THE SHAPE OF THE EGG AND ITS INHERITABILITY.

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The egg as an article of commerce.

The purpose of poultry-keeping has in the first place been to produce eggs for food purposes and only secondarily to produce flesh. As the food of the fowl earlier consisted to a large extent of products taken from the nature direct, the hens did not always get enough of all necessary foodstuffs to promote a better production. Thus the laying has been scarce and always depending on the possibilities of obtaining food.

The use of eggs in the household has, therefore, in earlier days been a mere chance. As the consistency of the egg and the importance of the foodstuffs contained therein as human food was not yet known at that time, the consumption of eggs was not particularly large.

As the standard of living became higher and science had analyzed the composition of the egg, people were able to understand the importance of the egg as a foodstuff, and, on account of this, also the poultry breeding has considerably increased and become more thorough.

As the demand for eggs increased more and more and the question of feeding became an object of scientific research, it was possible also to increase the production of eggs to a considerable extent.

The immense use of eggs before the war appears from the yearly consumed amount of eggs in various countries (table 1) as follows at the next page.

The aforementioned numbers given by STEIGER (19) thus show that the egg trade comprises at least 70 mill. eggs yearly. As especially the great European consumer countries are not able to satisfy their demand for eggs by their own production, they are depending on import. This calls forth a huge international egg trade. It is clear, that in such a large action of trade there are many possibilities of treacherous methods.

The importing countries have therefore taken measures in order to avoid an anferior import by stipulating various conditions with regard to the quality of the imported eggs.

Table 1. The consumption of eggs in various countries before 1939.

Belgium	1.293	mill. eggs
Bulgaria	673	»
Holland	661	» »
Ireland	843	» »
Great Britain	6.724	» »
Austria	809	» »
Japan	3.529	» »
Jugoslavia	1.113	» »
Lithuania	168	» »
Norway	345	» »
Palestine	200	» »
France	6.468	» »
Sweden	672	» »
Finland	182	» »
Germany	7.981	» »
Switzerland	658	» »
Denmark	267	» »
Turkey	843	» »
Czecho-Slovakia	2.050	» »
Uruquay	153	» »
Estonia	104	» »
U.S.A.	30.243	» »
Canada	2.614	» »
French Marocco	823	» »
	69.416	mill. eggs.

In all stipulations concerning the quality of the imported eggs the main attention is drawn to the freshness of the eggs, but also to the size of same, the consistency of the shell and other qualities.

A characteristic, with regard to which no demands have been stipulated, but which nevertheless means a lot in practice, is the shape of the egg.

The most suitable eggs for export and import are those which are as equal as possible with regard to the size and the *shape*. According to AXELSSON (4) the egg-trade experts are of the opinion that the ideal shape of the egg is a thickness of between 73 and 76 % of the length of the egg and the thickest part to be 4 mm from the central part towards the end.

Especially too long eggs are to be considered unsuitable, because they do not fit the compartments of the standardized transport boxes and are usually crushed by the weight of the eggs lying above or get, easier than eggs of a shorter shape, cracks during the transport. In practice such eggs are not approved as export eggs.

The shape of the eggs is, consequently, of a very great importance in the international as well as in the national egg trade.

Under these circumstances efforts ought to be made to get the shape of the eggs standardized in order to make the export article as uniform and profitable as possible.

As the shape of the eggs produced in Finland has not been studied earlier and the fixing of same presupposes that the shape of the egg is hereditary, we have tried to make the matter clear in the following.

The formation of the egg and of its shape.

The development of the egg occurs in the genitals or in the sexual glands and in the oviduct.

The yolks develop and mature in the sexual glands or in the ovaries. Having come to full size the yolk escapes and falls in normal cases into a funnel at the primary end of the oviduct, from which it gradually passes on through the oviduct to the other end of same. The oviduct may, with regard to its action, be divided in different parts. Of these parts may be mentioned the primary end (fig. 1: 4), in which the albumen of the egg is formed around the yolk; the albumen being in this stage still rather thick. In the next part, the isthmus (fig. 1: 5), the both membranes are formed around the egg, and, thereafter, albumen — containing comparatively much water — is taken by osmosis through the shell membranes. When the inner strain of the egg has become strong enough, the egg passes on from the isthmus into the uterus (fig. 1: 6), in which a shell, consisting of calcium carbonate, is formed around the egg. When this shell has been formed, the egg comes out through the cloaca.

