order 7 into their squares in one of the two conformal groups. In the other group the reverse is true. Hence it is not possible to establish a simple isomorphism between the operators of these two groups. In view of the elementary properties of these groups it appears strange that the wide-spread error noted above was not corrected for more than a quarter of a century, especially since the incorrect results obtained by O. Hölder have been used by various writers in extending his work.

THE GLOBE, A SIMPLE TRISOMIC MUTANT IN DATURA
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Communicated by C. B. Davenport, March 10, 1921

In a series of articles already published,\(^1\),\(^2\),\(^3\) or at the present writing in press (American Naturalist, Genetics), a number of recurrent mutants discovered in the Jimson Weed (\textit{Datura Stramonium}) have been described and their peculiarities in external appearance shown to be connected with the presence of one or more extra chromosomes in their nuclei. Evidence has been presented which indicates that a given mutant of the "simple trisomic" type is conditioned by the presence of a single extra chromosome in a specific one of the 12 chromosomal sets. Such a form is called a simple trisomic mutant since in its somatic nucleus one of the 12 sets is a trisome with three homologous chromosomes instead of all the sets being di- somes with two chromosomes each. The presence of an extra chromosome in a specific chromosomal set not only causes specific peculiarities in the growth and appearance of the mutant which results, but also brings about peculiarities in the inheritance of the mutant complex.

It is the purpose in the present paper to summarize the findings in regard to one of the simple trisomic mutants—the Globe—in anticipation of a more detailed paper to be published shortly in Genetics. The data were accumulated for the most part before the chromosomal condition in the Globe and other simple trisomic mutants had been determined by my colleague, Mr. John Belling, from studies of mitotic figures in the pollen mother cells.

The Globe was the first mutant recognized in the Jimson Weed, having been discovered in 1915. Its depressed globose capsules suggested the name. Its adult characters as well as the broad entire leaves of its seedlings render the Globe one of the easiest mutants to recognize at any stage of development. It is the only one in fact that we have been able to pick out readily in the seed pan. Since usually it has not been necessary to grow plants beyond an early seedling stage when it is desired to distinguish Globes from normals, it has been possible with this mutant to base conclusions on a larger number of individuals than could readily have been obtained if we had been dealing with the other mutant forms.
The Globe mutant differs from normals apparently in all parts of the plant. It shows a complex of characters readily recognized, whether the plants in question have purple or white flowers, many or few nodes, and spiny or smooth capsules. Globes, like other mutants of this type, are slower in growth than normals; and in competition with normals are liable to be crowded out by them.

**TABLE 1**


<table>
<thead>
<tr>
<th>ORIGIN OF SEED</th>
<th>SEEDS PARENTS</th>
<th>SEEDS PLANTED</th>
<th>SEEDLINGS</th>
<th>PER CENT SEEDLINGS</th>
<th>GLOBES</th>
<th>NORMALS</th>
<th>PER CENT GLOBES</th>
<th>RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globe</td>
<td>27</td>
<td>3015</td>
<td>1782</td>
<td>59.10</td>
<td>400</td>
<td>1382</td>
<td>22.45 = 0.676</td>
<td>1:3.46</td>
</tr>
<tr>
<td>Selfed</td>
<td>27</td>
<td>2628</td>
<td>1935</td>
<td>73.63</td>
<td>500</td>
<td>1453</td>
<td>25.84 = 0.671</td>
<td>1:2.87</td>
</tr>
<tr>
<td>Globe x Normal</td>
<td>27</td>
<td>2771</td>
<td>1812</td>
<td>65.39</td>
<td>53</td>
<td>1759</td>
<td>2.92 = 0.269</td>
<td>1:33.19</td>
</tr>
</tbody>
</table>

Percentage difference between offspring from Globe Selfed and from Globe x normal =3.39 = 0.935. Diff./E. Diff. = 3.59.

