CRATAEGUS

IN

SOUTHERN MICHIGAN.

BY

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Director of the Arnold Arboretum.

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LETTER OF TRANSMITTAL.

OFFICE OF THE STATE GEOLOGIST,

LANSING, MICHIGAN, March 21, 1907.

To the Honorable the Board of Geological Survey of the State of Michigan:

Hon. Fred M. Warner, President.
Hon. D. M. Ferry, Jr., Vice-President.
Hon. L. L. Wright, Secretary.

Gentlemen:—I herewith transmit for insertion in the report for 1906, as especially authorized by your Board by vote of March 1, 1907, the paper on Crataegus, an interesting apple genus, present in our State in unusual variety, and in a wealth of forms. This paper is prepared by the eminent authority, Prof. C. S. Sargent of Harvard University, and is recommended to us by Prof. C. A. Davis, Vice-President of the Botanical Section of the Academy of Science and by your Scientific Advisors, Prof. W. J. Beal of the Agricultural College and Prof. F. C. Newcombe of the University. The subject of plant variation is now attracting a great and wide scientific interest and in the hands of the men like that son of Michigan, Prof. L. H. Bailey, and Luther Burbank, is proving of great practical value as well.

To one point I would call attention. The farther knowledge of this group depends, as the author says, on study at different times of the year, that is, essentially upon local observers. No occasional visit of a specialist can do the work which belongs to our own citizens, who have had their eyes opened to observe the nature around them.

Very respectfully,

ALFRED C. LANE,
State Geologist.

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CRATAEGUS IN SOUTHERN MICHIGAN.

BY C. S. SARGENT.

In the following paper I have attempted to give an account of the species of Crataegus that are now known to occur in the southern part of the State in the hope that its publication, by calling attention to the richness of the Michigan flora in the plants of this genus, may encourage its more general study.

Southern Michigan forms the western extension of what is perhaps the richest Crataegus region in the world; certainly in no other part of the world where the genus has been at all carefully studied are there so many species as in the territory extending from the valley of the Genesee River in New York, up both banks of the Niagara River and through southern Ontario into southern Michigan, and nowhere are there more distinct or beautiful species.

Of the genus as it occurs in Michigan little is yet known. It has been carefully and systematically collected only on Belle Isle in the Detroit River by Mr. O. A. Farwell, in St. Clair county by Mr. C. K. Dodge, and in the neighborhood of Grand Rapids by Miss E. J. Cole. It is now possible, however, to distinguish fifty-five species and of these twenty-five are now first described. Eighteen others, briefly described by Ashe from St. Clair county, are also described in this paper from material and notes furnished me by Mr. Dodge. All the St. Clair county species described by Ashe have now been identified with the exception of *C. passens,* collected at Port Huron, and probably one of the *Flabellatae, C. fallax,* from "rocky hills near Port Huron," and *C. borealis* without other locality than "Michigan." The latter species is given in Beal's Michigan Flora, 1904, "St. Clair Co., W. W. Ashe, Keweenaw Co., O. A. Farwell."

In Beal's Michigan Flora of 1904, the following species of Crataegus, besides those mentioned, reported as occurring in Southern Michigan by various collectors, have not been seen from the State by the writer.

C. acutiloba, Sargent, Detroit, O. A. Farwell.
C. altrix, Ashe, Detroit, O. A. Farwell.
C. coccinea, L. common throughout.
C. Crus-galli, L. common throughout.
C. decans, Ashe, Detroit, O. A. Farwell.
C. filipes, Ashe, St. Clair Co., W. W. Ashe.
C. macrantha, Lodd, common throughout.
C. nuperia, Ashe, Detroit, O. A. Farwell.
C. obtecta, Ashe, Detroit, St. Clair Co., W. W. Ashe.
C. onusta, Ashe, St. Clair Co., W. W. Ashe.
C. pastorum, Sargent, Detroit, O. A. Farwell.

C. prunifolia (Marsh.), Pers., Detroit, O. A. Farwell.
C. pubipes, Ashe, St. Clair Co., W. W. Ashe.
C. redolans, Ashe, Detroit, O. A. Farwell.
C. rotundifolia (Ehrh.) Borck. Grand Rapids; Island Lake. C. F. Wheeler.
C. virella, Ashe, St. Clair Co., W. W. Ashe.

