Botany. — "*The disappearance of the diploid and triploid magnicoronate narcissi from the larger cultures and the appearance in their place of tetraploid forms*". By Dr. W. E. DE MOL. (Communicated by Prof. G. VAN ITERSON JR.).

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I. *Introduction.*

Simultaneously with my investigations into the causes which lead to the immense variety of size and form in the *Hyacinthus orientalis* in Holland, I commenced a similar research with respect to the species of narcissi and narcissus-hybrids under cultivation. These comparative researches have led to some noteworthy results. One conclusion I arrived at was that, as is the case with *Hyacinthus orientalis*, the remarkable size of the bulbs, leaves and flowers which characterize the bastards of *Narcissus Pseudonarcissus* now cultivated, correspond mainly with the number of chromosomes of which, according to my cytological observations, the somatic nuclei consist.

This feature which, as far as I have been able to observe, occurs in *Hyacinthus orientalis* only in the Dutch cultures, is found both in England and in the Netherlands in *Narcissus Pseudonarcissus*, and is more pronounced than in the hyacinth. In the latter there are probably no tetraploid plants yet, whereas there are several in the *Narcissus Pseudonarcissus*.

II. *Some results of the cytological investigation.*

The preparations which I used in my cytological researches were made in the same way as those for hyacinths. The thickness of the sections is 10 or 15 μ according to the size of the cells and nuclei.

ASCHERSON and GRAEBNER (1) give the *Magnicoronati* as the 1st. section of the sub-genus *Eunarcissus*. This section is entirely formed by the class *N. Pseudonarcissus*, which they divide into 2 subclasses, *N. festalis* and *N. minor*. For convenience sake in describing the varieties studied, I shall keep to this classification, except that I shall place the sub-division *N. minor* first.

1. *N. minor.*

The somatic nuclei of *N. minor* (the type), *N. nanus*, *N. minimus* and *N. cyclamineus*, (which is best classed with the sub-species

N. minor) consist of 14 cylindrical chromosomes, 10 long ones and 10 short ones.

2. *N. festalis.*

a. Diploid varieties.

The somatic nuclei of *N. muticus* (syn. *abscissus*), *Capax plenus* (which perhaps ought to be classed under *N. minor*), *Telamonius plenus* (Double Sion, Wilmer's great double golden yellow Daffodil), large old double yellow trumpet Daffodil) also comprise 14 chromosomes which I cannot distinguish from the former ones.

b. Heteroploid varieties.

N. Johnstoni Queen of Spain possesses somatic nuclei with 20 chromosomes. In *Maximus* and *Golden Spur* these nuclei consist of 21 chromosomes, so that judging from the number these varieties are triploid.

The nuclei of *Bicolor Victoria* and *Buttonhole* (obtained from *Bicolor Victoria* by budvariation) contain 22 chromosomes. The chromosomes-garniture of both forms is the same.

The varieties *King Alfred* and *van Waveren's Giant* are, to judge from the number of chromosomes, tetraploid, for here the somatic nuclei consist of 28 chromosomes.

In all the 14 forms above-mentioned and examined, the chromosomes — both long ones and short ones — correspond in size and shape. The diploid nuclei always consist of 10 longer and 4 shorter chromosomes. I cannot yet state the exact number of long and short chromosomes of the nuclei of the heteroploid forms. To do this it is necessary to examine over 3000 good sections with dividing nuclei; I have now examined this number. Probably the longer and shorter chromosomes do not differ in length and breadth from each other, and as in *Hyacinthus orientalis* the pairs of long and short chromosomes will not be distinguishable from each other by any characteristic constant difference in form, as is described of *N. poeticus* by Stomps (3).

III. *Self-pollination in diploid, triploid and tetraploid forms.*

In contrast with *Hyacinthus orientalis*, in such categories as can be distinguished cytologically, self-pollination yields good practical results. From the few seeds of the diploid *N. minimus, minor, cyclamineus* (and *N. triandrus albus*), taken in 1913, 1914 and 1915, I have reared plants which are not distinguishable in bulb leaf and flower from the parent species.

