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-- SEEDS AND SEEDLINGS OF BRASSICA. --

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Object of Investigation.- The cabbage plant, *Brassica oleracea*, presents us with a wider range of varieties than perhaps any other cultivated plant. There is no other of our garden vegetables which gives so many useful forms as it does. In the wild state it is found on the coasts of western Europe, and persons familiar only with the garden forms would, most likely, not recognize it. Seedlings of the wild plant grown in rich soil show great variations. Selection of these variations has resulted in a number of races, each with numerous varieties. At maturity these races differ very markedly in certain characters. It is not difficult to appreciate the difference between the green and the red cabbage with great single heads; Brussel-sprouts with numerous little heads; broccolis and cauliflowers with the greater number of their flowers in an aborted condition, incapable of producing seed and borne in a dense corymb instead of in an open panicle; Savoy with their blistered and wrinkled leaves; and borecoles and kales which come nearest to the wild parent form. Now the seeds of these races are uniform to a degree. Seen in mass some are a little lighter or darker, some are smaller or larger than usual, but in no case are there any distinguishable markings. As there are no distinguishable features in the seeds, the question we are concerned with is; How soon in the life history of the plants does differentiation begin.

Races.- We studied representatives of the following species of *Brassica*: *oleracea*, *napus*, *campestris*, *rapa*, and *pe-tsay*. Of these the species *oleracea* presents the greater and most interesting variety of forms. It is well, therefore, to enumerate the

varieties now recognized. But first let us say that the species other than that of oleracea were studied chiefly as checks on the work. Bailey gives (1900) the following varieties of Brassica oleracea: acephala, kales and collards; gemmifera, Brussel-sprouts; capitata, true cabbage, and caulo-rapa, kohlrabi.

Dr. Lindley's system of classification, founded on the state of development of the terminal and lateral leaf buds, is the most satisfactory one from a botanical standpoint. It follows: I.-All leaf buds active and open as in the wild cabbage, kale, etc. II.-All leaf buds active, but forming heads, as in Brussel-sprouts, etc. III.-The terminal leaf bud alone active, forming a head, as in common cabbage, Savoy, etc. IV.-Terminal leaf bud alone active and open, with most of the flowers abortive and succulent, as in the cauliflower and broccoli. V.-All the leaf buds active and open, with most of the flowers abortive and succulent, as in the sprouting broccoli.

The races of the cabbage plant furnish a good illustration of the manner in which a single plant may vary in cultivation, and be thus adapted to different seasons and uses. The principal races will now be briefly discussed.

KALE never makes a head, but only a cluster of loose leaves, in different sorts beautifully cut and curled, and often presenting fine colors. This is a very useful but neglected race.

In the SAVOY CABBAGES we have the leaves broader, still much curled and wrinkled but formed into a more or less compact head. It is the richest of all cabbages, and is distinct in appearance and flavor from the other forms of cabbages. They are late and stand severe frosts.

In the CABBAGE PROPER are a great number of varieties differing in season of maturity, shape of head, etc. Many varieties,

though differing in one point, are essentially the same. The red cabbage as a class is to be distinguished from the common green cabbage. The leaves of the red cabbages are dark purple and those of the head bright red. The heads are small, but usually very solid, and are especially esteemed for use as cold slaw.

In the CAULIFLOWER and BROCCOLI, which are very much alike, the leaves do not fold, but surround a center which is a mass of fleshy flower stems and undeveloped flower-buds, all so closely crowded together that their parts are not distinguishable.

BRUSSEL-SPROUTS present a curious variation. The stem grows tall and, instead of producing a head at the top, it forms a great number of small heads, about the size of walnuts, along the stem.

KOHLRABI shows a remarkable variation from the normal form of the species' type as represented by the cabbage. The leaf is rejected, but the stem, which swells out like a turnip, is the edible portion. Thus it comes between the cabbage and the turnip.

Botanical History of Brassica Oleracea:- CABBAGE, Brassica oleracea capitata DC., common green cabbage.- The headed cabbage is of ancient origin. There is an unmistakable reference to a cabbage in a work by Ruellius in 1536. De Candolle divides our present cabbages into five types or races, -flat-headed, round-headed, egg-shaped, elliptic and conical. There are now perhaps seventy-five varieties not including the Savoy. Flat-headed Cabbage.- First authentic appearance in 1673. There are varieties of this now that are remarkably flat and solid. Round Cabbage.- This is the earliest known form of cabbage. It was the principal sort, if not the only one, known during several centuries. About the first known description is dated 1542. Egg-Shaped Cabbage.- First known mention was made in 1726. Not commonly grown. Elliptic Cabbage.- First mentioned in 1765.

