and “ r ” terms. The two lines are added at sight and the anti-logarithm found. The sign of each expression, given in brackets, is a great help to rapid work.

+	-
·18185	1·27847
·23257	3·35251
17·09435	2·42526
44·98925	3·13669
5·15557	·72984
13·61071	·95317
·08889	·62902
·11703	1·66492
<hr/> 81·47022	<hr/> 14·16988
<hr/> 14·16988	
log 67·30034 =	1·8280173
	<hr/> 1·2575460
	<hr/> 1·0855633 ... 12·17765

Using the annuities for 51, 28 ; 51, 29 ; 52, 28 and 52, 29 with formula (2) I get 12·1775.

III. Variation in the Moscatel (*Adoxa Moschatellina*, L.).

By HENRY WHITEHEAD.

THE mode of arrangement of flowers in globose heads in the Moscatel (*Adoxa moschatellina*, L.) is often cited as an example of packing the maximum number of flowers in the minimum of space. An inflorescence of the Moscatel generally consists of five flowers—one terminal and four lateral. The terminal flower has two bracts, four petals, four branched stamens and four carpels ; and each of the lateral flowers possesses three bracts, five petals, five branched stamens and five carpels. This is the most common form of arrangement, but the plant varies considerably and the following figures show that only 55 per cent. of the numbers counted agree with the above description, and 51 other methods of arrangement are noted.

The number of flowers in the inflorescence is a variable quantity as well as the number of parts in the perianth, and for the sake of convenience these variations are considered separately.

The specimens examined were obtained from three localities, Chislehurst in Kent, Caterham in Surrey, and Theydon Garnon in Essex.

I. Variation in the number of flowers in an inflorescence.

The number of flowers constituting an inflorescence varies from three to ten. 1071 inflorescences were counted and the following results were obtained :

TABLE I.

Number of flowers	3	4	5	6	7	8	9	10
Actual quantities...	6	71	934	26	24	7	1	2
Percentages	0.6	6.6	87.2	2.4	2.1	0.6	0.1	0.2

Diagram I. represents the above figures in a graphical form.

DIAGRAM I. Number of flowers per inflorescence.

In Gerard's *Herbal* (2nd Ed. 1633), p. 1090, there is a note relating to the Moscatel which is interesting. He says "the floures grow clustering on the top of a stalk, commonly five or seven together,.....; it floures in Aprill and is to be found in divers places amongst bushes at that time, as in Kent about Chiselhurst, especially in Pits his wood and at the further end of Cray heath on the left hand under a hedge among bryers and brambles, which is his proper seat." Gerard gives an illustration of the Moscatel which shows two flowering stems, one

of these has a clustered group at the top with one small lateral flower some distance down the stem, and the other a clustered group with two lateral flowers in a lower position. Several plants bearing seven flowers were found near the spot mentioned by Gerard as "Cray beath." It seems strange that Gerard should give the numbers as five to seven when the four-flowered inflorescences occur more than twice as often as either the six-flowered or the seven-flowered.

II. Variation in the number of petals.

Before considering the variation in the number of petals it would be as well to say a few words about the mode of arrangement of the parts of a flower of the normal type.

The tips of each of the uppermost petals of the four pentamerous lateral flowers (1, Diagram II) fit into the space between two petals (4) of the terminal and tetramerous flower.

DIAGRAM II. Plan and side view of inflorescence without terminal flower.

The arrangement of the remaining petals is shown in Diagram II, where the petal indicated by 2' in the expanded lateral flower shown in the diagram touches petal 2 of the flower on the left hand, while petal 2 of flower A touches 2' of its neighbour on the right. The petals marked 3 and 3' touch in a similar manner.

The order in which the various flowers and petals in an inflorescence generally open is very curious. First, the four petals of the terminal flower expand simultaneously, then two lateral buds which are diametrically opposite (a and a') open, and finally the opening of the other pair of buds (b and b') takes place. The order in which the petals of the pentamerous flowers expand is 1, 2 and 2', and 3 and 3'. Mathematical precision is necessary where the flowers are packed in such a neat fashion, otherwise the struggle for space would result in a haphazard arrangement and consequently a loss of space.

The terminal flower is the least variable of all. Out of 763 terminal flowers 754 (about 99 per cent.) were found to be tetramerous; 4 being pentamerous and 5 trimerous. The fixity in the number of parts of the terminal flower is used for the purpose of classifying and tabulating the variations from the normal type as given in Table II.

The numbers given in Table II. lines 16—20 deserve special notice. Line 16 shows that 420 inflorescences with 4 pentamerous lateral flowers (represented by the entry 4 in column 5) were noted. In line 17 where there are 3 "fives" and 1 "four" in the inflorescence the number has dropped to 125. In line 18 where there are 2 "fives" and 2 "fours" the number is 59, and lines 19 and 20 show a further decrease in the totals as the florets with four petals take the places of those with five. The same rule holds in cases where the numbers of flowers in the inflorescences are seven, six and four.