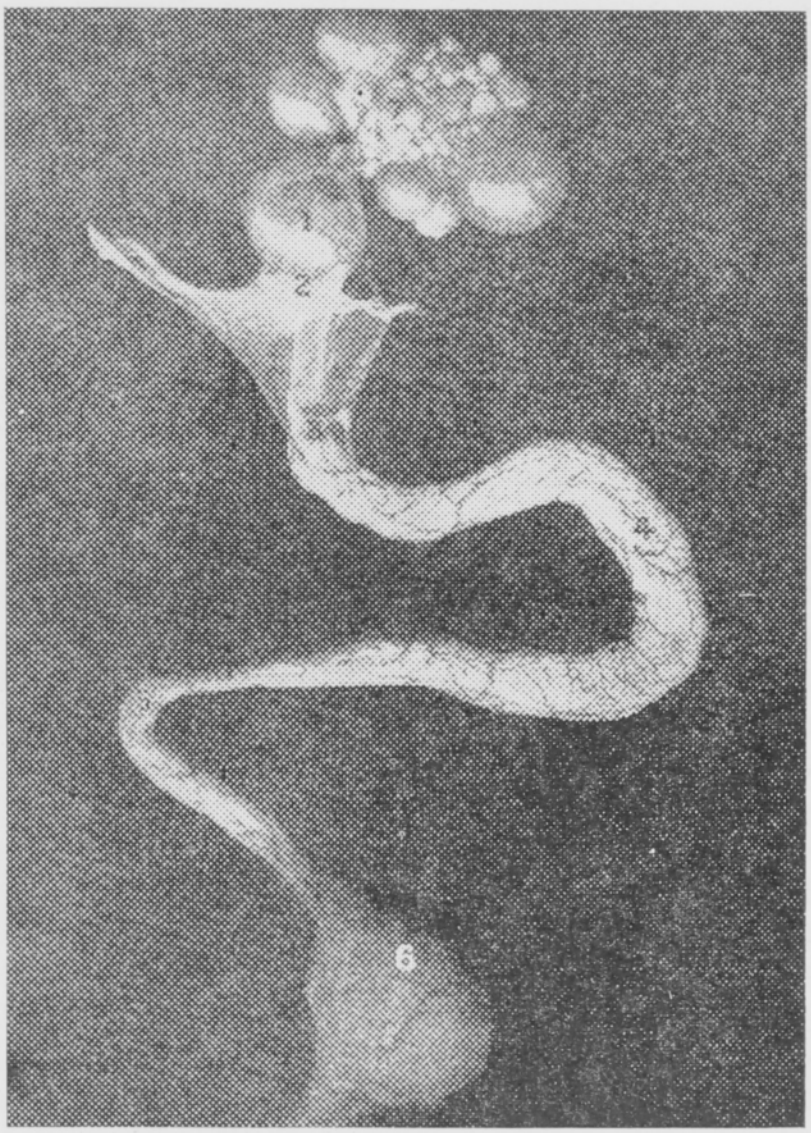


Fig. 1. Egg organs of a fowl: (1) yolk ready to drop into funnel of oviduct; (2) as follicle that envelops it becomes ruptured; (3) section where fertilization takes place; (4) albumes-secreting section; (5) isthmus where shell membrane is formed; (6) uterus where shell is secreted; (7) ovary with ova in different stages of development. (Roy H. Waite).

The question as to in which phase the egg gets its final shape has already for a long time interested the scientists. Thus, for instance, THIENERMANN (21) was in 1838 of the opinion, that the shape of the egg to some extent depends on the shape of the body of the bird. He declares among other things that birds, which have a short and thick body, lay round eggs, while birds having a long body, lay

long eggs. Also NIKOLSKY and WAGNER (14) are of quite a special opinion regarding the shape of the eggs, as according to them the shape of the eggs is to a great extent depending on the posture of the body of the birds, viz. that a bird which keeps its body upright lays round eggs and a bird keeping ist body in a horizontal position lay elliptic eggs.

DE BLAINVILLE and FRESNAYE were according to FALIO (8) of the opinion that the shape of the egg depends on the breast-bone of the bird and on the whole skeleton altogether.

Still, in the same year BERGE declared according to FALIO (8) that in his opinion the shape of the egg is depending on the strength of the bird, on the genitals and particularly on the width of the oviduct.

Also MOQUIN-TANDON is according to FALIO (8) of the same opinion, that the shape of the egg is depending on the oviduct.

RYDER (17) declares in 1893, that the shape of the egg depends on the action of the oviduct and that its final shape depends on the strength with which the parietes are pressing the egg. As the pressure is not equal in both ends, the egg looses here its elliptic shape.

The results achieved by THOMPSON (22) point in the same direction, as he declares that the shape of the egg is the longer, the stronger the pressure is by which the egg is forced forwards from the oviduct.

CURTIS (6) declares also, that the shape of the egg is influenced by the action of the muscles of the oviduct, while on the other hand Serebrowsky (18) thinks that except the action of the muscles, also the shape of the oviduct itself has influence on the shape of the eggs.

In spite of the opinion being prevalent, that the influence of the oviduct on the shape of the egg was rather big, there were in 1860 several deviating opinions. Thus e.g. GRÄSSNER (10) thinks that the shape of the egg depends on the action of the uterus.

In the course of years we find later several investigators, which are of the same opinion as Grässner. Thus, for instance, CRUSHNY (7) declares, that the muscles of the uterus being stronger than other muscles, the influence of the uterus on the shape of the egg is also the biggest.

Later, however, the matter has been studied more thoroughly. SZIELASKO (20) for instance has been studying especially the formation of the shape of pigeons' eggs, and by syringing water into the uterus from the end at the stomach, after having closed the end at the vagina, there was a bulge formed like an egg and therefore he is of the opinion that the egg gets its shape in the uterus.

PEARL (15) has in his research regarding the shape of the egg come to the result, that the general shape of the eggs is already formed when the egg comes into the uterus, while the details depend on the action of the muscles of the parietes of the uterus.

ASMUNDSON and BURMESTER (2) have, however, resected parts from the side as well as from the stomach-side of the uterus and it resulted in a greater variability in the shape of the egg. Before these resecting experiments ASMUNDSON (1) was,

however, of the opinion, that the general shape of the eggs is depending on 1) the quantity of albumen, secreted in the albumen secreting part of the oviduct, 2) the size of the opening between the albumen part and the isthmus and 3) the action of the muscles of the parietes of these parts. When the egg had thus got its general shape, the uterus would then form the details.

On account of some results achieved by resection ASMUNDSON states that the eliminating of parts of the uterus did not influence the shape of the eggs particularly, but the greater effect had the eliminating of parts of the isthmus. If, for instance,the primary part of the isthmus was eliminated, the eggs got unequal shapes. If the isthmus was cut in longitudinal direction and was sewn again, the shell of the egg became rumpled.

The fact, that in any case the uterus too to some extent influences the shape of the eggs, appears from a case, when from the side of the uterus was resected a piece of $2{,}5 \times 1{,}1$ cm and the egg turned out flat on one side.