Judging from the material which I have seen from other parts of the lower peninsula and which is too incomplete for critical study, it seems probable that there are still in the southern part of the State a large number of unnamed species, and when these are all known it will not be surprising if the flora of Michigan is found to contain a much larger number of species than are now described.

The collection of Crataegus presents no practical difficulty but it requires care and patience if the material is to be really useful for study. As plants of the same species often appear so different in the spring and autumn, it is necessary to mark with a number written on a permanent label or cut into the bark each plant from which specimens are taken, so that there can be no mistake in securing flowering and fruiting specimens from the same individual. When the flowers are gathered the stamens and styles should be counted and the average number in several flowers recorded in the field notebook. The average diameter of the expanded flowers should also be recorded, and special care should be taken to note carefully the color of the anthers, that is, whether dark or light rose color, pink, or pale yellow. The color of the anthers is important as furnishing a good character for the determination of species; this soon fades and it is entirely lost in drying. The color in some specimens changes even before the flowers fade, and the safest way is to take notes on the color of the anthers before the petals expand. The autumn specimens should be gathered when the fruit is ripe or nearly ripe. Specimens gathered in summer with only partly grown fruit are absolutely worthless for the determination of species, and time spent in preparing such specimens is wasted except that they may record the existence of plants needing further investigation. When the fruiting specimen is collected the shape, size (length and diameter), and the color of the fruit should be noted, and whether it is pruinose or not. Notes should be made also on the color of the flesh, and on its character, whether succulent, dry or juicy, sweet or bitter. The field notes should give the date when the flowers and fruits are gathered, the size and habit of the plant, the character of the bark and the absence or presence of spines on the stems and large branches, the nature of the soil and situation where the plant grows, its abundance and such other information as cannot be obtained by the examination of the herbarium specimen. If these simple rules are followed no difficulty will be found in preparing specimens that can be used for the determination of species and the description of new ones, and the Michigan Academy of Sciences, through its members living in different parts of the State, can by organizing a systematic study of this interesting genus, make an important contribution to the knowledge of the North American flora.

SYNOPSIS OF THE NATURAL GROUPS OF THE SPECIES OF SOUTHERN MICHIGAN.

1. Nutlets without ventral cavities.
   Petioles short, glandless or with occasional minute glands, leaves obovate to oblong, oval or rarely ovate, cuneate at the base; corymbs many-flowered (few-flowered in some species of *Punctatæ*); flesh of the fruit hard and dry.
      Leaves coriaceous, dark green and shining above, usually serrate only above the middle, their veins thin except on vigorous shoots; fruit oblong to subglobose, not more than 1.5 cm. long; nutlets 1-3, generally 2, rounded or rarely acute at the ends, prominently ridged on the back. 1. Crus-galli.
      Leaves thin to subcoriaceous, acute or occasionally rounded at the apex, their veins prominent; fruit short-oblong to obovate, often conspicuously punctate, 1-1.2 cm. in diameter or in No. 1 up to 2.5 cm. in diameter; nutlets 2-5, prominently ridged on the back. 2. Punctatæ.
   Petioles elongated, usually slender, generally glandular only toward the apex.
      Leaves mostly broad at the base.
         Corymbs many-flowered (few-flowered in some species of *Pruinosæ*).
            Fruit subglobose to short-oblong or obovate, red or green, often slightly 5-angled, generally pruinose, especially during the summer; fruit less than 2 cm. in diameter; flesh dry and hard; leaves thin to subcoriaceous, sometimes cuneate. 3. Pruinosæ.
            Fruit short-oblong to obovate, red or scarlet, mostly lustrous, usually 1-1.5 cm. long; flesh succulent; anthers rose color or pink; leaves thin, sometimes cuneate at the base. 4. Tenuifoliæ.
            Fruit subglobose to obovate or short-oblong, scarlet, often pubescent, 1.5-2 cm. long; flesh thick, soft and edible; nutlets pointed at the ends, usually slightly ridged; leaves thin, broad, cuneate or rounded or cordate at the base, more or less pubescent below. 5. Molles.
            Fruit short-oblong to obovate, 1.5-2 cm. long, scarlet, lustrous; flesh succulent; nutlets 3-5, occasionally ridged on the back; anthers rose color; leaves large, thin, oblong, more or less acutely lobed. 6. Flabellatæ.
      Leaves cuneate at the base (rarely rounded in *Intricatæ* and *Anomalæ*), thin to subcoriaceous.
         Corymbs usually few-flowered; fruit short-oblong to obovate, 1-1.5 cm. long, greenish yellow or red; flesh dry and hard; nutlets 3-5, rounded at the ends, generally conspicuously ridged on the back. 7. Intricatæ.

