Average Total Protein	Average Egg Production	P-E Factor
9	4.47	2.36	6.88	25.4	.27
7	4.22	2.19	6.41	26.3	.24
8	4.94	1.97	6.92	30.0	.23

These averages for total serum proteins differ slightly from those reported in an earlier work by Hayden and Fish (8). They found the average for ten yearling White Leghorn hens to be 4.259 per cent and 4.934 per cent for a group of older birds, including eight roosters, four non-laying hens and three layers.

Thompson (32), working with fasting birds, found an average total serum protein of 5.0 per cent for hens between the ages of one and two years. At the same time he reported an average of 6.0 per cent

for a number of fasting roosters four years old. He made no mention of the breed of birds used, however. Even these figures are much higher than values found by Briggs (3). He worked with a number of roosters between the ages of one and two years. He reported averages of only 3.3 per cent total serum protein for normal and 4.13 per cent for fasting birds.

These figures indicate variations in the serum proteins apparently due to both the age of the birds and the methods of feeding.

Part II

Speed of Regeneration of Serum Proteins in Cases of Continued Bleeding.

The second part of the problem deals with the effect of continued bleeding with respect to the per cent of serum proteins found in the blood.

By taking the per cent of serum proteins for each bird on a single day the average for the whole pen on that day was determined. Figures 7 to 14 give these summaries. Graph I shows these averages to vary regularly but within a relatively narrow range.

In the same way the average for the birds in Pen 8 was obtained for each day that samples were taken. These results, as shown by Figures 15 to 36 and Graph II, are quite different.

The average of the total serum protein for the first day that samples were taken (July 8) was 7.36 per cent. On July 10, the average total serum protein was 7.33 per cent while on July 12, a further decrease brought the value to 7.15 per cent.

This seemed to be following exactly some earlier results obtained by Brocq-Rousseu (4) while working with the serum of horses. He bled his animals for 13 consecutive weeks. The results showed a slight but gradual decrease in the total serum proteins for the first nine weeks, but after that there was no regularity. He made no attempt to explain the cause of these variations.

With the first results found in this work it appeared that the results were going to follow very closely those of Brocq-Rousseu,

but such was not the case. As had been planned, the birds in Pen 8 were bled three times a week, on Monday, Wednesday and Friday. This gave an interval of two days between the Monday and Wednesday, and Wednesday and Friday samples. The interval from Friday until Monday gave three days in which the serum protein was rapidly regenerated. In fact, as the figures show, the average of the samples taken on Monday for the second and third weeks of the tests were even higher than the average on the first day. This regular decrease and regeneration was observed for three weeks.

On Monday for the fourth week, July 29, there was no evidence of serum protein regeneration. For the next three weeks the phenomenon of the first three weeks was repeated, but at a series of lower figures. On the seventh week there was a rapid regeneration which approached very nearly the initial per cent of total serum protein.

This apparently shows that for three weeks the birds were not able to assimilate protein material fast enough to maintain the normal level in the blood serum when bled every other day. However, the interval of three days made possible a regeneration to even above the normal, for three successive weeks. At the end of that time the effect of continued bleeding caused the birds to establish a physiological equilibrium at the lower level of serum protein. That lower level was then maintained for three weeks, gradually regenerating serum proteins fast enough to approach the normal by the beginning of the seventh week.

This work is also in accord with the investigations of Rozanski (28) who found that, following cases of severe loss of blood, fibrin regenerated within an increase of 60 to 80 per cent, but within two or three weeks had again returned to a normal level.

Had it been possible to continue these studies over a longer period it is predicted that the birds would have continued to establish new levels of serum protein, approaching more and more nearly the normal.

Figure 7

Pen 7 July 8th

Bird Number	Albumin %	Globulin %	Total Protein %
9338	4.5	2.4	6.9
9379	3.4	2.5	6.9
9395	3.4	1.7	5.1
9410	---	---	---+
9442	3.4	2.0	5.4
9454	3.4	2.4	5.8
9466	4.5	2.8	7.3
9478	3.4	3.0	6.4
9484	2.3	2.8	5.1
9552	3.4	1.8	5.2
Average	3.52	2.37	6.01

+ See foot note Figure 1.

Figure 8

Pen 7 July 15th

Bird Number	Albumin %	Globulin %	Total Protein %
9338	5.6	2.5	8.1
9379	5.6	1.3	6.9
9395	3.4	2.6	6.0
9410	---	---	---+
9442	3.4	2.6	6.0
9454	3.4	2.2	5.6
9466	5.6	1.7	7.3
9478	5.6	2.0	7.6
9484	5.6	0.9	6.5
9552	3.4	2.6	6.0
Average	4.62	2.04	6.67

+ See footnote Figure 1.