In the case of the triploid *Golden Spur* self-pollination yielded

plants which in form and size differed from each other and from the parent species.

By means of self-pollination of the tetraploid *King Alfred* I got hundreds of seeds in 1914 and 1915. In 1916 I had about 1400 small bulbs. This spring 50 flowers came out, which differed greatly in form and size from each other and from *King Alfred*. Most of them were smaller than the parent species. The tetraploid *Van Waveren's Giant* can also be self-pollinated successfully.

IV. *Conclusion.*

1. Of the variety *Maximus* which I examined we are aware that it was already known in 1600, from which it may be inferred that even three hundred years ago there was triploidia in the magnicoronate narcissi. Triploidia must have commenced with the wild species or those again run wild, as the above-mentioned variety and *Golden Spur* (first cultivated between 1885 and 1888) were probably not obtained in nurseries (see 6). Regarding the wild variety of *N. Johnstoni Queen of Spain*, BAKER assumes that this is a hybrid between *N. Pseudonarcissus* and *N. triandrus*. If this is correct — and the bastards cultivated of these two varieties leave no room for doubt — this variety of *Queen of Spain* is in all probability a bastard between a heteroploid form of *N. Pseudonarcissus* and *N. triandrus*, as my experience shows the latter to be diploid and to possess the same chromosome garniture as the diplöid narcissi already mentioned.

2. If we keep to the classification of ASCHERSON and GRAEBNER we shall see that the feature of the heteroploidia was first seen in the genus or group of *N. Pseudonarcissus festalis major*, the diversity which by hybridization has principally yielded the large garden forms of the present day.

It is very interesting how the increase in the size of these varieties now cultivated can be traced. Up till 1885 — the diploid varieties were chiefly grown. The culture of the *Golden Spur* marks the beginning of the era of the triploid garden forms.

Bastards between *Maximus*, *Golden Spur* and other valuable kinds are grown, with the result that larger specimens have been obtained, of which *King Alfred* (England; firm of KENDALL) is the finest. From this dates the advent of the tetraploid varieties (1899).

Just as the climax in point of size of the diploids seems to have been reached in *Telamonius plenus*, and of the triploids in *Golden Spur*, the culminating point among the tetraploid forms seems to have been reached in *Van Waveren's Giant*. Nevertheless this

has been surpassed again by magnicoronate narcissi, the dimensions of which are greater in one or two respects (e. g. *Early Giant*, *Apotheose*, *Ajax Grand Vizier*, *Imperator* and *Mammoth*; (see for this the "Weekblad voor Bloembollencultuur", 32nd. Year, 1922, Nos. 85, 87, 89, 91 and 93), so that we may suppose that there are already hypertetraploid forms. In this connection the significant question arises as to whether the number of chromosomes may go on increasing indefinitely. Or, in other words: Is there any limit, and if so, where?

The same question has been asked by BEUMER with regard to the increasing size. ("Weekblad" n°. 101). In the following table some of the measurements are given in millimetres; they are nearly the same as those given in the publication of SYDENHAM (4), with the exception of those for *Mammoth*, which are mentioned in "Weekblad", n°. 93.

Name of variety	Diameter perianth	Tepals		Paracorolla		Number of chromosomes
		length	breadth	length	breadth	
Queen of Spain	82	35	15	28	28	20
Bicolor Victoria	101	44	35	44	44	22
King Alfred	107	40	28	44	50	28
Van Waveren's Giant	127	50	38	50	50	28
Mammoth	140	?	?	55	60	?

3. It goes without saying that I cannot now sacrifice the plants that I have obtained from *King Alfred* and *Golden Spur* for a cytological examination. But even without this examination it seems to me highly probable, especially when I test these observations by those conducted by WINKLER with *Solanum* (5) and those of VAN OVEREEM with *Oenothera* (2), that these conspicuous differences in form and size are primarily due to an unequal distribution of the chromosomes in the reduction-dividing of which an unequal combination of the sex nuclei is the inevitable result.

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Plant physiological Laboratory of Prof. ED. VERSCHAFFELT,
Hortus Botanicus, at Amsterdam.