Said to have come originally from Flanders. There are now many varieties of this class. Conical Cabbage.- This type is described in 1783, but appears to be identical with the Battersea named in 1726.

SAVOY CABBAGE, Brassica oleracea bullata DC.- This race of cabbage is distinguished by the blistered surface of their leaves, and by forming only a loose or little compact head. Probably the heading cabbages of the Romans belonged to this class. In this class there are three types and a number of varieties. Spherical-Headed.- Most common type. Occurs in various degrees of blistering and in a large number of varieties. Elliptical-Headed.- This type has long been known. Conical-Headed.- The one form of this type is first mentioned in French works in 1824.

RED CABBAGE, Brassica oleracea (capitata) rubra L.- The first certain mention of this was made in 1570. All the figures given it by the early writers are of the spherical-headed type. Oblong- or pointed-headed types now occur. The solidity of the head and the perfectness of the form in this class of cabbage indicate long culture and a remote origin. In this country they are grown principally for pickling.

PORTUGAL CABBAGE, Brassica oleracea costata DC.- This race is easily recognized through the great expansion of the midrib and veins of the leaf, and the midrib losing its identity in the multitude of radiating, branching veins. In some plants the petioles are winged clear to the base. This race reached English gardens from Portugal about 1821, and American gardens about 1850. We did not study this race.

CAULIFLOWER, Brassica oleracea botrytis cauliflora.- The cauliflower is not described by ancient authors. It is said to have been mentioned in 1553 or 1559 and reported as abounding at Hayti

in 1565. Varieties are essentially of one type, with difference in size and season, one kind even being purplish in the head.

BROCCOLI, Brassica oleracea botrytis cymosa. - The early botanists did not describe or figure the broccoli. It was, in all probability, confounded with the cauliflower. The Romans probably knew the plant and described ^{it} under the name cyma. The first notice was taken of it in 1724. All the types now grown have originated from Italy. Two types can be defined, the sprouting broccolis and the cauliflower broccolis.

BRUSSEL-SPROUTS, Brassica oleracea bullata gemmifera. - It has been stated that Brussel-sprouts has been grown from time immemorial about Brussels in Belgium. The early botanists, however, did not give it a figure. It has been in general use in Europe for at least a hundred years, and in 1806 was mentioned as occurring in American gardens. Just two classes are known, the Tall and the Dwarf. These are distinct in habit and leaf. The origin, in all probability, does not date back very much more than a century, and likely was derived from a variable of the Savoy cabbage type.

KALE, Brassica oleracea acephala DC. - Kales are an extremely variable class of vegetable and have been under cultivation from a most remote period. There is no doubt that some of the varieties of cabbage known to the ancient Greeks belonged to the kales. I. - The form of kale known in France as the Chevalier seems to have been the longest known. This race is probably the levis of Cato. There are many varieties of this form. II. - There are but few varieties of the Dwarf Kales, the best marked of which is the Dwarf Curled. III. - The Portugal Kales include two sorts having an extensive rib system.

KOHLRABI, Brassica oleracea caulorapa DC. - In 1558 the kohlrabi is mentioned as having lately come into Germany from Italy.

Some writers believe it to be a cross between the cabbage and the rape. Probably the more correct view is that it is derived from the marrow cabbage. It may have come from Greece. Even though the present kohlrabi has received its development in northern countries, it has a southern origin. The varieties now grown are the white and purple, the curled-leaf and the artichoke-leaved.

Botanical History of the Brassica Studied.- CHINESE CABBAGE.- Two species of this cabbage have reached European culture. They are Brassica pak choi and Brassica pe-tsai, and are known by their specific names. It was in cultivation in China as early as the fifth century. The pe-tsai forms an elongated head, rather full and compact, and the leaves are a little wrinkled and undulate on the borders. Both species are annual plants.

RAPE, Brassica napus.- Found nothing bearing on history of rape.