Figure 9

Pen 7 July 22

Bird Number	Albumin %	Globulin %	Total Protein %
9338	2.3	3.7	6.0
9379	5.6	1.5	7.1
9395	4.6	1.7	6.3
9410	---	---	---+
9442	4.5	2.4	6.9
9454	4.5	2.4	6.9
9466	5.6	2.2	7.8
9478	4.5	2.2	6.7
9484	5.6	1.1	6.7
9552	5.6	1.5	7.1
Average	4.76	2.08	6.83

+ See footnote Figure 1.

Figure 10

Pen 7 July 29th

Bird Number	Albumin %	Globulin %	Total Protein %
9338	2.3	3.9	6.2
9379	2.3	2.8	5.1
9395	1.6	3.6	5.2
9410	---	---	---+
9442	2.3	3.3	5.6
9454	2.3	3.5	5.8
9466	3.4	3.1	6.5
9478	3.4	3.3	6.7
9484	3.4	2.0	5.4
9552	3.4	2.4	5.8
Average	2.71	3.10	5.81

+ See footnote Figure 1.

Figure 11

Pen 7 August 5th

Bird Number	Albumin %	Globulin %	Total Protein %
9338	2.3	3.1	5.4
9379	3.4	2.2	5.6
9395	1.8	3.0	4.8
9410	---	---	---+
9442	5.6	1.7	7.3
9454	2.7	2.7	5.4
9466	4.5	1.3	5.8
9478	4.5	2.4	6.9
9484	4.5	1.5	6.0
9552	4.5	1.5	6.0
Average	3.76	2.16	5.91

+ See footnote Figure 1.

Figure 12

Pen 7 August 12

Bird Number	Albumin %	Globulin %	Total Protein %
9338	2.3	3.9	6.2
9379	6.8	0.4	7.2
9395	5.6	0.9	6.5
9410	---	---	---+
9442	5.6	1.5	7.1
9454	3.4	2.2	5.6
9466	5.6	1.7	7.3
9478	5.6	1.7	7.3
9484	5.6	1.1	6.7
9552	5.6	1.7	7.3
Average	5.12	1.68	6.80

+ See footnote Figure 1.

Figure 12

Pen 7 August 19

Bird Number	Albumin %	Globulin %	Total Protein %
9338	2.3	4.1	6.4
9379	6.8	0.7	7.5
9395	4.5	1.1	5.6
9410	---	---	---+
9442	6.8	1.7	8.5
9454	5.6	0.9	6.5
9466	2.3	3.5	5.8
9478	5.6	2.6	8.2
9484	4.5	1.3	5.8
9552	6.8	1.3	8.1
Average	5.02	1.91	6.93

+ See footnote Figure 1.

Figure 14

Pen 7 August 26th

Bird Number	Albumin %	Golbulin %	Total Protein %
9338	4.5	1.7	6.2
9379	4.5	2.8	7.3
9395	3.4	2.8	6.2
9410	---	---	---+
9442	4.5	2.2	6.7
9454	3.4	2.4	5.8
9466	2.3	3.3	5.6
9478	4.5	2.2	6.7
9484	5.6	0.9	6.5
9552	5.6	1.7	7.3
Average	4.26	2.22	6.48

+ See footnote Figure 1.