ASMUNDSON has later, through resections he made together with JERVIN (3), become assured of the great influence of the isthmus on the formation of the shape of the egg. They cut 64 hens and came to the result that the shape of the egg does not change to a worthwhile degree after the egg has escaped the isthmus.

LIPPINCOTT (13) is of the same opinion as the aforementioned investigators, that the shape of the egg is dependant of the isthmus, as after cutting away parts of the isthmus quite shapeless eggs turned out. Still, he does not deny that also the uterus may to some extent influence the shape of the egg.

Earlier studies regarding defining of the shape of the egg.

When the egg has escaped the body of the fowl the shell, consisting of calcium carbonate, has already become hard and is thus unchangeable with regard to the shape. The shape of the egg is evidently not always the same, as the variation of same has interested the investigators. As the shape of the egg is not like a ball but oval, the thickest part of it, anyhow, not always being in the same place or in the central part of the egg, in which case it would be elliptic, the matematic defining of the shape seems to be exceedingly difficult.

SZIELASKO (20) has, anyway, tried to define the shape of the egg exactly and has come to the result that the question can be solved by using an equation of the fourth degree.

Others have, however, used simpler methods of defining the shape of the egg, which methods can be used even in practice, handling great quantities of eggs.

Thus ASMUNDSON (1), for instance, has defined the shape of the egg by fixing the length of the egg as well as the thickness of it in four spots which are at an equal distance from each other.

SEREBROWSKY (18) has, however, still simplified the method by using only the length measure and 2 thickness measures, which lastmentioned are taken on a certain distance from the ends.

Still, it is now in general considered a sufficiently exact method to use an index

number as a measure, which indicates how many per cent the thickness is of the length. This measure showing the shape of the egg has been used e.g. by CURTIS (6), GROSSFELD (9), JULL (11) and PEARL (16).

AXELSSON (4) too has used that method but has completed it so that he has at the same time determined how far the thickest spot is from the central part of the egg, using in his calculations the scale 0—10. The center has been indicated by 0. The numbers 1—10 are given according to how many millimetres the thickest part of the egg is from the centre.

Research made by the author.

Defining of the shape of the egg.

For defining of the shape of greater quantities of eggs we need an index, which easily indicates the shape of the egg. As the index used by SZIELASKO (20) is not suitable for this purpose, but the index used by Curtis etc. meets the requirements set for this index, the lastmentioned method has been used also in the following research.

The shape of the egg has been defined so that the length and the width of the egg have been measured in millimetres with one decimal's accuracy, and thereafter, by using the following formula:

$$\text{Index for the shape of the egg} = \frac{100 \times \text{width}}{\text{length}}$$

the index indicating the shape of the egg has been achieved. It is the bigger the rounder the egg is.

In that way the shape of all eggs from hens, having been in the Laying Trials of the Poultry Breeding Association in Hämeenlinna in 1930/31, was defined. After that the average index was taken from the indexes of eggs, laid by each of the aforementioned hens during the period of a month. Thus a series showing the shape of the egg and comprising 11 numbers was achieved from each hen, having laid eggs regularly during that time. From the average number of these indexes the definite index indicating the shape of the eggs was achieved for each one of the hens.

If the production of the hens has become disturbed and they therefore have laid no eggs for a month or more, or if the hen has started laying only a month after arrival or stopped laying earlier, the index for the eggs produced by these hens has been calculated on the basis of the index of the shape of as many eggs as possible. For 48.553 eggs of 297 hens in all the index has been calculated.

The average index (M_1) for all aforementioned eggs is

$$M_1 = 71{,}3$$

As disturbances having occurred in the laying possibly might have influenced the index of the shape of the egg, the average index has been taken also of all those hens, which had been laying without disturbance during all the months. Thus the following index was obtained:

$$M_1 = 71{,}2$$

this being the average index of 17.992 eggs of 87 hens.

The above shows that disturbances in the production have not influenced the average index of the eggs.

External factors having influence on the shape of the egg.

a. The length of the production period.

As it was ascertained in the preceding chapter, the number of eggs of all hens did not differ from the number of eggs laid regularly during a period of 11 months.

As, however, disturbances may be of other kinds too, it is advisable to study the shape of eggs laid by hens having been disturbed in different ways. The results are as follows:

1. The average index of eggs of all laying hens 71,3
2. The average index of eggs laid regularly during a period of 11 months 71,2
3. The average index of eggs laid regularly during a period of 10 months 72,4
4. The average index of eggs laid regularly during a period of 9 months 71,7

The results show an extraordinary uniformity, which proves that the length of the time of production does not influence the shape of the egg to a worthwhile degree if the hens otherwise lay eggs regularly and continuously.

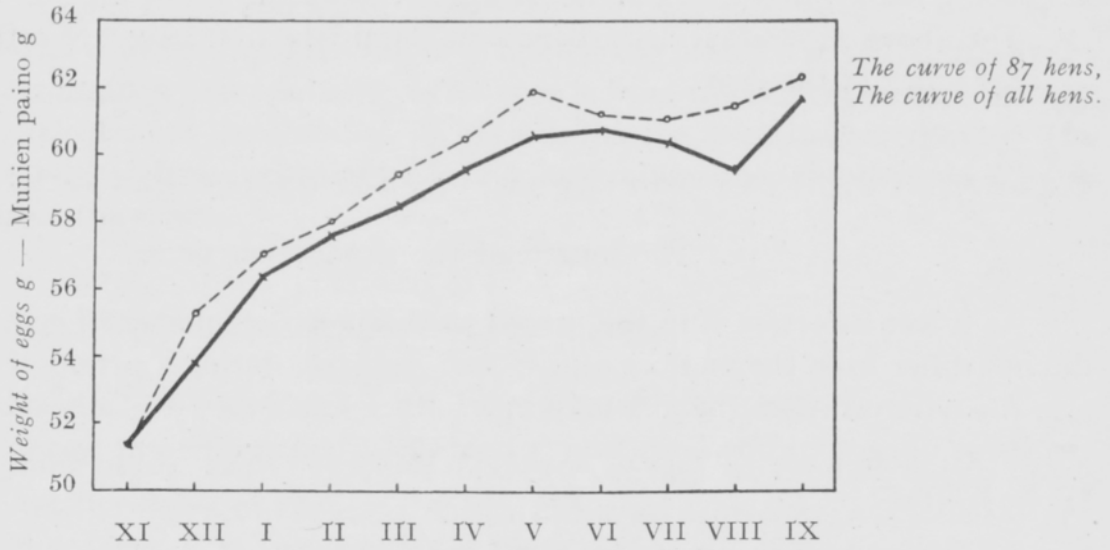
b. The month of laying.

