FLORAL TERATOLOGY IN LILIUM, DATURA, LATHYRUS, RIBES, HEMEROCALLIS, HEPATICA, AND MYOSOTIS

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Flowers, of the genera mentioned in the title, exhibiting peculiar and interesting abnormalities, were collected from plants found in or near Evanston, Illinois, in 1927. With the exception of *Hemerocallis,* only a single plant of each species was observed to produce abnormal flowers. However, many cases of the "double-flowered" *Hemerocallis* were observed, and a detailed study of fifteen such flowers is included in this report.

The abnormalities observed in the various flowers consist of deviation from the typical number of parts and malformation of structures. The causes of these monstrosities are not known, since the plants were not subjected to experimentation, though in some instances certain environmental conditions, such as temperature, suggest the possible stimuli.

Lilium longiflorum L.

Among the many Easter Lilies used in the exhibit of spring flowers at the Garfield Park Conservatory, Chicago, a single abnormal plant was noted. The stem was about four feet high and fasciated. It produced six flowers, two of which were normal in every respect, while the other four showed deviation from the typical number of parts and malformation of structures. Since the variation in each was individual, the flowers are described as A, B, C, and D. (Plates I and II.)

Flower A had seven perianth segments, of which five were typical (figure A). Two segments were smaller and otherwise abnormal. One of these was united with a normal segment along one margin and free on the other. The free margin was thickened, being rolled back at the midrib and having a flap-like lobe extending inward for nearly its entire length. The other abnormal segment, which was free as far as the receptacle, was inrolled, had several lobes of tissue, and along one margin for a short distance a pollen sac (figure 2). There were five stamens, four normal ones and one which had a slightly blade-shaped anther. The pistil

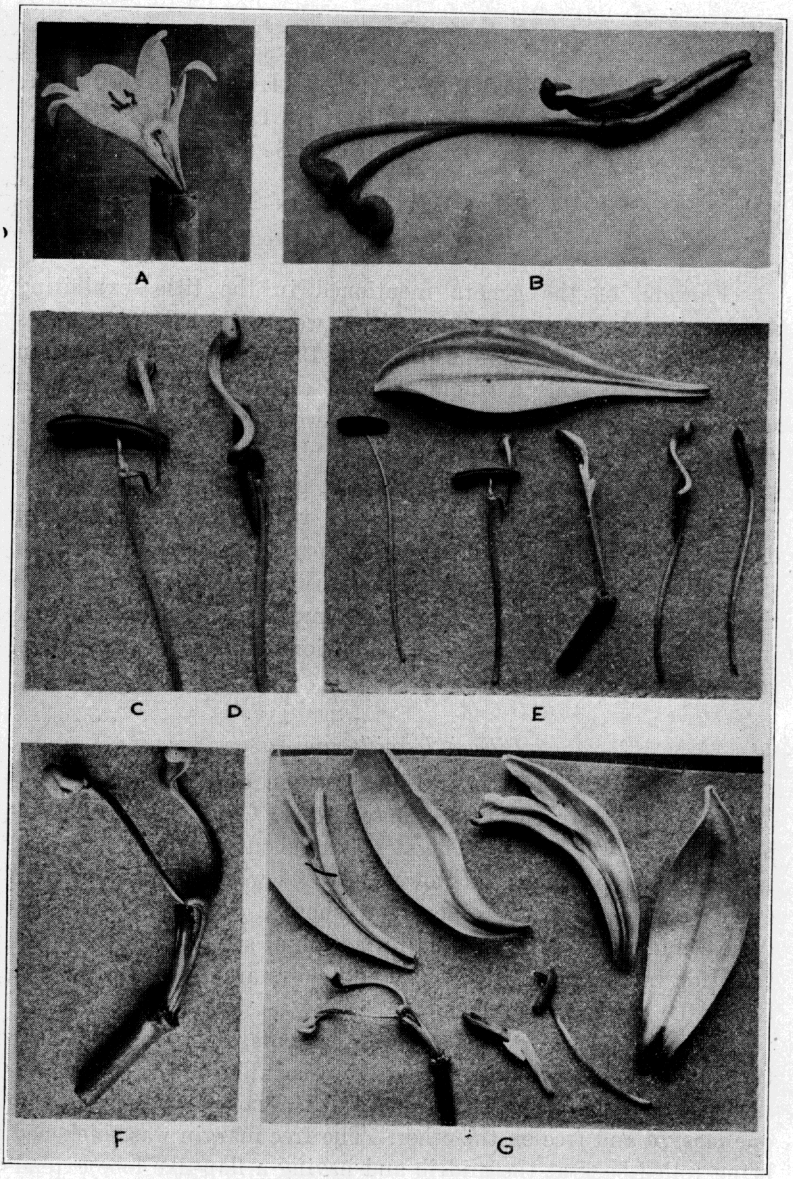

Plate I.