TURNIP, Brassica rapa.- The turnip is of ancient culture. Pliny (First century) mentions seven kinds. There are now at least three forms: I, French turnips, having smooth and glaucous leaves and sweet flavor, and furnishing white, yellow and black varieties. II, This class has a large root expanding under the origin of the stem into a thick, round, fleshy tuber, flattened at the bottom. It has white, yellow, black, red or purple, and green varieties. III, The tuber in this class is long and oblong, tapering to the radicle. It seems to be an ancient form. In general the turnip is believed to have reached England from Holland in 1550, but before this it had reached the new world. Cartier sowed turnip seed in Canada in 1540. There are now perhaps forty distinct varieties.

ruta baga, Brassica campestris.- This includes two forms,

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one with white flesh, the other with yellow. The white-rooted form was first described in 1620. The other form has a more regular root, round or oval, yellow both without and within. This form is said to have been introduced into Scotland about 1781-'82, and into England in 1790.

Kinds in Cultivation.- Cato, who lived about 201 B. C., describes the Brassicae as: (1) levis having large, broad leaves and a large stalk; (2) crispa or apiacon having crisped leaves, and (3) lenis having a thin stalk and smooth and tender, but rather sharp-tasting leaves. Pliny in the first century describes (1) cumana, with sessile leaf and open head; (2) aricenun, not excelled in height but with more numerous and thinner leaves, -"the most useful of all"; (3) Pompeianum, tall, and the stalk, which is thin at the root, increasing in thickness as it rises among the leaves, which are fewer in numbers and narrower, very tender and unable to stand the cold; (4) Brutiana, with remarkably large leaves, thin stalk, pungent flavor, and thriving all the better for cold; (5) Sabellica, admired for its curled leaves whose thickness exceeds that of the stalk, -of very sweet flavor; (6) Lacturres, with very large heads, and leaves almost without number, some being round and smooth, others long and sinewy, (7) Tritianon, often a foot in diameter and late in going to seed, and there is mention of two other kinds now known to be something other than cabbage.

Upon examining various seed catalogues we found the largest number of varieties of the cabbage tribe in that published for Haage and Schmidt of Erfurt, Germany. The number of varieties of each race they have catalogued is as follows:

Cauliflower, B. oleracea botrytis cauliflora . . . 25

Broccoli,	<i>B. oleracea botrytis cymosa</i>	16
Cabbage, white,	<i>B. oleracea capitata</i>	55
Cabbage, red,	<i>B. " "</i>	13
Cabbage, Savoy,	<i>B. " " bullata</i>	34
Brussel-sprouts,	<i>B. " bullata gemmifera</i>	10
Kale,	<i>B. " acephala</i>	30
Kohlrabi,	<i>B. " congyloides (caulo-rapa)</i>	16
Ruta Baga,	<i>B. napus rapifera</i>	17
Turnip,	<i>B. rapa hortensis</i>	33

The above gives a good idea of the relative number of varieties of the different races under cultivation at present.

Discussion of Brassica as a Genus.- Brassica is an old classical name applied to a genus in the natural family Cruciferae, which contains some one hundred species of annual, biennial and perennial, mostly the last, herbs, native of the temperate regions of Europe, Asia and Africa. The flowers of Brassicae have four petals and four stamens, the pod is long and beaked, and the seeds not winged. The genus includes all the mustards, cabbages, turnips and the like. It may be said that the genus Brassica has received too little attention from botanists. The following classification of the cultivated Brassicae is from Bailey's Cyclopaedia of Horticulture (1900):

A. Plant glaucous-blue when in flower; leaves of floral stem clasping; flowers various.

B. Leaves from the first more or less fleshy throughout, and glaucous-blue even when young; flowers large and creamy yellow, the petals conspicuously long-clawed and the sepals usually erect.

Brassica oleracea, L. Cabbage, cauliflower, Brussel-

sprouts and kale.

Brassica napus, L., Rape. More deeply scalloped leaves than B. oleracea.

Brassica campestris, L., Rutabaga. First leaves hairy; root usually tuberous.

BB. Leaves not of floral stem, thin and green; flowers smaller and bright yellow, and petals less prominently clawed.

C. Plant potentially biennial, foliage firm in texture.

D. Foliage distinctly hairy.

Brassica rapa, L., common turnip.

DD. Foliage not hairy.

Brassica chinensis, L., Pak choi cabbage.

" napiformis, L., Tuberous-rooted Chinese mustard.

Brassica pe-tsai, Bailey, Pe-tsai cabbage.

