Oct. still warm and less than average rain, though over 1 inch fell on 13th.
Nov. stormy, wet and warm.
Dec. calmer and warm, about average rain.

Through the generosity of Lord Bute the set of meteorological instruments available for the observations of the Society has been rendered complete. A sunshine recorder, a thermometer screen and thermometers for use in the grass and one foot underground are among the valuable additions which have been made.

The sunshine recorder has been erected on the top of the tower at the County Buildings. This position is perhaps the most suitable that can be got, but it is not quite perfect. In the winter months on account of the high ground to the east and to the west of it, a small portion of the possible sunshine is unable to be recorded. After all, however, the drawback is comparatively slight, and in all other respects, the site is satisfactory.

The records for the three months during which the instrument has been at work are as under. The figures for Douglas, I. O. M. and Blackpool are also given and it may be assumed that the instruments in these towns are absolutely favourably situated.

	Oct.	Nov.	Dec.
Rothesay, Daily average in hours	2.95	1.36	0.94
Percentage of possible sunshine	29	17	14
Douglas, Daily average in hours	2.64	2.03	1.37
Percentage of possible sunshine	26	24	24
Blackpool, Daily average in hours	2.77	1.75	1.41
Percentage of possible sunshine	27	21	19

The comparison between the figures will be more interesting when we have the records for a full year.

COMPARISONS OF SOME CHANCE GROUPINGS WITH MENDEL'S LAWS.

By W. J. Millar, C.E.

[Read 25th November, 1913.]

At a meeting of this Society held on 13th January 1909, papers were read by Mr William Cuthbertson and Dr. Andrew Hall upon "Mendel's Laws of Heredity and their Application to Plants and Animals, with an Account of Some Experiments" During his remarks Dr. Hall used some draught men to illustrate the Mendelian principle of the 3 to 1 grouping found to exist in some organic elements of plants. Being interested in the chance groupings of the black and white draught men exhibited I have since then carried out a number of experiments with the chance relations of black and white balls which I will now summarize:—

The simplest arrangement is to take four pairs of draught men, or preferably four pairs of balls, one half of these being black and the other half white, place them in a bag, shake them up and draw out in pairs without looking at them; it will then be found that they will take two or three different groupings, but, if this is done two or three times a definite grouping will be noticed, viz.:—that we get one pair black, two pairs black and white, and one pair white. Further, if the drawing takes place up to say thirty times, it will be found that this grouping can be depended upon for 21 times out of 30. We may call this a 3 to 1 arrangement as, if we confine our attention say to the black elements, we find that the black enters

into *three* pairs and white only in *one* pair, and may be taken to represent the Mendelian 3 to 1 ratio expressed as 1 D; 2 D R; 1 R, where D and R are assumed to be dominant and recessive characters in the seed vessels. So long as we keep to the four pairs of balls the 3 to 1 proportion falls out about 21 times in 30 trials, but if we take double the number of balls, that is eight pairs, we find under the same circumstances the 3 to 1 ratio falls to 16 times in 30 trials. If we add another four pairs, so as to work with twelve pairs, we find that the 3 to 1 chances have fallen to 14 times in 30 trials, and finally, if we go on to forty-four pairs, we find the 3 to 1 grouping only occurring 9 times in 30. To tabulate these groups from the 3 to 1 arrangement is as follows:—See Table I.

TABLE I.

With	4	pairs,	21	times in thirty trials.
,,	8	,,	16	,, ,,
,,	12	,,	14	,, ,,
,,	16	,,	12	,, ,,
,,	20	,,	10	,, ,,
,,	24	,,	10	,, ,,
,,	28	,,	12	,, ,,
,,	32	,,	10	,, ,,
,,	36	,,	10	,, ,,
,,	40	,,	10	,, ,,
,,	44	,,	9	,, ,,

The relations of these groupings may be shown by a curve whose equation is $xy = 105$, and is approximately a hyperbola. We may write this as $y = \frac{105}{x}$ where y represents the number of times the 3 to 1 arrangement takes place, and x a factor starting at 5; thus, in the first example for four pairs we would have $y = \frac{105}{x}$ or $21 = \frac{105}{5}$ With eight pairs the divisor would be 6; twelve pairs 7; and so on.