Photographs, showing the abnormal structures of the *Lilium longiflorum* flowers, some of which are shown in detailed drawings on Plate II.

FIG. A. Flower A before dissection.
FIG. B. The pistil of flower A.
FIGS. C-D. Stamens from flower D.
FIG. E. Structures of flower D.
FIG. F. The pistil of flower C.
FIG. G. Structures of flower C.

was quite unusual in bearing two styles with very large stigmas; and on the ovary one of the carpels was extended above the middle region into an elongated horn-shaped protuberance bearing pollen in a depression on its surface (Plate I, figure B, and Plate II, figure 3).

Flower B had six perianth segments, which were parted all of the way to the receptacle. One of them had a smaller petal-like lobe produced from its midrib and extending for more than half of its length. Otherwise the flower was normal.

Flower C had five perianth segments, two of which were of typical shape but free to the base. Two others were small, coalesced along two-thirds of their length, and very much thickened along the line of union. The fifth segment was lobed and had one inrolling margin. There were only two stamens and both were malformed. One (figure 4) had a short wide filament with a wing extension of petal-like tissue from which an anther protruded. Below this anther and along one side of the broadened filament another smaller atypical anther was formed. In the other stamen the filament was somewhat flattened, becoming broader at the base and producing pollen sacs which were split into two completely separate halves. The pistil was also malformed, being open near the apex and twisted to form a two-lobed apex exposing small ovules along its inner margin (figure 5). Styles arose from the two apical lobes and each produced an enlarged stigma which was split along one side. (Plate I, figures F and G.)

Flower D had six typically-shaped perianth segments that were slightly narrower than average, and free and distinct to the base. The pistil was lacking. Of the four stamens present, one was practically normal. The second had two white lobes on the filament, a small one arising a short distance below and a broader blade-like one just below the anther (figure 6). The third and fourth stamens produced stigmas on long style-like filaments branching from the connectives of large anthers (figures 7, 8). These stigmas were large and in general like those on the abnormal pistils in flowers A and C. (Plate I, figures C, D, and E.)

The cause of these monstrosities, on a plant which produced two normal flowers, is not known. The plants were grown in the propagating houses of the conservatory and may have been forced for early blooming. This was the only plant of several hundred examined that showed any apparent deformations.

There is little reference to monstrosities of *Lilium longiflorum* in the literature. Penzig (1894) states that Lynch (Gard. Chron.,