Graph I

Average Total Serum Protein

Pen #7

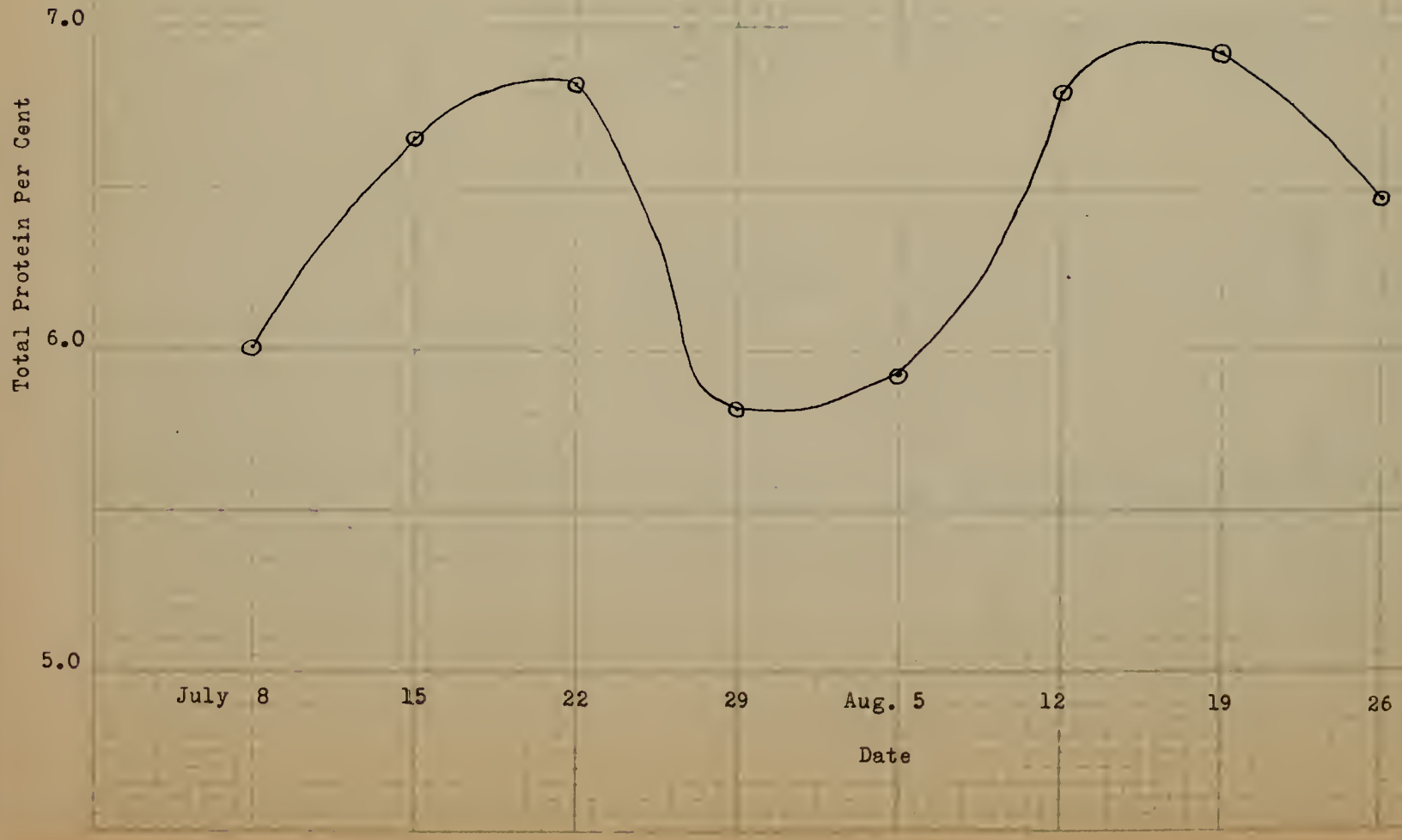


Figure 15

Pen 8 July 8th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.7	7.3
9382	3.3	2.6	5.9
9388	5.6	1.1	6.7
9433	6.8	1.2	8.0
9435	5.6	1.7	7.3
9448	6.8	1.7	8.5
9451	6.8	1.7	8.5
9459	2.3	2.6	4.9
9485	5.6	2.6	8.2
9520	6.8	1.5	8.3
Average	5.52	1.84	7.36

Figure 16

Pen 8 July 10th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.7	7.3
9382	3.3	2.2	5.5
9388	5.6	1.1	6.7
9433	6.8	1.1	7.9
9435	5.6	1.7	7.3
9448	6.8	1.7	8.5
9451	6.8	1.7	8.5
9459	2.3	2.6	4.9
9485	5.6	2.6	8.2
9520	6.8	1.7	8.5
Average	5.52	1.81	7.33

Figure 17

Pen 8 July 12th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.7	7.3
9382	4.2	1.3	5.5
9388	6.8	0.4	7.2
9433	3.4	2.6	6.0
9435	4.5	3.5	8.0
9448	7.9	0.7	8.6
9451	5.6	1.7	7.3
9459	3.4	2.2	5.6
9485	6.8	0.4	7.2
9520	7.9	0.9	8.8
Average	5.61	1.54	7.15

Figure 18

Pen 8 July 15th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.7	7.3
9382	5.5	1.3	6.8
9388	5.6	1.3	6.9
9433	5.6	1.3	6.9
9435	10.6	1.2	11.8
9448	7.9	1.1	9.0
9451	5.6	2.4	8.0
9459	5.6	3.1	8.7
9485	6.8	0.4	7.2
9520	7.9	2.2	10.1
Average	6.67	1.60	8.27