" japonica, L., California pepper-grass, pot herb mustard.

AA. Whole plant green or but slightly glaucous when in flower; leaves on floral stem not prominently clasping; flowers small and yellow; annuals.

(This includes the mustards and charlocks with which we did not work.)

Brassica oleracea capitata, L.- Cabbage in the wild state grows on the sea cliffs of western and southern Europe. It is a perennial plant, sometimes biennial, with a very tough and woody root, a diffuse habit of growth, and large, thick, deep-lobed leaves in various shades of green and red, and more or less glaucous.

The following is a simple classification of cabbages, due to Bailey:

- A. Leaves plain.
 - B. Head oblong or conical.
 - C. Green.
 - CC. Red.
 - BB. Head oblate or flattened.
 - C. Green.
 - CC. Red.
- AA. Leaves blistered or puckered. Savoy cabbages.
 - B. Head oblong or conical.
 - C. Green.
 - CC. Red.
 - BB. Head oblate or flattened.
 - C. Green.
 - CC. Red.

Methods of Work.- As a basis for our work ninety-two varieties of seed were ordered from J. M. Thorburn and Co., Seedsmen of New York. It may be well to give a list of the varieties with their numbers and hereafter to refer to them by their numbers. This is the complete list, with the numbers which we used in planting starred (*):

KALE, 8 varieties.

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| 1. Jersey Winter. | *5. Tall Brown Curled. |
| 2. Siberian, Thorburn Improved. | 6. Curled Dwarf Green Scotch. |
| *3. Emerald Isle. | *7. Tall Green Scotch. |
| *4. Striped and Variegated. | 8. Dwarf Brown Curled. |

CAULIFLOWER, 12 varieties.

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| *1. Thorburn Extra Early Snowball. | 7. Nonpareil. |
| 2. " Large " " | *8. Extra Early Paris. |
| 3. Denmark. | *9. Autumn Giant. |
| 4. Thorburn Large Early Dwarf Erfurt. | 10. Lenormand Giant. |
| 5. " Gilt Edge. | 11. Algiers. |
| *6. " Extra Early Dwarf Erfurt. | 12. Early London. |

BROCCOLI, 5 varieties.

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| *1. Mammoth White. | *4. Early Walcheren. |
| *2. Early " | 5. Veitch Self-protecting. |
| *3. " Purple Cape. | |

BRUSSEL-SPROUTS, 3 varieties.

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| *1. Long Island Grown. | *2. Improved Half-dwarf. | *3. Improved Dwarf German. |
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CABBAGES, 26 varieties.

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| *1. Succession. | *14. Thorburn Drumhead Savoy. |
| *2. Express. | 15. Large Flat Dutch. |
| 3. Selected All Seasons. | *16. Thorburn Red Stone Head. |
| *4. Early Jersey Wakefield. | 17. Large Late Drumhead. |
| *5. All Head. | *18. Danish Ball Head. |
| 6. Etampes. | *19. Early Winningstadt. |
| 7. Charleston Wakefield. | 20. Extra Early Jersey Wakefield. |
| 8. Stein Early Flat Dutch. | 21. Fine Large Late Flat Dutch. |
| *9. Early Vienna Savoy. | *22. Green Glazed. |
| 10. " York. | 23. Large Early York. |
| 11. " Spring. | *24. Early Ulm Savoy. |
| 12. Thorburn Colossal. | *25. Red Berlin. |
| 13. Improved Early Summer. | *26. Red Danish Oval. |

KOHLRABI, 5 varieties.

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| *1. Early White Vienna. | *4. Early Purple Vienna. |
| *2. Large " or Green. | 5. " White. " |
| *3. Purple Vienna. | |

CHINESE CABBAGE, 1 variety.

- *1. Pe-Tsai.

RUTA BAGA, 5 varieties.

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| *1. Champion Purple-Top. | 4. Thorburn Improved. |
| *2. Family. | *5. White-Fleshed. |
| *3. Laings. | |

RAPE, 2 varieties.

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| *1. English. | *2. German. |
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TURNIP, 25 varieties.