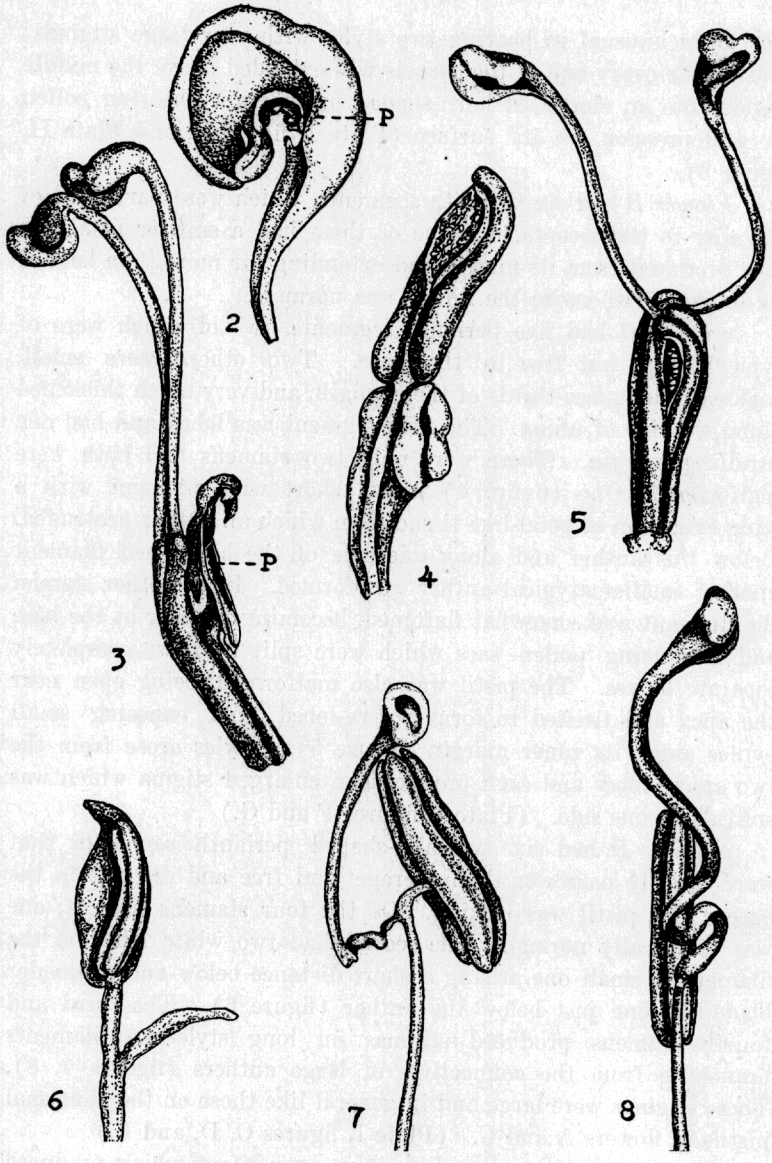

Plate II. Abnormalities of *Lilium longiflorum*.

Fig. 2. The single inrolled petal of flower A showing pollen on one margin P.

Fig. 3. The pistil from same flower, with two styles and pollen sac P extending from one carpel.

Figs. 4–5. Malformed structures of flower C.—*4*. Unusual stamen producing a second anther from the filament. *5*. A pistil split and exposing ovules near lobed apex.

Figs. 6–8. Monstrous stamens from flower D.—*6*. Stamen with white petal-like outgrowths. *7, 8*. Styles with stigmas arising from the connectives of anthers.

1886, II, p. 628) observed a flower with perianth segments parted to the base. Masters (1869) reports pistillody of the stamens in this species.

Datura fastuosa var. *alba,* Clarke

Late in the fall a single plant, which had appeared as a weed in a flower-bed on the campus of Northwestern University and was thought at first to be *Datura Stramonium* L., was noted to produce two blossoms of the hose-in-hose, or cornucopia type. The corollas were 5½ and 6 inches long, thus exceeding the maximum figure given for *Datura Stramonium.*

These flowers, designated here as *E* and *F,* had two corollas; the inner in each case was longer, more lobed, and much wider—and therefore folded within the outer tube. Upon dissection both of the flowers were found to have abnormal androecia.

Flower E had three narrow filaments and a single wide, branching one that was united with the inner corolla tube near the base (figure 9). Of the three narrower filaments, one had no anther and showed no evidence of ever having produced it, another formed practically a normal stamen, and the third possessed a thin, white, lobe-like outgrowth slightly below the anther. The fourth, or wide, filament was double, being fused along three-fourths of its length, then branching. On one branch there was a normal anther and below it on the filament was a small petal-like extension. The other branch produced two normally-shaped anthers at the apex of the filament. A sixth anther of an abnormal type was attached directly to the corolla tube (figure 9).

Flower F had five anthers, all of which were deformed. They were attached either on the lobes or at the sinuses of the inner corolla. On the tube, extending from the base to the anthers, were thickened ridges corresponding to filaments.

In both blossoms the pistils were of the usual type. The plant had other small buds, but these were dropped when the plant defoliated after being brought into the greenhouse to avoid frost. Although new leaves formed, there is no evidence of flower buds to date, so that it can not be determined whether all of the blossoms of the plant would be of an abnormal type.