From experience we know, that the production of a hen, having begun in the autumn, might become very active, but, that it also during the production period becomes often disturbed in the beginning of winter and even later in spring-summer. The size of the eggs too varies during the production period. In general, the first eggs of a hen are comparatively small; the size grows, however, considerably during the period of production. The feeding being suitable the size of the eggs develops in accordance with the hereditary disposition.

According to results achieved, the development of the size of the eggs appears from fig 2. The drawing shows that the weight of all eggs of hens having started laying in November, has been 51,3 gr and that the weight has increased the whole time until June, after which month the size of the eggs has become somewhat smaller and in the last month risen to its highest weight, 61,6 gr.

For the sake of comparison, in the drawing has also been indicated the development of the weight of the eggs of those 87 hens, which laid eggs regularly during all months of the production period. Also these hens' eggs show the same develop-

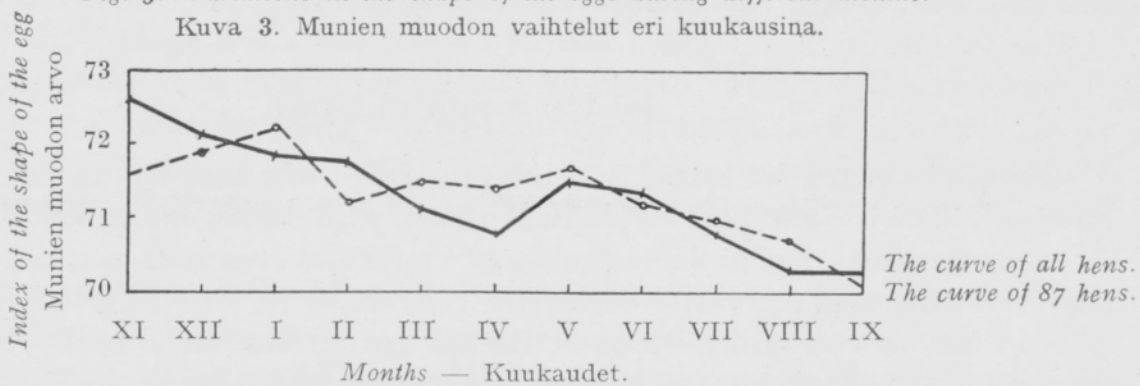
Fig. 2. Variations in the weight of the eggs during different months.
Kuva 2. Munien painon vaihtelut eri kuukausina.



ment of the weight, except that one culmination has been reached already in May, after which month a fall is taking place during two months as in the previous case, and thereafter a rise during two months to the highest weight, 62,3 gr.

It is therefore imaginable, that also the shape of the egg changes during the production period. On the basis of the material at hand it has been ascertained that the shape has changed comparatively little, as appears from fig. 3.

Fig. 3. Variations in the shape of the eggs during different months.
Kuva 3. Munien muodon vaihtelut eri kuukausina.



The above curves show that the average index of eggs of all hens has in the beginning of the laying been 72,6, but has decreased from one month to another, on account of which fact the shape of the eggs has become more and more oval, except in May, when the index has risen from 70,8 to 71,5, falling thereafter again til 70,3, *or during the whole production period 2,3 %.*

In the table has also been indicated the shape curve of the eggs of those 87 hens, which had laid eggs regularly during all months. This curve thus confirms what is said above, as it also ends with the index 70,1.

c. The size of the eggs.

As mentioned in the preceding paragraph, it has been ascertained that the size of the egg grows during the production period. At the same time it has also been ascertained, that the shape of the egg during the production period becomes to some extent more oval. It is therefore imaginable, that the shape of the eggs would have some relation to the size of the eggs. The dependance of the shape of the egg with regard to the size of the egg is shown in the correlation table N:o 1.

On the basis of the table the correlation has been found exceedingly small, the coefficient being.

$$r \quad -0{,}031 \pm 0.019$$

which number with regard to the Standard error is very uncertain.

Even by studying the table it can be ascertained, that the weight of the eggs being between 63 and 64, the index of the eggs may vary between 85 and 62, the difference making 23 %. Likewise may for instance the weight of eggs in the index class 74—75 vary between 40 and 78, etc. The regression coefficients, counted on the basis of the aforementioned relation coefficient, are:

$$\frac{Rx}{y} = -0{,}053$$

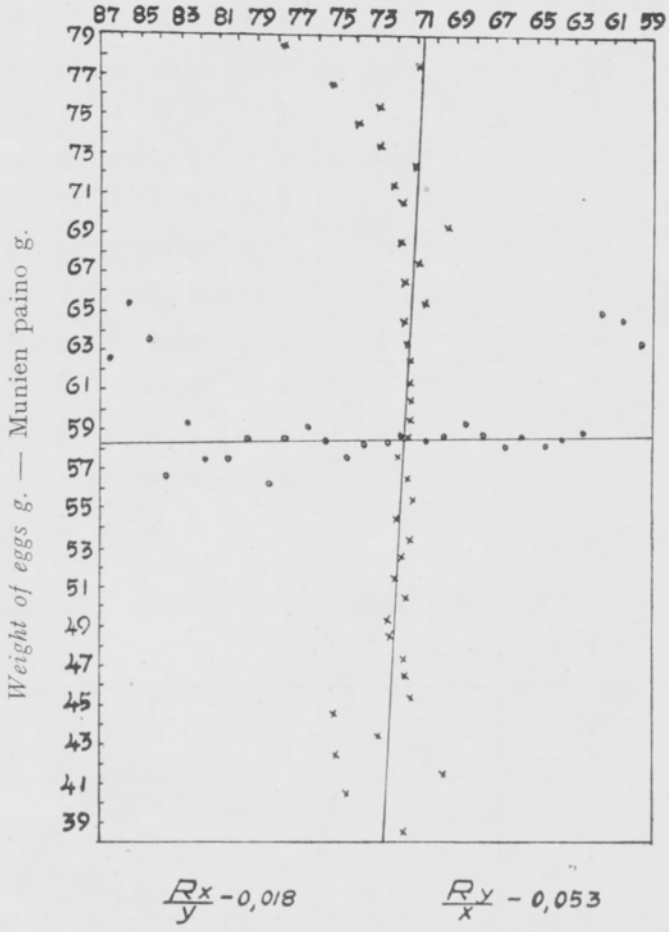
and

$$\frac{Ry}{x} = 0{,}018$$

and the results have been shown graphically in the regression *table N:o 1.*

As shown by the aforementioned indexes, the shape of the egg changes only little when the weight of the egg increases. The relation coefficient being negative, the shape of the egg becomes somewhat more oval when the weight increases.

Regression table n:o 1. Regressiotaulu n:o 1
The index of the shape of the eggs.
Munien muodon arvoluku.



d. Annual production.

As it appears from the above that the shape of the egg is to some extent dependent of the month of production and the size of the egg, it is to be expected that there exists a certain relation between the amount of production and the shape of the egg. In order to illustrate this matter, the correlation *table N:o 2* has been made.

Correlation table n:o 1. — Vuorosuhdetaulu n:o 1.

The index of the shape of the eggs. — Munien muodon arvoluku.

	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59		
79										1		1																		2	77.5
78														1					1	1										3	70.8
77											1			1	1															3	75.2
76													2			1					1									4	72.8
75												1	1	2						1										5	73.9
74													1			2		1												4	72.8
73												2		1		3	1			3		1		1						12	71.0
72												2		3	4	3	2	1	1		2			1						19	72.1
71											1		1	1	1	1	4	2				1		1						13	71.7
70												1		1		2	4	5		3		2					1	1	1	21	69.3
69											2	2		2	5	4	2	1	2	3	4	1								28	71.8
68		1									1	3	2		1	4	3	1	3	2		1		2	2			1		27	71.1
67							1				2	1	6	6	3	9	11	11	18		2				2	1				73	71.6
66												4	2	4	4	10	12	12	8	1	11	1	3			1		1		74	70.6
65		1		1							3	1	2	6	9	14	11	8	11	11	4	1	3							86	71.6
64			2						2	1	3	5	3	2	13	14	24	20	6	13	9	4	3	1		1				126	71.4
63				1		1		2		5	3	2	10	10	26	14	29	21	17	32	9	6	4	2	1	1				196	71.3
62											2	6	2	12	19	21	28	18	26	7	7	4	3	2	1	2				160	71.2
61		1				1	2		1		3	2	9	16	25	26	31	30	25	15	12	10	6	4	1		1			221	71.2
60						1			2	2	5	3	7	7	25	29	29	27	23	19	7	8	5	3	4	1				207	71.2
59							3			4	1	2	6	11	18	34	20	19	41	18	12	4	2	1						196	71.3
58			1							3		3	6	17	24	38	26	18	17	8	5	3	2	4	3				1	179	71.9
57					1					4	3	2	15	12	21	27	36	26	21	13	4	7	4	5	2			1		204	71.4
56										1	1	4	12	20	18	17	21	20	17	8	8	11	5	5	2	1				171	71.1
55						1			1	4	2	9	8	13	12	12	22	26	16	9	3	3	4	2	1					148	71.9
54								1	1			2	6	9	5	14	17	16	15	6	5	4	1			1				103	71.3
53									1	1		5	5	15	10	14	9	19	8	6	5	6		2	1					107	71.7
52							1			1	1	2	5	6	9	6	9	5	8	4	3	2	1			1				64	71.9
51										2	1	1	1	5	11	5	4	9	10	6	2	2			1					60	71.5
50								1			2	3	3	6	6	11	9	3	3	1	4	2								54	72.4
49										1	1	2	2	4	5	4	3	2	3	2	5									34	72.2
48												2	1	6	3	7	4	2	3	2	2	2				1				35	71.6
47											1		1	2	3	6	3	1	3	2	1	1	1							25	71.5
46										1	1			2	1	2	2	2	3		2		1	1						18	71.2
45							1			2	1	1				1		1					1							8	75.1
44														1	2	2		3						1						9	72.9
43										1			1		1	1														4	75.0
42												1				1		1		1					1					5	69.5
41											1				1		1													3	74.5
40																														—	—
39																1														1	71.5
38																														2712	
		62.5	65.3	63.5	56.5	59.3	57.4	57.5	58.4	56.2	58.5	59.1	58.2	57.5	58.2	58.3	58.7	58.4	58.6	59.3	58.7	58.1	58.6	58.2	58.5	58.9	65.0	64.7	63.5		

$$M = 71.6 \pm 3.274$$

$$r = -0.031 \pm 0.019$$

Correlation table n:o 2. — Vuorosuhdetaulu n:o 2.