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| *1. Thorburn Yellow Stone. | *14. Yellow Tankard. |
| 2. Early Purple Top Milan. | 15. Cow Horn. |
| 3. Red Top Globe-shaped. | 16. Half-Long White. |
| *4. " " Strap-leaf. | 17. Yellow Finland. |
| *5. Golden Ball. | 18. Yellow Malta. |
| *6. Early White Milan. | 19. White Tankard. |
| 7. White Strap-leaf. | *20. Yellow Aberdeen. |
| *8. Early Snowball. | 21. White Norfolk. |
| *9. White Egg. | 22. White Model. |
| *10. Yellow Globe. | *23. Scarlet Kashmyr. |
| 11. White French. | 24. Early Dutch. |
| *12. Pomeranian White Globe. | *25. Seven Top. |
| 13. Purple Top Munich. | |

The first thing done after we received the seeds was to

select the varieties we wished to plant. However, with one exception, that of cabbage, the selection was of no great importance. We tried to select as widely varying types as possible. In the case of cabbage, as we had no description of the different varieties at our command, we made in a rough way four groups. Two of the groups are distinguished by plain leaves, one with head oblong or conical, and the other with head oblate or flattened, (AB and ABB in classification of cabbages given above); the Savoy cabbages constituted the third group, and the red cabbages made up the fourth group. We selected three varieties in each group and, in addition, No. 22 (Green Glazed), for it was said to be unlike other cabbages in the color and appearance of the leaf. In all we selected 13 varieties of cabbage, 12 of turnip, 4 each of cauliflower, kale, broccoli, kohlrabi and ruta baga, and all the varieties of Brussel-sprouts, Chinese cabbage and rape, thus making a total of 51 varieties planted. These were planted in germination boxes Monday afternoon, April 25. These boxes were set in a glass case in front of a window in the botanical laboratory room. The turnips were the first to show through. A few observations were taken to see the early differences in the seedlings. On May 6 the boxes of plants were removed to the open air and shaded by a gunny-sack screen. The work of transplanting was not commenced, on account of lack of time and too much rain, until May 17, on which day all the cabbage was transplanted. On the following day all the Brussel-sprouts and three varieties of kohlrabi were set out. On May 19 the fourth variety of the kohlrabi and the broccoli were transplanted. Nothing more was done until the 23rd, when the remainder of the plants were set out. These last were in a bad condition when transplanted, while at the same time the ground was not in as good

condition. Thus a difference was brought about, and still exists (June 22). This has caused us trouble in our study of the plants.

Observations and Results.- On April 28 several plants were showing through, especially the turnips. The following observations were made on April 29:

CABBAGE.- All show through except No. 18. Those farthest along are Nos. 24, 26, and 9. The red cabbages Nos. 16, 25, and 26 are clearly different from the others in that the hypocotyl and cotyledons are reddish purple in color. No differences in the others were noticeable.

BRUSSEL-SPROUTS.- No evidence of growth in No. 1. Nos. 2 and 3 are of equal development. Not distinguishable from cabbage.

KOHLRABI.- All show evidence of growth. Those farthest along are Nos. 1 and 4. In Nos. 1 and 2 the hypocotyl is pale green, and in Nos. 3 and 4, purplish.

BROCCOLI.- All up and growing. No. 1 farthest along with No. 2 next and Nos. 3 and 4 just showing through.

CAULIFLOWER.- All growing. No. 9 farthest along.

KALE.- All above ground. The hypocotyl is pale green in Nos. 3 and 7 and purplish in Nos. 4 and 5. No. 7 is farthest along, while No. 3 is the slowest.

RUTA BAGA.- Nos. 1 and 2 are above ground. No. 1 is farthest along, No. 5 is raising the crust, and No. 3 shows no evidence of growth.

TURNIP.- All but No. 5 show evidence of growth. No. 6 is tallest. Nos. 4, 20, and 23 are slow. Nos. 1, 8, 9, 10, and 12 are much alike. Nos. 14 and 25 are much alike and are lighter colored than the others.

RAPE.- No. 1 is farthest along and is more slender than No.

2, which has larger cotyledons and a stouter hypocotyl.

CHINESE CABBAGE.- Growth is good. Hypocotyl very light-colored and thick. Cotyledons fairly large.

General Observations.- The only plant that showed enough difference to discriminate it from the other varieties was the Chinese Cabbage. This was due to the thickness of its hypocotyl, the rather larger cotyledons, and the lighter color of the whole seedling. In all the cotyledons were broader than long, bifid with a broad sinus, lobes ascending, rounded, petiolate, unequal in size and length of petioles,- the larger cotyledon having the longer petiole.