The occurrence of a second or even a third corolla is reported to be fairly common among the Daturas, especially *Datura fastuosa.* Bailey (1914) states that this condition is likely to appear in practically any species. Wordsdell (1915) describes briefly a case cited by Goebel in which the androecium and

gynoecium were imperfectly formed in a flower having four corollas. According to Masters (1869) "some forms of duplicate or hose-in-hose corollas are apparently due, not so much to the for-

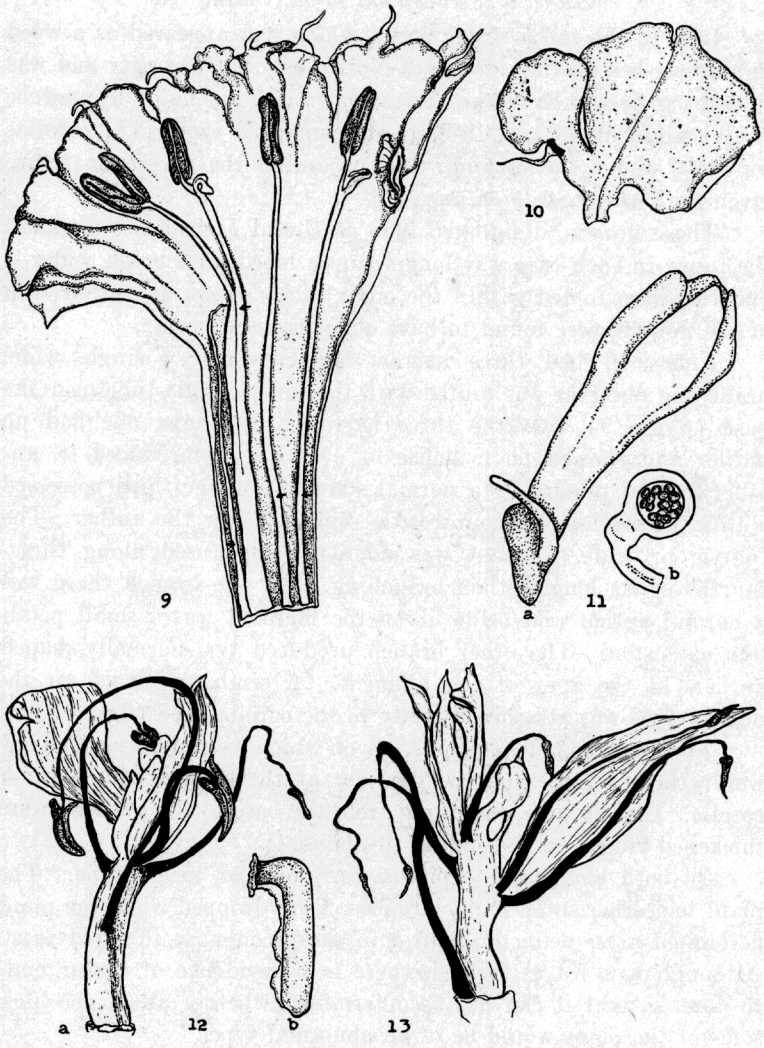

Plate III.

FIG. 9. The inner corolla of hose-in-hose *Datura* split open to show the abnormal stamens. The arrows mark the extent of the adherence of the filaments to the corolla tube.

FIG. 10. Standard of sweet pea flower showing pollen sac produced on lobe.

FIG. 11. Abnormal flower of *Ribes aureum*. a– habit sketch. b– c. s. of the ovary at the region of the outgrowth.

FIGS. 12, 13. Prolificated axes of *Hemerocallis* flowers bearing perianth segments and stamens. 12b. The central petaloid structure of the flower.

mation of a second corolla within the first, as to the presence of an inner series of petal-like stamens which, by their cohesion, form a second pseudo-corolla within the first. The staminal nature of this pseudo-corolla is inferred from the occasional presence of anthers on it." This seems very likely in this instance, as pollen sacs were found on the inner corolla in each case.

Lathyrus odoratus L.

Among some sweet peas obtained from a local florist a flower was noted in which the standard was enlarged and lobed. On the lobe a small pollen sac was produced from which extended a small elongated lobe of the same color as the petal (figure 10). Otherwise the flower was typical.

Ribes aureum Pursh.

On one of the numerous plants of *Ribes aureum* which grow on the campus of Northwestern University, a single blossom was noted to produce a peculiar horn-like outgrowth of the ovary (figure 11a). Upon examination this was found to be an inrolled petaloid structure of the same color as the sepals and about the same length as the ovary. It originated at about mid-point on the ovary, and a cross-section at this region showed it to be a continuation of the ovary wall (figure 11b). All other features of the flower were normal.