Early breeding work with the Globe indicated that the manner of its inheritance was not in accord with any simple Mendelian interpretation. A more extensive series of selfs and crosses was therefore carried out in order to determine more accurately the extent to which the Globe complex could be transmitted. In table 1 is presented a summary of the experiment. In this table are given the number of seeds planted and the percentage of recordable seedlings which they produced. It is obvious that a difference exists between the inheritance through the male and that through the female parent. The egg cells of Globes, whether fertilized by Globe pollen or by pollen from normal plants, transmit the Globe complex to only about 25 per cent of the offspring. Globe pollen, when used on normal plants, transmits the character to only about 3 per cent of the offspring. This figure, though small, is too large to be accounted for by the occurrence of new Globe mutations, in view of the rarity of Globes from normal parents in comparable material. The normal offspring of Globes seem to be true normals so far as their breeding behavior is concerned.

If 3 % represents the average number of Globe pollen grains which transmit the mutant character, we should expect a higher proportion of Globe offspring when Globe pollen is used than when pollen from normals is used on Globe females. The reverse, however, is actually the case, and Globes selfed produced a lower percentage of mutant offspring than Globes pollinated by normals. The explanation may possibly be connected with a difference in vitality between seedlings produced by self and those produced by cross pollination. The fact is at least suggestive that a lower per-
The first mutation found in 1915 is not included. Under "type," "P" stands for the Mendelian character purple and "W" for white, "AR" for armed capsules and "IN" for inermis, "M" for many nodes and "F" for few nodes.

The percentage of recordable seedlings was obtained when Globes were selfed than when they were crossed with normals.

Simple trisomic mutants produce dimorphic gametes with 12 and 13 chromosomes instead of gametes with uniformly 12 chromosomes as is characteristic of normals. Two types of egg cells should be produced in equal numbers and, on the assumption that in general only pollen grains with 12 chromosomes are able to assist in fertilization, an equal number of Globes and normals should appear in the offspring of Globes. That mutants and normals are not thrown in equal numbers is probably due to the weaker vigor of the mutant zygotes.

From the foregoing, it is concluded (a) that the mutant complex is transmitted primarily through the egg cells and (b) is transmitted not at all or only to a slight extent through the pollen; (c) that the deviation in the offspring from an equality of Globes and normals is due to the lessened vitality of the mutant forms; (d) that the higher percentage of Globes obtained by crossing Globes with normals, over selfing, is due to an increased vigor brought about by the cross.

Simple trisomic mutants are characterized by a considerable proportion of defective pollen grains. The Globe has about 8 per cent bad grains...
### TABLE 3

**Occurrence of New Globe Mutations from Mutant Parents**

<table>
<thead>
<tr>
<th>PARENT</th>
<th>MUTANT SELFED SEED</th>
<th>MUTANT X NORMAL SEED</th>
<th>NORMAL X MUTANT SEED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PAR.</td>
<td>NOR. GLOBES % GL.</td>
<td>PAR.</td>
</tr>
<tr>
<td>Poinsettia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>var. Wiry</td>
<td>11 968</td>
<td>4 0.41</td>
<td>5 389</td>
</tr>
<tr>
<td>Cocklebur</td>
<td>20 1859</td>
<td>1 0.05</td>
<td>8 1047</td>
</tr>
<tr>
<td>Ilex</td>
<td>8 855</td>
<td>0 0.00</td>
<td>5 538</td>
</tr>
<tr>
<td>Mutilated</td>
<td>16 871</td>
<td>1 0.11</td>
<td>8 351</td>
</tr>
<tr>
<td>Sugar Loaf</td>
<td>8 413</td>
<td>1 0.24</td>
<td>3 367</td>
</tr>
<tr>
<td>Rolled</td>
<td>8 705</td>
<td>1 0.14</td>
<td>2 222</td>
</tr>
<tr>
<td>Reduced</td>
<td>6 707</td>
<td>2 0.28</td>
<td>1 127</td>
</tr>
<tr>
<td>Buckling</td>
<td>8 856</td>
<td>1 0.12</td>
<td>1 106</td>
</tr>
<tr>
<td>Glossy</td>
<td>7 897</td>
<td>1 0.11</td>
<td>1 143</td>
</tr>
<tr>
<td>Microcarpic</td>
<td>18 994</td>
<td>1 0.10</td>
<td>5 178</td>
</tr>
<tr>
<td>Spinach</td>
<td>13 625</td>
<td>8 1.26</td>
<td>3 187</td>
</tr>
</tbody>
</table>