TABLE II.

Variations in the Number of Divisions of the Corolla.

Terminal Flower	Total Number of Flowers per inflorescence	Distribution of Petals in lateral flowers*						Locality			Totals	Number of Row
		8	7	6	5	4	3	Near Chislehurst, Kent	Caterham, Surrey	Theydon Garnon, Essex		
Tri-merous	4	—	1	—	2	—	—	1	—	—	1	1
	4	—	—	—	2	1	—	1	—	—	1	2
	4	—	—	—	1	2	—	—	—	1	1	3
	4	—	—	—	—	3	—	—	—	2	2	4
	3	1	—	—	1	—	—	1	—	—	1	5
	3	—	—	—	2	—	—	4	—	—	4	6
	4	—	—	—	3	—	—	16	3	2	21	7
	4	—	—	—	2	1	—	4	1	—	5	8
	4	—	—	—	1	2	—	3	—	1	4	9
	4	—	—	—	—	3	—	—	—	1	1	10
	4	—	—	2	—	1	—	1	—	—	1	11
	4	—	—	1	2	—	—	2	—	—	2	12
	4	—	—	1	1	1	—	1	—	—	1	13
	4	—	—	1	—	2	—	1	—	—	1	14
	4	—	—	—	2	—	1	1	—	—	1	15
	5	—	—	—	4	—	—	283	30	107	420	16
	5	—	—	—	3	1	—	91	6	28	125	17
	5	—	—	—	2	2	—	38	10	11	59	18
	5	—	—	—	1	3	—	27	1	4	32	19
	5	—	—	—	—	4	—	10	2	2	14	20
Tetra-merous	5	—	—	3	—	1	—	—	1	—	1	21
	5	—	—	2	2	—	—	1	1	—	2	22
	5	—	—	2	1	1	—	1	—	—	1	23
	5	—	—	1	3	—	—	4	3	—	7	24
	5	—	—	1	2	1	—	3	1	1	5	25
	5	—	—	1	1	2	—	1	1	—	2	26
	5	—	—	—	3	—	1	1	—	—	1	27
	5	—	—	—	2	1	1	1	—	—	1	28
	5	—	—	—	1	2	1	7	—	—	7	29
	5	—	—	—	1	1	2	—	—	1	1	30
	5	—	—	—	—	3	1	2	—	—	2	31
	6	—	—	1	4	—	—	—	1	—	1	32
	6	—	—	—	5	—	—	5	—	1	6	33
	6	—	—	—	4	1	—	1	—	—	1	34
	6	—	—	—	3	2	—	1	—	—	1	35
	6	—	—	—	2	3	—	1	—	—	1	36
	6	—	—	—	2	2	1	—	2	—	2	37
	6	—	—	—	1	4	—	2	2	—	4	38
	7	—	—	—	6	—	—	5	—	—	5	39
	7	—	—	—	5	1	—	1	1	1	3	40
Penta-merous	7	—	—	—	4	2	—	—	1	—	1	41
	7	—	—	—	4	1	1	1	—	—	1	42
	7	—	—	—	3	3	—	—	1	—	1	43
	7	—	—	—	3	2	1	1	—	—	1	44
	7	—	—	—	—	6	—	1	—	—	1	45
	7	—	—	—	—	3	3	2	—	—	2	46
	8	—	—	—	6	1	—	1	—	—	1	47
Penta-merous	5	—	—	—	4	—	—	1	—	—	1	48
	5	—	—	—	2	2	—	1	—	—	1	49
	5	—	—	—	1	2	1	1	—	—	1	50
	6	—	—	—	2	3	—	—	1	—	1	51

* The figures at the top of this column denote the number of petals per flower. The figures in the vertical columns denote the number of flowers of each type.

It will be seen that the corollas of the *Adoxa* are 8-, 7-, 6-, 5-, 4- and 3-partite, and the actual number of each of these types of corolla is shown in Table III, while Diagram III gives the results in a graphical form.

TABLE III.

	3	4	5	6	7	8
Number of flowers not including terminal flowers	25	514	2494	30	1	1
Number of terminal flowers	5	764	4	—	—	—
Totals	30	1268	2498	30	1	1
Percentages of totals (to nearest 10th) ...	0·8	33·1	65·3	0·8	—	—
Assuming that all inflorescences were normal then percentages of totals would be	—	20	80	—	—	—

The statistics presented in this paper show that the inflorescences of the Moscatel vary considerably from the normal type. A normal inflorescence consisting of five flowers has one tetramerous and four pentamerous, that is, a percentage ratio of 20 to 80, but the ratio of the observed percentages is as 33.1 to 65.3. The variation from the normal type therefore favours the tetramerous type more than the pentamerous type, while sports occur in the form of 3-, 6-, 7-, and 8-partite corollas though these form less than 2 per cent. of the total.