Figure 19

Pen 8 July 17th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.5	7.1
9382	5.7	2.0	7.7
9388	4.5	2.2	6.7
9433	4.5	2.2	6.7
9435	7.9	1.3	9.2
9448	5.6	2.2	7.8
9451	6.8	2.0	8.8
9459	5.6	2.8	8.4
9485	4.5	1.7	6.2
9520	7.9	2.0	9.9
Average	5.86	1.99	7.85

Figure 20

Pen 8 July 19th

Bird Nunber	Albumin %	Globulin %	Total Protein %
9341	3.4	3.1	6.5
9382	5.6	2.0	7.6
9388	5.6	1.3	6.9
9433	3.4	2.2	5.6
9435	5.6	2.0	7.6
9448	4.5	3.1	7.6
9451	4.5	3.5	8.0
9459	4.5	2.0	6.5
9485	3.4	2.8	6.2
9520	6.8	2.4	9.2
Average	4.73	2.44	7.17

Figure 21

Pen 8 July 22d

Bird Number	Albumin %	Globulin %	Total Protein %
9341	9.0	0.2	9.2
9382	4.5	3.1	7.6
9388	5.6	1.7	7.3
9433	5.6	0.9	6.5
9435	5.6	2.6	8.2
9448	5.6	2.6	8.2
9451	5.6	2.2	7.8
9459	4.5	1.5	6.0
9485	4.5	2.2	6.7
9520	5.6	3.5	9.1
Average	5.61	2.05	7.66

Figure 22

Pen 8 July 24th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	0.8	6.4
9382	4.5	2.8	7.3
9388	5.6	0.9	6.5
9433	4.5	2.0	6.5
9435	6.8	1.1	7.9
9448	6.1	2.7	8.8
9451	5.6	1.5	7.1
9459	4.5	1.5	6.0
9485	2.3	2.6	4.9
9520	7.9	2.0	9.9
Average	5.34	1.79	7.13

Figure 23

Pen 8 July 26th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	4.5	1.7	6.2
9382	3.4	3.5	6.9
9388	5.6	0.9	6.5
9433	4.5	1.3	5.8
9435	3.4	2.2	5.6
9448	4.5	2.2	6.7
9451	5.6	2.0	7.6
9459	3.4	2.0	5.4
9485	3.4	2.4	5.8
9520	7.9	0.9	8.8
Average	4.62	1.91	6.53

Figure 24

Pen 8 July 29th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	2.4	5.8
9382	3.4	3.5	6.9
9388	4.5	2.2	6.7
9433	4.5	1.1	5.6
9435	2.3	3.5	5.8
9448	3.4	3.5	6.9
9451	5.6	2.6	8.2
9459	3.4	1.7	5.1
9485	3.4	2.4	5.8
9520	4.5	2.6	7.1
Average	3.84	2.55	6.39

Figure 25

Pen 8 July 31st

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	2.2	5.6
9382	3.4	3.9	7.3
9388	4.5	2.2	6.7
9433	3.4	2.6	6.0
9435	3.4	2.6	6.0
9448	3.4	3.5	6.9
9451	5.6	2.2	7.8
9459	3.4	1.3	4.7
9485	3.4	2.2	5.6
9520	5.6	1.7	7.3
Average	3.95	2.44	6.39

Figure 26

Pen 8 August 2nd

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	1.7	5.1
9382	3.4	2.8	6.2
9388	4.5	1.5	6.0
9433	4.5	2.0	6.5
9435	2.3	1.1	3.4
9448	3.4	3.4	5.8
9451	6.8	1.1	7.9
9459	3.4	1.1	4.5
9485	5.6	1.5	7.1
9520	4.5	4.6	9.1
Average	4.18	1.98	6.16

Figure 27

Pen 8 August 5th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	1.1	3.5	4.6
9382	4.5	2.6	7.1
9388	4.5	3.7	8.2
9433	5.6	1.1	6.7
9435	3.4	2.8	6.2
9448	3.8	2.3	6.1
9451	4.5	2.2	6.7
9459	1.1	2.3	3.4
9485	4.5	2.4	6.9
9520	6.8	1.1	7.9
Average	3.98	2.40	6.38

Figure 28

Pen 8 August 7th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	4.5	1.3	5.8
9382	3.2	3.2	6.4
9388	4.5	1.7	6.2
9433	2.7	3.1	5.8
9435	4.5	2.1	6.6
9448	2.3	2.2	4.5
9451	4.5	2.2	6.7
9459	2.7	2.5	5.2
9485	3.8	2.9	6.7
9520	6.8	1.3	8.1
Average	3.95	2.25	6.20