Corymbs many or few-flowered; fruit subglobose, usually 9-12 mm. in diameter; flesh dry and mealy; leaves dark green and lustrous on the upper surface. 8. Coccineæ.

Corymbs usually many-flowered; fruit subglobose to short-oblong or obovate, generally 1-1.4 cm. long; nutlets sometimes furnished with obscure ventral depressions; leaves thick to subcoriaceous, usually scabrate above while young; anthers rose color or pink. 9. Anomalæ.

2. Nutlets with longitudinal cavities on their ventral faces; fruit pyriform to subglobose to short-oblong, 1-1.5 cm. in diameter, lustrous, orange or scarlet; flesh becoming succulent at maturity; nutlets 2 or 3, usually obtuse at the ends, prominently ridged on the back. 10. Tomentosæ.

I. CRUS-GALLI.

Pedicels glabrous; anthers usually 10-12, rarely to 18; fruit short-oblong. 1. C. attenuata.

Pedicels villose; stamens 8-10; fruit oval to slightly obovate. 2. C. Farwellii.

1. **Crataegus attenuata**, Ashe, *Jour. Elisha Mitchell Sci. Soc.* xix, 30 (1903).

Glabrous, with the exception of a few hairs on the upper side of the midribs of the young leaves. Leaves obovate-cuneiform, rounded, acute or acuminate at the apex, gradually narrowed to the entire base, and finely serrate above the middle, with incurved glandular teeth; more than half grown when the flowers open early in June and then dark yellow-green and lustrous above and pale below, and at maturity thin and firm to subcoriaceous, dark green and very lustrous on the upper surface, light yellow-green on the lower surface, 3-5 cm. long and 2-2.5 cm. wide, with slender midribs, and thin primary veins without the parenchyma; petioles slender, narrowly wing-margined nearly to the middle, 6-10 mm. long; leaves on vigorous shoots oblong-obovate to oval, acuminate, concave-cuneate at the base, coarsely serrate, 6-7 cm. long and 4-4.5 cm. wide, with stout midribs, conspicuous primary veins, and stout broadly winged petioles. Flowers 1.3-1.5 cm. in diameter, on long slender pedicels, in wide lax mostly 15-20-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or occasionally minutely dentate, reflexed after anthesis; stamens 10-18, usually 10-12; anthers pink; styles 2 or 3. Fruit ripening early in October and persistent until after the leaves have fallen, on slender drooping pedicels, in many-fruited clusters, short-oblong, full and rounded at the ends, dull red mottled with green, 1.2-1.4 cm. in length; calyx little enlarged, with a deep narrow cavity, and erect and incurved usually persistent lobes; flesh thin, green and hard; nutlets 2 or 3, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad high grooved ridge, 8-9 mm. long and 4-4.5 mm. wide.

A tree sometimes 5-6 m. high, with a trunk occasionally 3 dm. in

diameter, covered with dark scaly bark, large spreading branches forming a round-topped head, and stout slightly zigzag branchlets light orange-red and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous or dull orange-brown on vigorous sterile shoots in their first season and dark gray-brown the following year, and armed with numerous stout, nearly straight chestnut-brown shining spines 4.5-6 cm. long.

Near St. Clair, St. Clair County, *C. K. Dodge* (No. 74 type tree), May 29, 1903, May 29 and October 2, 1904, October 11, 1905; low sandy soil near the shores of the St. Clair River at Port Huron, *C. K. Dodge* (No. 42), May 30 and October 2, 1903, also Nos. 23, 30 and 38; Belle Isle, Detroit, *O. A. Farwell*, May 27 and October 10, 1903; Agricultural College, *W. J. Beal* (Nos. 8 and 13), May 28, 1900; Grand Rapids, *E. J. Cole* (Nos. 19 and 16), 1901.