Number of eggs. — Munien lukumäärä.

The index of the shape of the eggs. — Munien muodon arvoluku.	270	250	230	210	190	170	150	130	110	90	70	50	30	10			
85			1												1	240	
84																	
83																	
82																	
81																	
80																	
79																	
78																	
77			1		1								1		3	166	
76						1	2	1		1		1			6	133	
75	1			1		1	1	1		1					6	177	
74	1	1	3	3		8	2	2	3			1			24	176	
73		4	4	4		4	6	3	2	1					28	186	M = 71.4 ± 0.045
72		2	5	7		10	5	9	7	1	1	1			48	165	
71	1	3	5	9		7	9	6	1	4	1	2	1		49	167	
70		4	4	11		7	7	5	2	3	1	1			45	173	
69		1	7	6		8	4	3	1	2	2	1		1	36	167	
68			2	6		2	5	3	1	1	1		2		23	156	
67			1	1			3	1		1	2	1	1		11	127	
66				2		2									4	190	
65				1			1	1		2	1				6	130	
64																	
63																	
62				1											1	200	
	3	17	32	52		50	45	35	17	17	9	9	4	1	291		
	73.8	73.0	71.4	70.7		71.7	71.2	71.2	72.2	73.0	69.2	73.5	69.0	69.5			

M = 157 ± 0.946

r = + 0.085 ± 0.058

This relation table shows that the relation coefficient is

$$r = 0{,}085 \pm 0{,}058$$

the correlation thus being very small and with regard to the Standard error very uncertain.

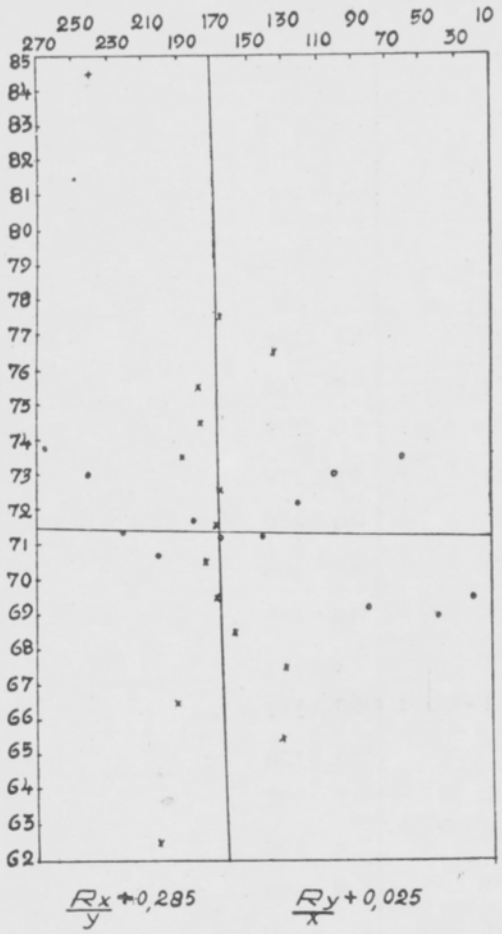
The regression coefficients, counted on the basis of the correlation coefficient, are as follows:

$$\frac{Ry}{x} = + 0{,}0285$$

$$\frac{Rx}{y} = + 0{,}025$$

Regression table n:o 2. — Regressiotaulu n:o 2.

Number of eggs. — Munien lukumäärä.



and the regression table N:o 2, drawn on the basis of the regression coefficients, shows that the regression is rather small, and that the average index of the various classes differs considerably from the regression line, which shows its uncertainty.

On the basis of the above the shape of the egg has been proved to be rather constant during the production period, the index becoming on the average abt. 2 % smaller or the egg becoming more oval. Furthermore, it has been ascertained, that between the index, the yearly production and the weight of the eggs is such an uncertain correlation, that it of the aforementioned characteristics of the eggs, and the heredity units of which are may be considered that the shape of the egg is a characteristic, which is independent inherited independently of these factors.

The inheritability of the shape of the egg.

As was already ascertained in the preceding chapter, the shape of the egg has been practically independent of other factors, its inheritability as a self-dependent factor thus being confirmed. Of researches concerning the ways of inheritability of the shape of the egg, we may mention the research made by BENJAMIN (5), according to which the shape of the egg is inheritable and the oval shape is dominating in relation to the round shape, as well as the research made by Kopeć (12), according to which the short and round shape is dominating in relation to the long shape.