Figure 29

Pen 8 August 9th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	4.5	2.0	6.5
9382	4.5	2.2	6.5
9388	5.6	1.1	6.7
9433	2.9	4.0	6.9
9435	3.4	2.4	5.8
9448	5.0	0.1	5.1
9451	4.5	2.0	6.5
9459	3.4	2.4	5.8
9485	4.5	2.4	6.9
9520	6.8	1.3	8.1
Average	4.51	1.99	6.48

Figure 30

Pen 8 August 12th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	4.5	1.5	6.0
9382	5.6	0.6	6.2
9388	6.8	0.7	7.5
9433	5.6	0.5	6.1
9435	5.6	1.1	6.7
9448	4.5	2.8	7.3
9451	4.5	1.5	6.0
9459	3.4	1.3	4.7
9485	4.5	1.3	5.8
9520	9.0	0.7	9.7
Average	5.40	1.20	6.60

Figure 31

Pen 8 August 14th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	2.2	5.6
9382	3.4	2.4	5.8
9388	5.6	0.7	6.3
9433	5.6	0.5	6.1
9435	6.8	1.2	8.0
9448	5.6	2.0	7.6
9451	5.6	1.7	7.3
9459	3.4	1.3	4.7
9485	4.5	0.9	5.4
9520	6.8	1.5	8.3
Average	5.07	1.44	6.51

Figure 32

Pen 8 August 16th

Bird Number	Albumin %	Globulin %	Total Ptoetin %
9341	5.6	0.9	6.5
9382	5.6	1.3	6.9
9388	5.6	0.9	6.5
9433	4.5	1.1	5.6
9435	5.6	0.4	6.0
9448	5.6	1.3	6.9
9451	4.5	2.2	6.7
9459	3.4	0.9	4.3
9485	3.4	1.7	5.1
9520	5.6	2.2	7.8
Average	4.94	1.29	6.23

Figure 33

Pen 8 August 19th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.3	6.9
9382	4.5	1.7	6.2
9388	5.6	1.7	7.3
9433	4.5	1.1	5.6
9435	5.0	2.5	7.5
9448	4.5	2.6	7.1
9451	5.6	2.2	7.8
9459	3.4	1.7	5.1
9485	2.3	2.2	4.5
9520	7.9	2.6	10.5
Average	4.89	1.96	6.85

Figure 34

Pen 8 August 34

Bird Number	Albumin %	Globulin %	Total Protein %
9341	5.6	1.3	6.9
9382	5.6	2.2	7.8
9388	5.6	1.7	7.3
9433	3.4	2.6	6.0
9435	4.5	2.6	7.1
9448	6.8	1.1	7.9
9451	6.8	2.6	9.4
9459	3.4	1.5	4.9
9485	3.4	1.7	5.1
9520	7.9	2.4	10.3
Average	5.30	1.97	7.27

Figure 35

Pen 8 August 23rd

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	2.8	6.2
9382	5.6	1.7	7.3
9388	5.6	1.7	7.3
9433	3.4	2.6	6.0
9435	4.5	2.6	7.1
9448	5.6	2.4	8.0
9451	6.8	2.6	9.4
9459	2.3	2.6	4.9
9485	3.4	2.2	5.6
9520	5.6	1.3	6.9
Average	4.62	2.25	6.87