Observations of April 30.-

CABBAGE.- Five plants of No. 18 show through. No difference in the others yet.

BRUSSEL-SPROUTS.- No. 1 is breaking through.

KOHLRABI.- No. 3 does not come up evenly. No. 1 has larger and darker-colored cotyledons than has No. 2.

BROCCOLI.- Nos. 3 and 4 have about caught up with No. 2.

CAULIFLOWER.- Shoots of No. 9 are lighter-colored than the others.

RUTA BAGA.- No. 5 is up well. No. 3 is just showing through.

TURNIP.- No. 6 has the largest cotyledons, while No. 23 has the smallest. No. 5 is just breaking through.

Observations of May 2.-

CABBAGE.- Plants 3 inches tall. Cotyledons large, and one, by reason of longer petiole, is borne higher than the other.

KOHLRABI.- Leaves- cotyledons- of Nos. 3 and 4 not as

dark as in the red cabbages.

BROCCOLI.- In Nos. 2 and 4 the hypocotyl is darker than in Nos. 1 and 3.

CAULIFLOWER.- Cotyledons of No. 8 are not open very well yet. They are spread out in the others.

RUTA BAGA.- Cotyledons smaller than in the cabbage. Plants four inches or more in height.

TURNIP.- Badly affected with "damping off".

RAPE.- No. 2 is taller than any of the other varieties growing, and it is standing fairly upright.

CHINESE CABBAGE.- Characterized by stoutness of growth, thick hypocotyl and large cotyledon, both being very light-colored.

No more notes were taken until a week after the work of transplanting was finished, which brings us down to May 30.

Observations of May 30:-

CABBAGES.- No. 1 has thirty plants, each with two or three leaves. No. 2 has sixteen plants with two, three, four or five leaves. No. 9 has thirty-four plants with two or three leaves; the third, when present, is blistered. Nos. 16, with forty-four plants, 25, with thirty-four plants, and 26, with twenty-five plants, are alike in that the hypocotyl and stem is purplish, as are also the leaf-veins. Each has two, three or four leaves. No. 5 has twelve plants, each with two or three leaves, the largest one of which is as broad as it is long. No. 4 has seventeen plants, each with three or four leaves. No. 14 has forty-two plants in the majority of which the third leaf is just starting. In Nos. 18, with eleven plants, and 19, with twenty-eight plants, there are two or three leaves. The two or three leaves in No. 24, which has twenty plants, show a tendency to blister, especially the third when present. No. 22, with thirty-

six plants, has three or four leaves, and is unlike the others in that the leaves are shiny, dark green.

BRUSSEL-SPROUTS.- No. 1, fourteen plants, has two, three or four leaves. No. 2, thirty plants, and No. 3, twenty-three plants, have three and four leaves.

KOHLRABI.- No. 1, with twenty-three plants, has two, three or four leaves; No. 2, with forty-three plants, has two or three leaves; No. 3, with thirteen plants, has three or four leaves with purple veins, and No. 4, with fifty plants, has two or three leaves and also has purple leaf-veins.

BROCCOLI.- No. 1 has eighteen plants, No. 2 has thirty-four plants, No. 3 has thirty-one plants, and No. 4 has thirty-six plants. Each variety has two or three leaves.

CAULIFLOWER.- Nos. 1 and 6 have twelve plants each, and no more than two leaves on the plant. In Nos. 8, with twenty-two plants, and 9, with seven plants, there are four leaves, of which in the second pair one is much larger than the other.

KALE.- No. 3 has twenty-seven plants; No. 4, twenty-one; No. 5, fourteen, and No. 7, thirty-two plants. The cotyledons are dead, while there is one large and one small leaf in second pair.

RUTA BAGA.- No. 1 has twelve, No. 2 has four, No. 3 has one, and No. 5 has five plants alive. Two leaves are present. They are pubescent and nearly equal.

TURNIP.- No. 14 has six plants with two leaves; No. 20 has three plants which may not survive on account of "damping off"; No. 23 has two plants; No. 25 has twenty-two plants and the third leaf is just opening; No. 8 has four plants with four leaves; No. 9 has seven plants and two leaves; No. 10 is wiped out by "damping off"; No. 12 has five plants and three leaves; No. 1 has eight plants and

two leaves; No. 4 has fourteen plants and four leaves, and Nos. 5 and 6 each have one plant.