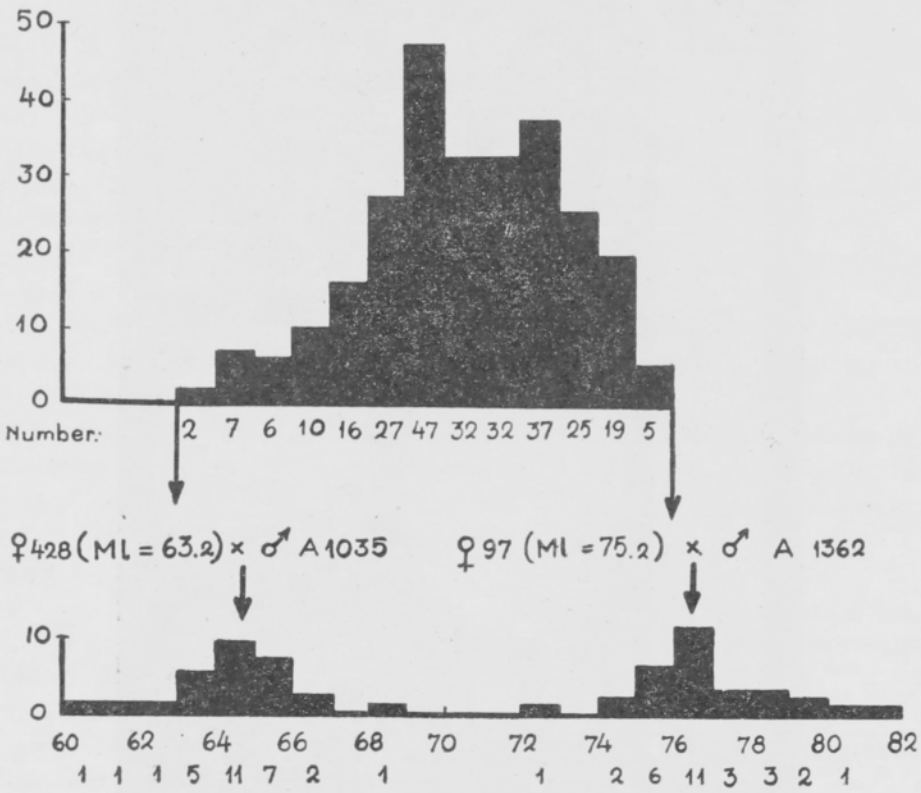
As the opinions of the ways of inheritability of the shape of the egg are thus quite contradictory, and as on the other hand it might be possible, that the inheritability of the shape could be dependent on several factors having the same effect upon it, the eggs of 265 breeder hens were measured and the indexes of these hens' eggs were measured. Thus it was ascertained that these indexes varied between 63 and 76, being divided among the different classes as per fig. 4 a.

Judging from the dividing it seems as if the material in question would be divided into two culminations, which indicates that the material is a fusion of two populations, which fact makes it possible to breed hens stocks, laying round as well as oval eggs.

After this the hen N:o 428 was in the following year used for breeding, the index of the shape of this hen's egg being the smallest, i.e. 63,2, as well as hen N:o 97, the index of this hen's egg being the biggest, i.e. 75,2. The firstmentioned hen was mated with cock N:o A1035, which was the chick of hen N:o 428, and the latter

Fig. 4. The dividing into classes of the whole breeding material and of the results of cross-breeding, on the basis of the shape of the egg.

Kuva 4. Koko siitosaineiston ja risteytystulosten jakautuminen munan muodon perusteella eri luokkiin.

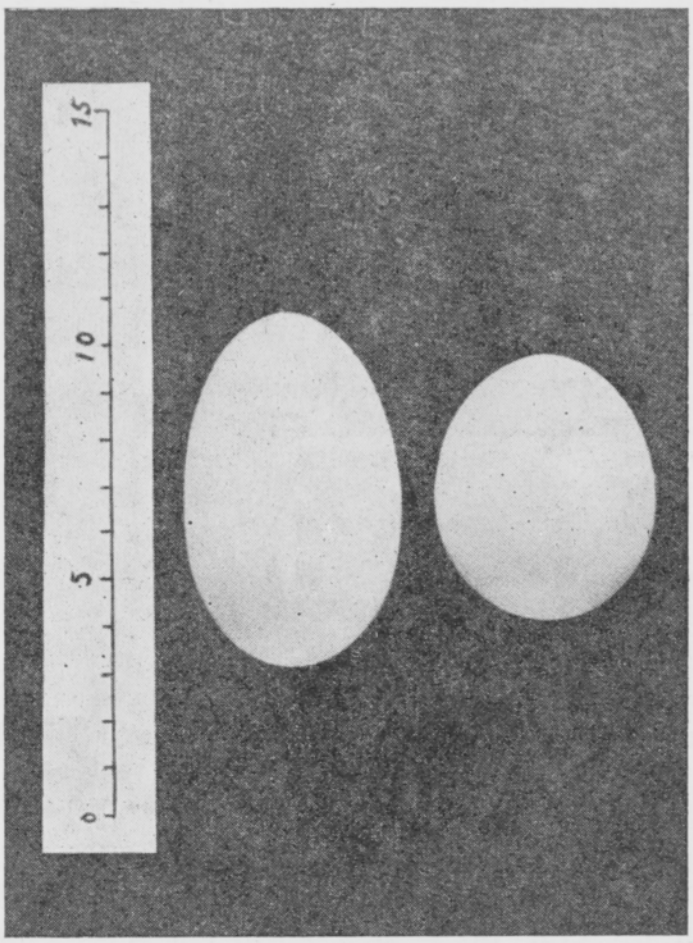


hen N:o 97 was mated with cock N:o A1362, which was the chick of this hen. Thus a method of close in-breeding, i.e. mother-chick, was employed. We can imagine, that the genotype of the off-springs of these extreme cases contain more or less hereditary units, influencing the roundness of the eggs, than usual. If that would be the case, the index of the egg of the offspring ought to exceed the indexes of the eggs of the parents, especially as also the genotype of the cock would contain more hereditary units causing either ovalness or roundness, and, furthermore, units working in the same direction as those of the mother. The results show — as it appears from the drawing N:o 3:a — that the average index of the eggs of the off-springs of hen N:o 428 is 64,5, the individuals being divided between 60 and 69, on account of which fact there are individuals among the off-springs, whose eggs are considerably more oval than those of the mother, while on the other hand the average index of the eggs of the off-springs of hen N:o 97 is 76,7, the index of the eggs of the different individuals varying between 72 and 81.

According to results achieved it seems that the selecting of cock N:o A1362 has been more successful, as the average index of the eggs of the female chicks is bigger than the index of the mother's eggs. But the cock has not decreased the average index of the eggs of the female chicks under that of the mother, though the index of the eggs of some individuals is lower.