Figure 36

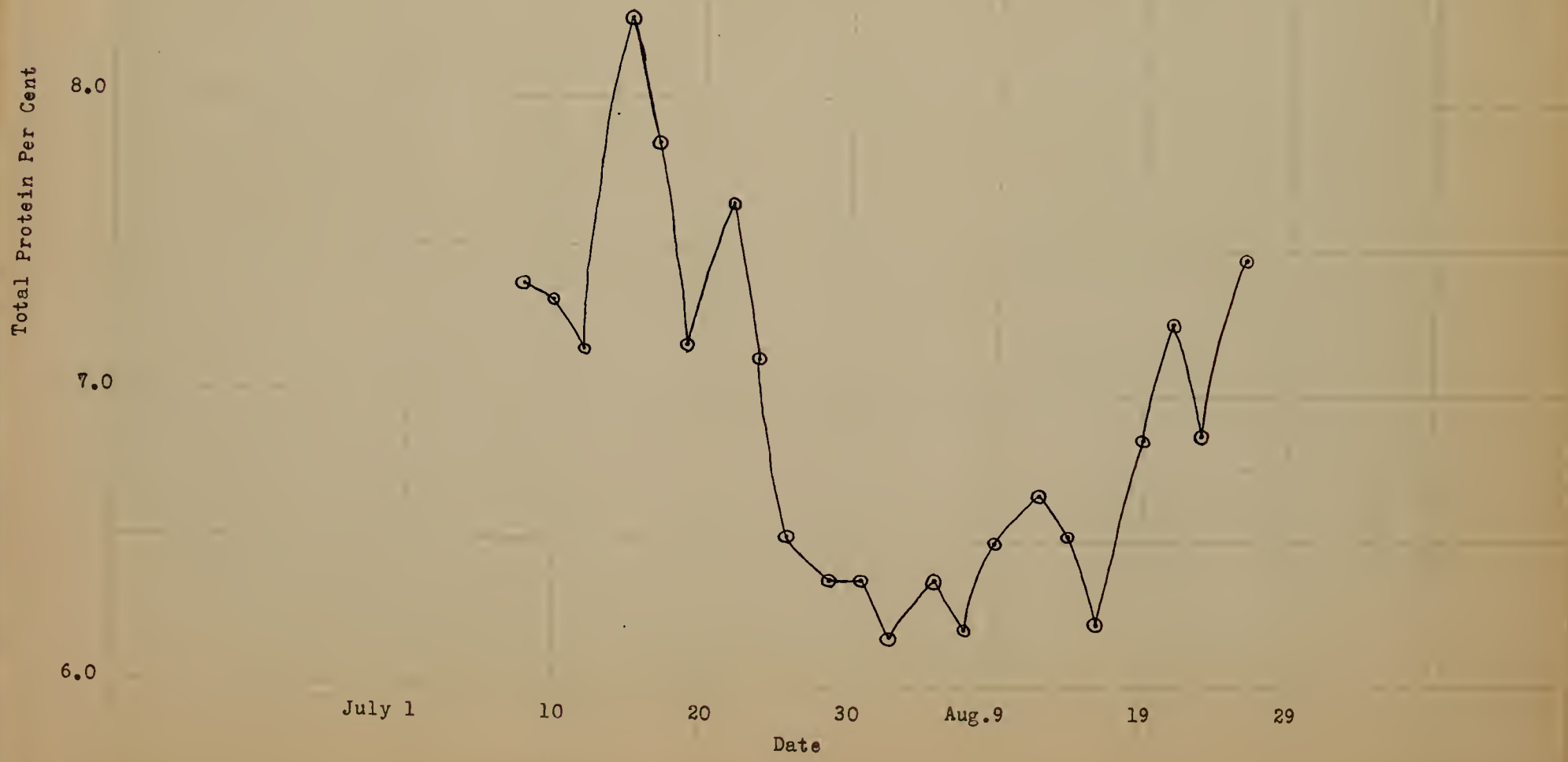
Pen 8 August 26th

Bird Number	Albumin %	Globulin %	Total Protein %
9341	3.4	2.6	6.0
9382	5.6	1.7	7.3
9388	4.5	2.8	7.3
9433	4.5	2.6	7.1
9435	6.8	3.1	9.9
9448	6.8	2.6	9.4
9451	5.6	2.8	8.4
9459	2.3	3.5	5.8
9485	2.3	3.5	5.8
9520	4.5	3.1	7.6
Average	4.63	2.83	7.46

Graph II

Average Total Serum Protein

Pen #8



During the course of this problem the birds were weighed every Monday morning. The record of these weights is given in the following pages. Although there is no apparent correlation between the body weights and any of the other factors studied, they do show that the birds remained in good flesh, during the experiment. This fact would indicate the healthy condition of the birds throughout the work. The only exception was bird #9390 in Pen #9. Her condition was previously mentioned on page 54.

Weights

Pen #7

Bird Number	July 1st Lbs.	Oz.	July 8th Lbs.	Oz.	July 15th Lbs.	Oz.	July 22nd Lbs.	Oz.	July 29th Lbs.	Oz.
9338	4	15	4	14	4	15	5	3	5	3
9379	5	4	5	4	5	0	5	2	4	14
9395	3	14	4	4	4	4	4	8	4	8
9410	4	6	4	9	4	7	4	5	4	8
9442	4	10	4	8	4	10	4	12	5	0
9454	4	10	4	15	4	10	4	12	4	12
9466	4	9	4	12	4	12	5	1	4	14
9478	4	3	4	8	4	10	4	8	4	8
9484	5	6	5	10	5	10	5	11	5	7
9552	4	9	5	2	5	2	5	1	4	12
Average	4	10.1	4	13.4	4	12.8	4	14.3	4	13.4