Hemerocallis fulva L.

Many cases of double flowers on *Hemerocallis fulva* were observed in gardens in Evanston, North Shore suburbs, and Chicago. Others were noted in South Dakota and Michigan, and along the roadside in Iowa they were found growing among plants which produced the single-type flowers. This condition was first noted among a row of many plants in the Botany Garden on the Evanston Campus. The first few flowers, opening about mid-July, were single and apparently otherwise normal. These plants, which had blossomed abundantly in previous years producing the single-type flowers, continued to bloom throughout the summer and to form only the double variety. However, they were not as prolific this season and many plants showed no indication of flowering. Those which did bloom were tagged and found to produce from several to numerous double flowers, a new one each day until the last bud had expanded.

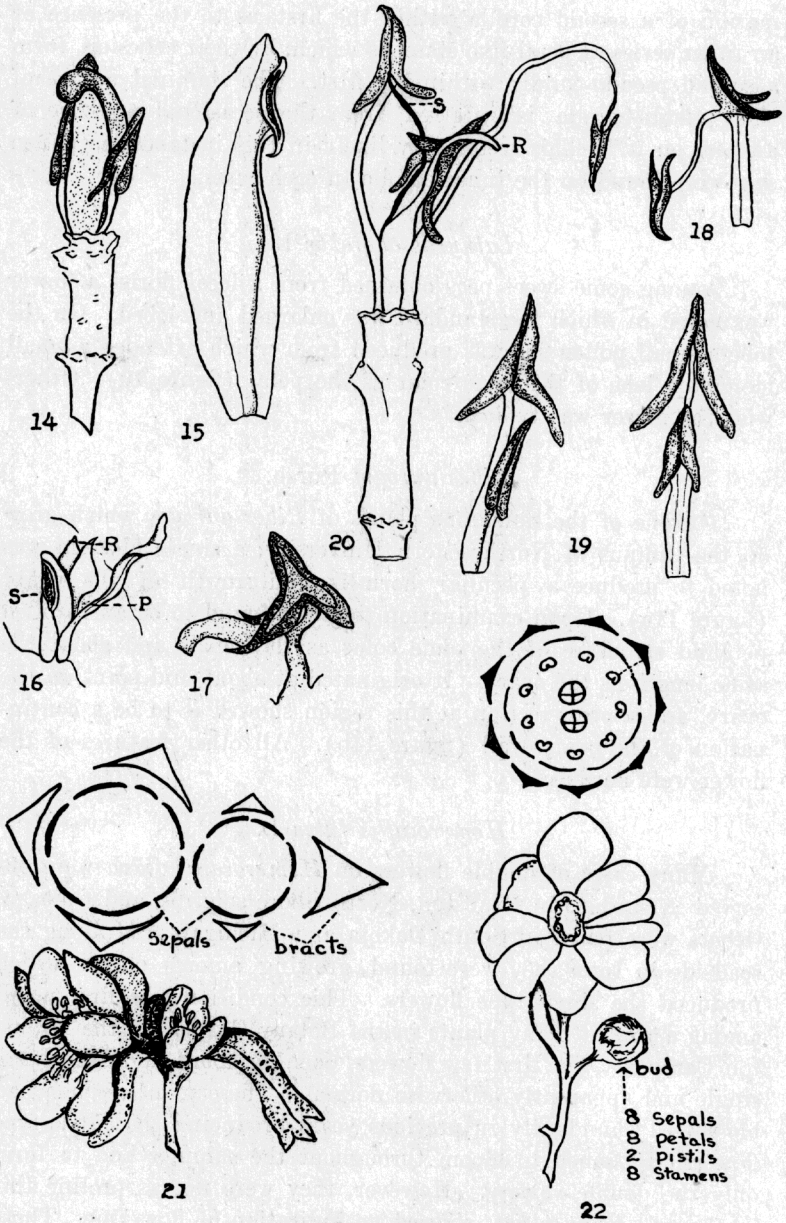

Plate IV.