In the case in question we have not found such extreme shapes as in the material dealt with previously, when the index of the egg of a hen which laid rounder eggs

Fig. 5. Two eggs of different type.
Kuva 5. Kaksi eri tyyppistä munaa.



The index of the egg to left 60.1 and to right 80.9.
Vasemman puoleisen munan arvoluku 60,1 ja oikeanpuoleisen munan arvoluku 80,9.

was 84,0, which index, besides, had maintained the whole time almost the same but according to the results it seems that by a suitable selection it would be possible to develop stocks of hens, laying either oval or round eggs. The author's intention was to continue the improvementwork entered upon, keeping these characteristics in mind, had the war not intercepted these plans and the hens had to be killed off according to regulations on account of lack of food.

Still, the aforementioned results support the conception that the shape of the egg is an independently hereditary characteristic and that we have possibilities to develop hen-stocks, which lay either oval or round eggs. It cannot be ascertained on the basis of this research how many hereditary units influence the shape of the egg, but evidently they are many multiple factors.

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SELOSTUS.

KANANMUNAN MUOTO JA SEN PERIYTYMINEN.

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Kananmunan tultua erittäin tärkeäksi kansainväliseksi kauppatavaraksi ja kulutuksen noustessa yli 70 milj. kappaleen vuosittain on useissa tuontimaissa kiinnitetty huomiota kananmunien laatuun kuten tuoreuteen, kokoon, kuoren laatuun ym. ominaisuuksiin. Koska kauppatavaran yhdenmukaisuus teknillisistä syistä on kaupankäynnille eduksi, tekijä on tutkinut kananmunan muotoa ja sen periytymistä.

Kananmunan muodon mittana tekijä on käyttänyt kananmunan leveyden suhdetta pituuteen, jolloin munan indeksi, muotoluku, on laskettu seuraavan kaavan mukaan:

$$\text{Kananmunan muotoluku} = \frac{100 \times \text{leveys}}{\text{pituus}}$$

Aineistona on käytetty Siipikarjanhoitajain Liiton munintatarkastusasemalla 1930/31 olleitten 297 kanan 48 553 munaa.

Kaikkien näiden munien keskimuotoluku (Ml) oli 71,3.

Koska oli mahdollista, että eräät ulkonaiset tekijät saattoivat vaikuttaa kananmunien muotoon, on tekijä lähemmin tutkinut tuotantokauden pituuden, munintakuukauden, munien koon ja vuosituotannon vaikutusta kananmunien muotoon.

Tulokset osoittavat, että

1) munan muoto ei muutu tuotantokauden lyhentyessä 11 kuukaudesta 9 kuukauteen, munien muotoluvun ollessa

11 kuukauden aikana säännöllisesti munineitten kanojen munilla	71,2,
10 kuukauden aikana säännöllisesti munineitten kanojen munilla	72,4,
9 kuukauden aikana säännöllisesti munineitten kanojen munilla	71,7,

2) munan muotoluku, muutamia poikkeuksia huomioonottamatta, muuttuu munintakauden aikana tasaisesti siten, että se pienence 2,3 prosenttia eli 72,6:sta 70,3:een, ja munat siis tulevat tuotantokauden kuluessa hieman pitkulaisemmiksi (kuva 2 ja 3),

3) munan muotoluku on munan koosta riippumaton, ja vuorosuhdekerroin on (vuorosuhdetaulu 1)

$$r = -0{,}031 \pm 0{,}019$$

ja regressiokerroin on (regressiotaulu 1)

$$\frac{Ry}{x} = -0{,}018$$

$$\frac{Rx}{y} = -0{,}053, \text{ sekä että}$$

4) munan muoto on myöskin riippumaton vuosituotannon runsaudesta, ja vuorosuhdekerroin on (vuorosuhdetaulu 2)

$$r = +0{,}085 \pm 0{,}058$$

ja regressiokerroin (regressiotaulu 2)

$$\frac{Ry}{x} = +0{,}0285.$$

$$\frac{Rx}{y} = +0{,}025$$

Kananmunan muoto on näin ollen osoittautunut edellä mainituista tekijöistä riippumattomaksi, joten sen voidaan katsoa periytyvän itsenäisenä tekijänä.

Tarkoittaen varmistua viimeksi mainitusta käsityksestä tekijä mittasi vielä 265 kanan munat, joiden muotoluku vaihteli 63 ja 76 välillä ja jotka jakautuivat eri luokkiin siten kuin kuvasta 4 ilmenee. Kun siitokseen käytettiin kahta sisarusparia, joista kana 428 ja kukko A 1035 kuuluivat pitkämuotoisia munia munivaan ryhmään ja jonka kanan munan muotoluku oli 63,2, ja kanaa 97 ja kukkoa A 1362, jotka kuuluivat pyöreämuotoisia munia munivaan ryhmään ja jonka kanan munan muotoluku oli 75,2, niin edellisten parituksesta saatiin yksilöitä, joiden munien muodon arvoluku oli keskimäärin 64,5 ja vaihteli 60 ja 69 välillä, ja jälkimmäisten parituksesta saatujen jälkeläisten munien keskimääräinen arvoluku oli 76,7 ja vaihteli 72 ja 81 välillä.

Edellä mainitut tulokset tukevat sitä käsitystä, että munan muoto on itsenäisesti periytyvä ominaisuus ja että meillä on mahdollisuuksia kehittää sellaisia kanakantoja, jotka munivat joko pitkulaisia tai pyöreitä munia. Tämän tutkimuksen perusteella ei kuitenkaan voida päätellä, miten monta perintöyksikköä vaikuttaa munan muotoon, mutta todennäköisesti niitä on useita ja luonteeltaan samanvaikuttavia. Sodan johdosta oli kuitenkin pakko luopua tällaisten jalostusmahdollisuuksien tutkimisen jatkamisesta.