Pen #8

9341	5	7	5	9	5	4	5	4	5	6
9382	5	4	5	4	5	4	5	7	5	6
9388	4	12	5	2	5	3	5	4	5	4
9433	5	3	5	8	5	7	5	6	5	7
9435	4	11	5	0	5	1	4	13	4	14
9448	4	9	4	10	4	11	4	8	4	6
9451	4	4	4	7	4	6	4	7	4	9
9459	4	2	4	9	4	15	4	15	4	9
9485	5	0	5	8	5	8	5	0	4	15
9520	4	8	4	11	4	11	4	8	4	8
Average	4	12.4	5	0.4	5	0.6	4	15.2	4	14.8

Pen #7

Aug. 5th Lbs.	Oz.	Aug. 12th Lbs.	Oz.	Aug. 19th Lbs.	Oz.	Aug. 26th Lbs.	Oz.	Sept. 2nd Lbs.	Oz.	Sept. 9th Lbs.	Oz.	
4	14	5	5	5	3	5	8	5	10	5	12	
4	13	5	3	5	3	5	6	5	0	5	4	
4	8	4	13	4	8	4	12	4	14	4	11	
-	--	-	--	-	--	-	--	-	--	-	--	*
4	13	4	15	5	5	5	6	5	6	5	8	
4	10	4	9	4	12	4	12	4	10	4	15	
4	14	5	4	4	15	4	15	5	2	4	13	
4	9	5	2	5	0	4	12	5	6	5	8	
5	7	5	14	5	12	5	14	6	0	6	1	
4	12	5	8	5	4	5	6	5	3	5	4	
4	11.6	5	1.0	5	1.0	5	3.3	5	4.0	5	4.9	

Pen #8

5	4	5	5	5	2	4	15	5	2	5	6	
5	8	5	8	5	7	5	8	5	6	5	7	
5	2	5	7	5	4	5	6	5	6	5	4	
5	8	5	7	5	6	5	9	5	12	5	9	
4	10	4	10	4	13	5	0	-	--	-	---	**
4	8	4	8	4	8	4	7	4	9	4	7	
4	7	4	4	4	4	4	6	4	4	4	6	
4	9	4	10	4	6	4	12	5	1	5	1	
5	8	5	4	4	13	4	13	5	6	5	0	
4	9	4	12	4	9	4	11	4	12	4	7	
4	15.3	4	15.5	4	13.6	4	15.1	5	1.1	4	15.9	

* See footnote page 50. ** See footnote page 52.

Weights.

Pen #9

Bird Number	July 1st. Lbs.	Oz.	July 8th. Lbs.	Oz.	July 15th. Lbs.	Oz.	July 22nd. Lbs.	Oz.	July 29th. Lbs.	Oz.
9334	5	4	5	6	5	5	5	7	5	10
9344	5	13	5	15	5	10	5	14	6	0
9358	4	4	4	8	4	13	5	3	5	1
9387	4	6	4	9	5	4	4	4	3	15
9390	4	13	4	14	4	7	4	4	3	15
9414	5	0	5	0	5	2	5	5	5	6
9425	5	5	5	12	5	14	5	9	5	10
9481	5	2	5	10	5	5	5	4	5	2
9495	5	6	5	12	5	12	5	12	6	0
9538	5	4	5	5	5	4	5	8	5	4
Average	5	0.9	5	4.3	5	4.4	5	3.8	5	5.3

Weights (Cont.)

Pen #9

Aug.5th. Lbs.	Oz.	Aug.12th. Lbs.	Oz.	Aug.19th. Lbs.	Oz.	Aug.26th. Lbs.	Oz.	Sept.2nd. Lbs.	Oz.	Sept.9th. Lbs.	Oz.
5	8	5	11	5	6	5	9	5	8	5	7
6	4	6	5	6	5	6	2	6	4	6	8
4	12	4	15	4	14	4	12	4	8	4	9
3	12	4	8	4	5	4	8	4	6	4	7
3	10	3	11	3	10	3	8	3	7	3	5
5	8	5	8	5	6	5	6	4	15	5	6
5	14	6	4	5	14	5	13	6	0	6	0
5	4	5	6	5	2	5	4	5	1	5	7
6	2	6	7	6	7	6	6	6	7	6	6
5	7	5	13	5	14	5	14	5	15	6	0
5	6.1	5	10.3	5	8.1	5	8.2	5	7.1	5	9.1

CONCLUSIONS

Part I

Birds fed on a normal diet and bled either once or three times a week over a period of eight weeks showed certain correlations between the serum protein content of the blood and egg production.

An increase in serum albumin and total serum protein was accompanied by an increased egg production. An increased serum globulin seemed to be associated with a decrease in egg production.