FIGS. 14–20. Abnormal stamens of *Hemerocallis fulva*. *14*. From flower No. 5 showing inrolled terminal structure and two atypical anthers. *15*. Anther on a perianth segment from No. 4. *16*. Pollen sacs., attached to perianth segment, split open and showing a petal-like extension P from the vase of one sporangium; R-two extensions of perianth tissue. *17*. Anther from No. 3, with extension of the connective. *18*. Stamen from No. 14,

Pistils were lacking in every case. The perianth segments were all free and often had ragged margins, especially the inner ones.

Fifteen flowers were carefully studied and the results are shown in the accompanying tables.

As seen in Table II, there seems to be a fair correlation between the number of parts produced on the receptacle and the number on the elongated axis or stalk. Seven of the fifteen flowers had a total of 23 floral parts, whereas the others varied in having from 20 to 25. There seemed to be no general rule concerning the number of anthers, either on filaments or on perianth segments. The number on filaments, in the individual flowers, varied from 4 to 14, and those on the perianth segments from 1 to 7. The minimum number of anthers in any one flower was 9, which occurred in four cases, and the maximum number was 14. Six stamens on the receptacle, the normal number for this plant, were observed in only two cases. In Table II it will be noted that the number of abnormal perianth segments, which generally had anthers on them, added to the number of stamens on the receptacle, makes a total number of 6, in five cases, which suggests that petaloidy of stamens was probably the cause of the abnormal perianth segments.

Abnormality of stamens other than unusual position and lack of filaments, was frequently observed. Some of these peculiarities are shown in figures 14 to 20.

At the terminal of the prolificated axis there were usually found several small pale-orange segments which were often rolled inside one another (figures 12, 13, 14). Occasionally these petal-like structures were absent near the apex and stamens terminated the stalk (figure 20).

The peculiar formation in these flowers is probably similar to the condition which Penzig (1894) states was observed by Godron.

Grier (1918) reports six double flowers of *Hemerocallis fulva,* collected at Kirkwood, Missouri, in which the perianth was composed of distinct segments, but definitely twelve. Likewise, there

with second anther produced on a filament arising from connective tissue. *19.* Two views of same stamen, showing a second anther produced on the filament below the first. *20.* Central structure of No. 7, showing two abnormal stamens. R– connective of peculiar stamen which extends beyond the pollen sacs. S–a thin filament which extends from the connective of the anther under a lobe of another anther to the base of the latter's filament, firmly united at both ends.

FIG. 21. Habit sketch and floral diagram of an abnormal *Hepatica.*

FIG. 22. Habit sketch and floral diagram of an abnormal *Myosotis* flower.

TABLE I—NUMBER AND CHARACTER OF PARTS OF FLOWERS OF HEMEROCALLIS FULVA L.

Flower No.	On receptacle			On stalk			Character of the terminal structures
	Perianth segments without anthers	Perianth segments with anthers or otherwise abnormal	Normal stamens	Perianth segments	Normal stamens	Abnormal stamens	
1	7	2 half length, with thickened midrib.	4	6 light orange petal-like.	4	1, attached on abnormal petal. (figure 16).	Thickened incurved greenish envelope open along one side and with a loose ruffle of tissue on one margin, terminating in an orange colored disk. (figure 12b.)
2	7	2 as in A.	3	1 pale orange broad petal-like.	6		5 small pale orange segments (figure 13).
3	7		6		7	1, abnormal in shape and with a peculiar extension on one side (figure 17).	2 inrolled light orange colored petal-like structures.
4	7	2 as in A and with anthers (figure 15).	3	5 large (2 with anthers). 1 small with anther.	1 small		2 yellowish contorted small leaf-like structures with anthers.
5	6		5	6 (2 with anthers).	1	2, filaments short anthers atypically shaped.	2 segments, one pale orange, other green, infolded around a central immature anther (figure 14).

TABLE I—Continued.

Flower No.	On receptacle			On stalk			Character of the terminal structures
	Perianth segments without anthers	Perianth segments with anthers or otherwise abnormal	Normal stamens	Perianth segments	Normal stamens	Abnormal stamens	
6	6	2 as in D.	4	3	5		Elongated thickened central structure enclosed by inrolling of 2 small orange petal-like segments.
7	6	4 with anthers.	2	3 (2 with anthers).	3	2, forming central structure.	One stamen fairly normal in shape but with a long filament extending from connective to filament of another stamen where it was attached on other stamen. The connective was elongated into a horn-like protuberance and pollen sacs were atypical in shape. (figure 20).
8	9		3	2 small (with anthers).	4		Inrolled petal-like structures with three other segments closely inrolling (with anthers).
9	7		4	3	6		2 inrolling perianth segments.
10	7	2 with anthers.	3	2	4	2	3 central perianth segments (2 with anthers).