**Totals** 125 9939 21 0.211 43 3670 12 0.326 29 5396 5 0.093

= .031 = .064 = .028

Percentage difference between offspring from mutant selfed and mutant x normal = 0.115 ± 0.071. Diff./E. Diff. = 1.62.

Percentage difference between offspring from mutant x normal and normal x mutant = 0.233 ± 0.070. Diff./E. Diff. = 3.33.

which is the lowest average for any of the Datura mutants of this type yet investigated. Normal plants show only about 2.7% of defective grains.

Before the cause of the Globe mutation was discovered, an attempt was made to increase by selection the proportion of Globes in the offspring of selfed Globe parents. Globes were accordingly inbred for ten generations but the proportion of mutants and normals in the offspring was not noticeably affected.

Inasmuch as the Globe is one of the most readily recognized of all the Datura mutants and has been sought for in our cultures since its first appearance in 1915, it is possible to give more reliable figures in regard to the frequency of its new appearance than could be done for the mutants discovered later. In table 2 is summarized the occurrence of Globe plants in offspring from selfed parents of the 19 different main lines. The various lines have the color, spine and node characters indicated in the table. It is seen that new Globe mutations have occurred in all the lines considered together in about 0.05% of the offspring which is about one out of 2000 individuals. The offspring from crosses between main lines have shown new Globe mutations in about the same proportion as in the main lines themselves.

We have just discussed the occurrence of Globe mutations from normal parents. It will be of interest to consider the occurrence of this mutant from parents belonging to the other mutant forms. In table 3 are shown
the percentages of new Globes that have occurred from selfing the various mutants and from crossing them reciprocally with normals. The percentage of Globes appears to be somewhat higher than from the main line parents. It is of interest to note that when mutants are used as males in crosses with normals, the percentage of Globe mutations is reduced to about the average expected from the assemblage of main line parents. A comparison of table 3 with table 1, however, will be instructive and lead us to the conclusion that the egg cell is not only more effective in transmitting the mutant character, once it has arisen, but is also more effective in originating these mutations than is the pollen grain.


STUDIES OF MAGNITUDES IN STAR CLUSTERS
XIII. VARIABLE STARS IN N. G. C. 7006

BY HARLOW SHAPLEY AND BEATRICE W. MAYBERRY

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Communicated by G. E. Hale, March 22, 1921

The faintest and most distant variable stars on record have been found on photographs of the globular cluster N. G. C. 7006 made with the 60-inch and 100-inch reflectors at Mount Wilson. The new variables are of considerable value in measuring the size of the galactic system, because they are members of one of the remotest stellar groups now known and serve to determine its distance and dimensions.

The position of the cluster for 1900.0 is:
R.A. = 20° 56' 8", Decl. = +15° 48'

Its galactic coördinates are:
β = -20°, λ = 32°

and its apparent diameter on the Franklin-Adams charts is three-fourths of a minute of arc.

By the usual photometric methods for determining the distances of globular clusters, the parallax of N. G. C. 7006 has been estimated to be:

\[ \pi = 0'.000015, \text{from the parallax-diameter correlation.} \]
\[ \pi = 0.000014, \text{from photographic magnitude of brightest twenty-five stars.} \]
\[ \pi = 0.000016, \text{from photovisual magnitude of brightest thirty-eight stars.} \]
\[ \pi = 0.000016, \text{from integrated visual magnitude.} \]

The foregoing accordant results make it fairly certain that N. G. C. 7006 is somewhat more distant than any other globular cluster in the present lists;