The averages for serum albumin and total serum proteins were higher for birds bled three times a week than for those bled only once in the same length of time. Serum globulin showed the opposite tendency. The average was lower in the birds bled three times a week than in those bled but once.

The average total protein per egg produced was lower for the birds bled three times a week than for those bled only once.

Part II

The average total protein for birds bled once a week varied regularly and within rather definite limits.

The average total proteins for birds bled three times each week showed a regular decrease when bled every second day,

but a rapid regeneration took place when three days elapsed between samples. The regular decrease and regeneration lasted for three weeks at the end of which time the birds evidently established physiological equilibrium with a lower level of serum proteins. By the end of the seventh week, however, the serum proteins had gradually increased and approached very nearly the normal.

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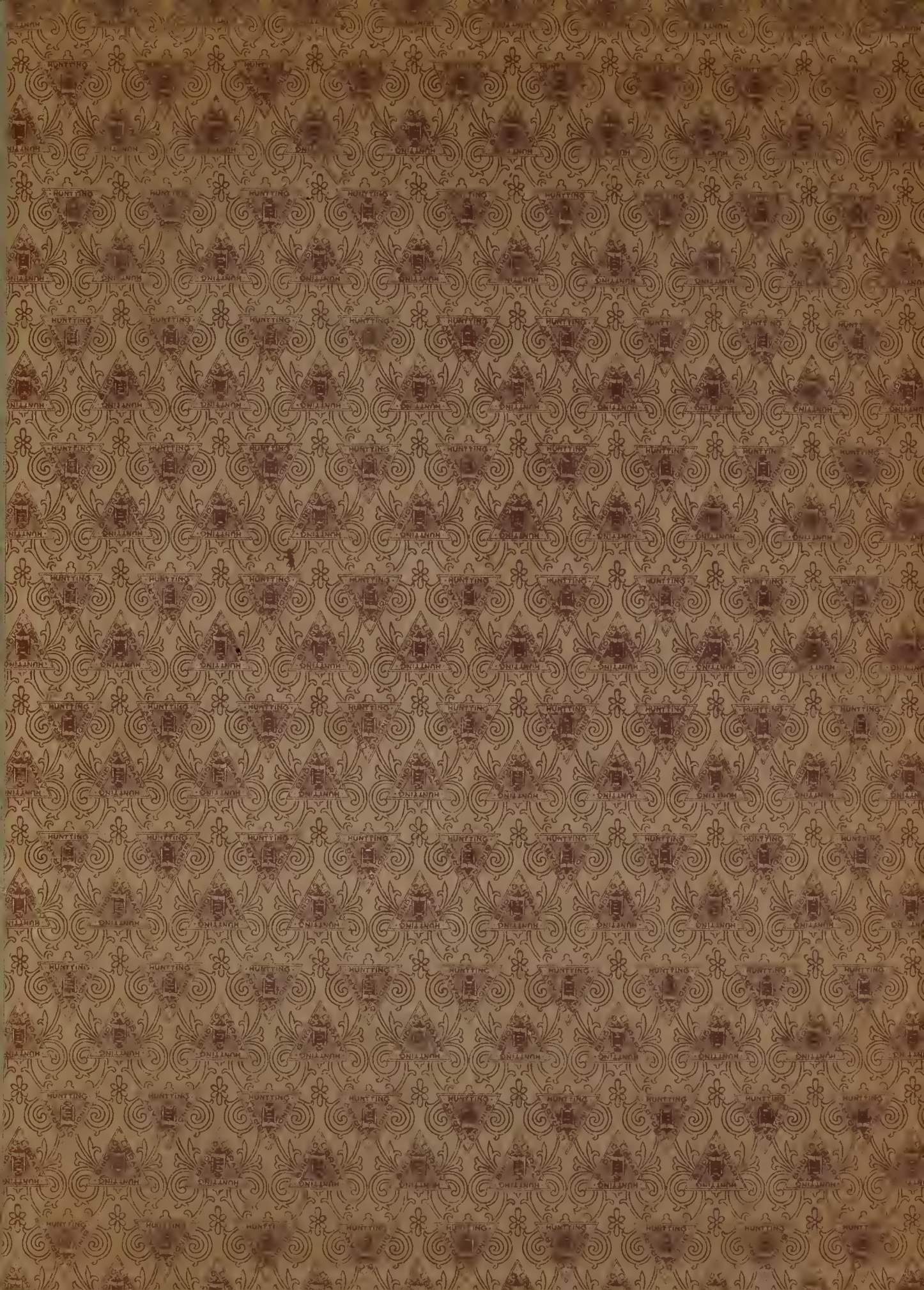
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