In Professor Bateson's work on "Mendel's Principles of Heredity," at page 327, he gives the result of some of Mendel's experiments on hybrid peas, as follows:—See Table II.

TABLE II.

	PEAS.	
	ROUND.	ANGULAR.
1.	45	12
2.	27	8
3.	24	7
4.	19	10
5.	32	11
6.	26	6
7.	88	24
8.	22	10
9.	28	6
10.	25	7

TABLE III.

BALLS.	
Black and Black and White Elements.	White Elements.
45	12
26	9
25	6
22	7
35	8
26	6
84	28
25	7
26	8
25	7

Taking No. 1 we find that out of 57 peas from a plant there were 45 round and twelve angular shaped, and so on for the 10 examples. I took as many pairs of black and white balls as there are peas in each of the above ten examples and found that the pairs containing black elements bore the same relation almost to the pairs with white elements alone; in three cases they were similar as did those peas (see above Table III.) The peas were put into a bag, shaken and drawn out by chance.

The organic and inorganic substances seemed therefore to be governed by the same law of division. Professor Jevons says, that there is no such thing as chance, there are laws acting of which we are not aware.

In the *Hazelmere Gazette* of 1907, which can be seen in the Library of the Society, there are some rabbit experiments

with Mendelian results appended. Results are given of crossing hybrids bred from pure Angoras and pure short haired rabbits thus:—See Table IV.

TABLE IV.

	Rabbits.	
	Short Haired.	Long Haired.
7	5	2
2	1	1
3	2	1
3	2	1
5	4	1
2	1	1
2	1	1
8	7	1
7	5	2
3	2	1
4	4	0
7	6	1
7	5	2
8	6	2
2	2	0
	53	17

TABLE V.

	Pairs of Black and White Balls.	
	Black and White.	White and White.
7	5	2 D
2	1	1
3	2	1 D
3	2	1 D
5	4	1 D
2	1	1
2	1	1
8	7	1
7	5	2 D
3	2	1 D
4	4	0
7	6	1
7	5	2 D
8	6	2 D
2	2	0 D
	53	17

Table V. placed along side of Table IV. for comparison shows the chance groupings of black and white balls taken in pairs as in the pea experiments. To represent the first litter of 7 rabbits I took seven pairs of black and white balls, placed them in a bag and shook them up, then drew them out in pairs and assorted them as before into their black and black, black and white, and wholly white pairs, from which we get in the first example 3 pairs of black and white, 2 pairs black and black, and 2 pairs white and white, or the ratio of five pairs with a black element to two pairs all white so that we may say that is in the ratio of 5 is to 2 which is the same assortment as in the short and long-haired rabbits and so on throughout Table V. The results given in this table are taken from thirty trials in each case. Thus, in the first case the seven pairs of balls were tried over and over again

for thirty times and the prominent grouping noted, which was 5 to 2, and this occurred thirteen times out of the thirty trials. Again in the case of the litters with three each, taking three pairs of black aud white balls and treating them as before I found that the dominant grouping was one pair black and white, one pair black, and one pair white, or a ratio of 2 to 1, and this grouping occurred 20 times out of 30 chance draws, and so on with the others.

The letter D in Table V. shows where the Dominant grouping occurs; with other cases not marked the grouping does not happen to be in a majority.

What is known as the Mendelian expectation is shown by the totals 53 to 17 of the division of the rabbits into short and long haired classes; curiously enough the totals of the pairs of balls in Table V. gives the same ratio.

I have submitted these experiments to a number of biological experts, and they have all been interested in the results; the "parallelism" of those representing the pea experiments being taken special notice of. And one writer finds no difficulty in accepting the similarity as he assumes *chance* to govern the mating of the cells in the living organisms, and so the black balls and the white balls may readily represent these cells of assumed different characters.