RAPE.- No.1 has six plants alive while No. 2 has eighteen. The leaves are pubescent.

CHINESE CABBAGE.- There are thirteen plants alive. There are three leaves which are pubescent and lighter-colored than rape.

General Observations.- There are approximately 950 plants alive. The cabbages, Brussel-sprouts, kohlrabis and broccolis are far in advance of the others owing to conditions at planting and can not easily be compared with the others. In general appearance the broccoli and cauliflower resemble each other and cabbage. The other varieties are readily distinguishable. The leaves of Brussel-sprouts are entire and somewhat circular in outline, and the upper surface is usually concave. The leaves of kohlrabi are deeply indented, much longer than broad, and have a pointed tip. It is easily distinguishable from the other varieties. In kale the leaves are more finely scalloped than in the other varieties and, hence, are readily distinguishable. The leaves of ruta бага, turnip, Chinese cabbage and rape are pubescent. The Chinese cabbage is readily separated from the others by reason of its lighter-colored and less scalloped leaves.

Observations of June 18:-

RAPE.- No. 1 is in blossom. Flowers yellow. Leaves blistery and pubescence disappearing. Plants glaucous-blue. No. 2 is not in blossom, is glabrous and glaucous-blue.

KOHLRABI.- The stem has already commenced swelling out.

CABBAGE.- The leaves in Nos. 1, 5, and 18 are comparably broader in respect to length than in Nos. 2, 4, and 19. The leaves, especially the younger ones, in Nos. 9, 14, and 24 are blis-

tered. Nos. 16, 25, and 26 are practically alike, and have purplish leaf-veins.

Observations of June 21.-

KOHLRABI.- The swollen part of the stem varies in diameter from just starting in No. 2, an average of $3/8$ " in No. 4, an average of $5/8$ " in No. 1, up to one inch in one or two cases in No. 3.

RUTA BAGA.- Leaves glaucous-blue, blistery, slightly pubescent, pubescence disappearing on larger leaves.

TURNIP.- All the plants are pubescent with blistery leaves except in No. 6, which is not pubescent and does not have blistery leaves.

CHINESE CABBAGE.- Plants pubescent, leaves blistered, mid-rib enlarged, very broad and prominent, veins very prominent on under surface of leaf. Plant has a low growth.

All varieties needing it were thinned out today.

Final Observations, June 22.- The races of *B. oleracea* resemble each other markedly, likewise the other plants, turnip, ruta бага, Chinese cabbage and rape, resemble each other. In rape, the only plant to flower, the leaves of the floral stem were clasping. In this it resembles the ruta бага and the cabbage tribe. Ruta бага nearly resembles rape and it would be somewhat hard to distinguish between them at present. In the turnip the leaves are thin, green, and hairy. The leaves are thin and green in the Chinese cabbage. The leaves are hairy but lack the deep incisions of the turnip, etc., and in shape more strongly resemble a cabbage leaf. Its mid-rib is very broad at the base, the leaf-veins are sunken and very prominent on the under surface of the leaf, and the leaf is notched at the apex. Thus the Chinese cabbage is a plant distinctly separate from the

others. In the cabbage tribe, the green cabbage, broccoli, and cauliflower strongly resemble each other, the resemblance being especially strong between the two latter. The leaves of cabbage are relatively broader and shorter than in broccoli, while the leaves of cauliflower are of the same shape as those of broccoli. The Savoy and the red cabbages are clearly differentiated from each other and the green cabbages. The two groups of green cabbage are as yet not easily distinguishable. Kohlrabi, Brussel-sprouts and kale are each characteristic and need no further mention.

Summary.- This work on the whole has proven to be both profitable and interesting, even though carried on under difficulties, the chief of which was lack of time. In at least two cases no distinct separation has been made. This could be done in time, which would also bring out other interesting differences. It seems that this work can be carried on for some time yet very profitably. The plants are now in good shape and it is very likely that some other person will continue and supplement our work. At the same time we regret very much our inability to remain and see the conclusion of the work on which we have spent so much time and labor. Still we feel that not all was in vain, that at least a little has been accomplished and that we are free to go.

Cabbage, No. 14.

Cabbage, No. 1.

22

Cabbage, No. 19.

Cabbage, No. 22.

Cabbage, No. 16.



Brussel-sprouts, No. 2.



Kohlrabi, No. 1.



Broccoli, No. 2.



Kohlrabi, No. 2.