TABLE I—Concluded.

Flower No.	On receptacle			On stalk			Character of the terminal structures
	Perianth segments without anthers	Perianth segments with anthers or otherwise abnormal	Normal stamens	Perianth segments	Normal stamens	Abnormal stamens	
11	7	1 with anther.	5	6 (3 with anthers).		2	As in E.
12	7	1 with anther.	5	7 (3 with anthers. 1 abnormal and with anther).	1		2 inrolled pale orange perianth segments.
13	7		5	4 (1 with anther).	5	1	1 curved and inrolled small perianth segment.
14	7		4	3	4	2, producing a second anther from the connective in one case and filament in other (figures 18 and 19).	3 small yellowish segments (2 with anthers).
15	6		6	6 (2 with anthers).		1	Single inrolled perianth segment.

were twelve stamens. The styles were two and mostly aborted to a C-shaped or claw-shaped appendage, and the ovules were usually minute.

The presence of only single flowers in former years in the Evanston garden, and likewise in a garden in Glencoe, and the appearance this season of only the double variety (with the exception of the very few which bloomed first in the Evanston garden), raises the question whether these plants should be classified as *Hemerocallis fulva* var. *Kwanso,* Hort. It seems more likely that in this case the plants were not the horticultural variety called the double orange lily, but that the doubling and accompanying deformations which appeared in either cultivated or wild plants of *H. fulva* were caused by a stimulus or stimuli so far undetermined. Temperature may have been the causal factor, as a long cool spring was characteristic of all localities where this phenomenon was observed. During the summer of 1928 double flowers again appeared, on the plants in the Botany Garden, which showed the same type of abnormality. Such flowers, however, were not as abundant as the previous year.

TABLE II—SUMMARY OF NUMBER OF PARTS OF FLOWERS IN TABLE I.

Flower No.	Total structures			Stamens		Stamens and abnormal perianth segments on receptacle		
	On receptacle	On central axis	Total	On filaments	On perianth segments	Perianth segments *Anthers	Stamens	Total
1	13	12	25	8	1	2	4	6
2	12	12	24	9	0	2	3	5
3	13	10	23	14	0	0	6	6
4	12	9	21	4	7	2*	3	5
5	11	11	22	8	2	0	5	5
6	12	11	23	9	2	2*	4	6
7	12	8	20	7	6	4*	2	6
8	12	10	22	7	5	0	3	3
9	11	11	22	9	0	0	4	4
10	12	11	23	9	4	2*	3	5
11	13	10	23	7	4	1*	5	6
12	13	10	23	6	5	1*	5	6
13	12	11	23	11	1	0	5	5
14	11	12	23	10	2	0	4	4
15	12	8	20	7	2	0	6	6

Hepatica triloba Chaix.

Late in April a peculiar Hepatica was brought in from an Evanston garden. Only one such case was found in this garden and an extensive search for similar or otherwise abnormal blossoms among wild plants brought no results. The flower stalk in this instance bore two blossoms, one of average size and in its axis a much smaller one (figure 21). The larger of the two flowers had three involucral bracts of normal size and appearance, while the smaller flower had two bracts of proportionate size and a third which was about four times the length of the other two and leaf-like in appearance. The larger flower had six large sepals and one small sepal, while the six sepals of the smaller flower were approximately the same in size (figure 21). Stamens and carpels were many, as is typical for the species.

Myosotis scorpioides L.

Two abnormal flowers were found on a plant which was purchased at a local florists in January. This plant had undoubtably been forced. However, the method of forcing is not known, and even if it was the cause of these malformations it could not be considered general, since only this one flower stalk, among a great many examined at this and later times, showed abnormalities.

A flower and one bud exhibited deviation from the normal, chiefly in the number of floral parts. The flower (figure 22) had 9 sepals, 9 petals (2 of which were only one-half the average size), 9 stamens, and 2 pistils with 4 nutlets each. The bud had 8 sepals, 8 petals, 8 stamens, and 2 pistils. All other flowers and buds on this plant produced the typical number of parts and were otherwise normal.

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