NOTE.

At the suggestion of Prof. Karl Pearson several old herbaria at Kew, the British Museum and at Cambridge were examined in order to see whether any of the specimens agree with the figure given in Gerard's *Herbal*, 2nd Ed., p. 1091 (edited by Thos. Johnson). None were found exhibiting the peculiar racemose arrangement which is so marked in his drawing. The first edition (published 1597) has an entirely different figure of *Adoxa*, which has evidently been borrowed from the *Krütter Buch* of Tabernaemontanus. In this case all the lateral flowers are tetramerous.

I am indebted to Miss K. M. Hall, Curator of the Stepney Borough Museum, for much help and many useful suggestions.

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IV. Seasonal Change in the Characters of *Aster prenanthoides*, Muhl.

IN the last number of *Biometrika* (pp. 304—315) a collection of evidence was published, showing the existence of periodic changes in the mean and modal numbers of floral organs, and in the constants expressing the variation of these numbers, in several plants. Just before the publication of this article, Mr G. H. Shull published in the *American Naturalist*, Vol. XXXVI. No. 422, an elaborate "Quantitative Study of Variation in the Bracts, Rays and Disk-florets of *Aster Shortii* Hook., *A. Novae Angliae* L., *A. puniceus* L., and *A. prenanthoides* Muhl., "from Yellow Springs, Ohio." In this paper the constants expressing the variation in and correlation between bracts, rays, and disk-florets are fully determined for each species; and in addition, the author describes the results obtained by examining four sets of flowers, collected from the same series of individuals of *A. prenanthoides* on four different days. The first of these four gatherings was made on September 27, the last on October 8; a comparison between

the four sets of results gives a remarkable and instructive demonstration of the change which may occur in individual plant characters within a short space of time. The following table, abridged from the fuller tables given by Mr Shull, shows some features of the change.

TABLE I.

Variation in Number and S. D. of Floral Organs on four different Days.

	September 27 (117 Capitula)	September 30 (143 Capitula)	October 4 (139 Capitula)	October 8 (176 Capitula)
Mean No. Bracts ...	47.410 $\pm$ 0.345	44.343 $\pm$ 0.291	43.835 $\pm$ 0.302	41.920 $\pm$ 0.249
S. D. of Bracts ...	5.524 $\pm$ 0.244	5.152 $\pm$ 0.205	5.276 $\pm$ 0.213	4.890 $\pm$ 0.176
Mean No. Rays ...	30.769 $\pm$ 0.249	28.706 $\pm$ 0.201	28.252 $\pm$ 0.200	26.335 $\pm$ 0.153
S. D. of Rays ...	3.986 $\pm$ 0.176	3.569 $\pm$ 0.142	3.501 $\pm$ 0.142	3.010 $\pm$ 0.108
Mean No. Disk-florets	56.427 $\pm$ 0.249	51.713 $\pm$ 0.232	49.158 $\pm$ 0.279	45.778 $\pm$ 0.242
S. D. Disk-florets ...	3.986 $\pm$ 0.176	4.993 $\pm$ 0.199	4.883 $\pm$ 0.198	4.777 $\pm$ 0.171

The change in mean and standard deviation of all the organs studied during the short interval between September 27 and September 30 is of especial interest in connection with the asserted multimodal distributions so often described in floral organs.

Mr Shull lays little stress on the peaks of his frequency curves, but it is worth notice that in this carefully collected material there is not a single case of a many-peaked curve in which the "modes" coincide with the numbers of the Fibonacci series, and the author criticises the process by which previously recorded "modes" are brought into accord with this series. He says "The members of the series, along with Ludwig's 'Unterzahlen,' which are 'made up from the Fibonacci numbers by multiplication or addition,—e.g., 10=(2×5), '29=(8+21) etc.,—include so large a proportion of all the smaller numbers that many modes 'must fall on or near one of them, even if there be no fundamental relation existing between 'this complex series and the number of floral parts or other organs under consideration. 'To account for modes which do not fall on any of these, Ludwig creates the 'Scheingipfel,' 'which is formed by the overlapping of curves having their modes on adjacent numbers of 'the Fibonacci-Ludwig complex. Thus, if the maximum fall on 9, it is a 'Scheingipfel' 'formed by the union of curves having maxima upon 8 and 10; if it fall upon 11, it is 'made up of curves having maxima upon 10 and 13, etc. It is evident that such a scheme 'will furnish an explanation of almost any condition which might arise."

It is to be hoped that Mr Shull's admirable essay will induce future investigators to consider more carefully the sources of error in their process of collection before they assert that even statistically significant "multimodality" is an indication of actual polymorphism in plants, and to realise the importance of prolonged study before the differences between local races can be usefully insisted upon.

W. F. R. W.