Crataegus attenuata, which differs from the typical *Crataegus Crus-galli* L. in the primary veins being distinctly without the parenchyma and in the nutlets narrowed at the ends, appears to be the common and most generally distributed species of this group in southern Michigan. Nos. 154 and 157, shrubby plants collected by Miss Cole at Grand Rapids, with small thicker leaves, with prominent veins, and with obtuse nutlets, seem to be different from the typical *Crataegus attenuata* as it grows at St. Clair and may represent a different species.

2. **Crataegus Farwelli**, n. sp.

Leaves oblong-obovate, rounded or acute at the apex, gradually narrowed to the slender acute entire base, and finely serrate above with straight or incurved glandular teeth; more than half-grown when the flowers open at the end of May and then thin, yellow-green, lustrous and sparingly villose above and paler and glabrous below, and at maturity thin, glabrous, dark yellow-green and very lustrous on the upper surface, pale bluish green on the lower surface, 4-6.5 cm. long and 2-2.5 cm. wide, with thin midribs and slender primary veins without the parenchyma; petioles slender, narrowly wing-margined at the apex, slightly hairy along the upper side, becoming glabrous, 1-1.4 cm. in length; leaves on vigorous shoots subcoriaceous, acuminate, coarsely serrate, occasionally slightly lobed above the middle, often 7-8 cm. long and 5-6 cm. wide, with stout midribs, thick primary veins, and stout broadly winged petioles. Flowers 1.1-1.2 cm. in diameter, on slender villose pedicels, in wide lax mostly 15-20-flowered slightly hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, elongated, acuminate, entire or occasionally minutely dentate, glabrous on the outer, slightly hairy on the inner surface, reflexed after anthesis; stamens 8-10; anthers pink; styles 1-3. Fruit ripening the middle of October, on slender hairy reddish pedicels, in few-fruited spreading clusters, oval to slightly obovate, gradually narrowed to the rounded ends, crimson, lustrous, 1.2-1.3 cm. long, 9-10 mm. in diameter; calyx very small, with a shallow narrow cavity and reflexed closely appressed lobes; flesh thick, yellow, dry and mealy; nutlets usually 1 or 2, full and rounded at the ends, only slightly ridged on the back, 8-9 mm. long and 4-4.5 mm. wide, or when only one 6-7 mm. in diameter.

A tree with a stout trunk occasionally 3 dm. in diameter, covered like the stout erect secondary stems with gray-brown bark broken into

short oblong plate-like scales, ascending branches forming a hemispherical head, and slender, nearly straight glabrous branchlets, dark orange color and marked by pale lenticels when they first appear, becoming dark orange-brown and lustrous in their first season and dark gray-brown the following year, and armed with stout slightly curved dark red-brown ultimately ashy gray spines 3-6 cm. long, persistent, becoming branched and often 1.5 dm. in length on old branches sometimes 6 or 7 m. high.

Belle Isle, Detroit; common; *O. A. Farwell* (No. 28 type), May 29 and October 10, 1903, (No. 7) May and September, 1901, May, 1902, May 29 and October 10, 1903.

This handsome tree is named for Mr. O. A. Farwell of Detroit, whose persistent and careful collecting in various parts of the State, and critical study of the flora about Detroit, has added much to the knowledge of the plants of the regions in which he has worked.

II. PUNCTATAE.

Anthers rose color or pink (sometimes yellow in No. 1).
- Stamens 20.
  - Flowers in broad many-flowered corymbs; pedicels and lower surface of mature leaves villose. 1. C. punctata.
  - Flowers in few-flowered corymbs; pedicels and mature leaves glabrous or nearly glabrous; fruit short-oblong.
    - Anthers dark rose color; leaves obovate-cuneate. 2. C. nitidula.
    - Anthers pink; leaves rhombic to ovate. 3. C. compacta.
- Stamens 10-20; leaves oblong-obovate. 4. C. tenax.
- Stamens 10; leaves oval to obovate. 5. C. incerta.

1. **Crataegus punctata,** Jacquin, *Hort. Vind.* i. 10, t. 38 (1770).—Sargent, *Silva N. Am.* iv. 103, t. 184; *Proc. Rochester Acad. Sci.* iv. 110; *Man.* 89, f. 308; *Proc. Phil. Acad. Sci.* 1905, 583.

Leaves obovate, pointed or rounded at the apex, gradually narrowed to the cuneate entire base, sharply often doubly serrate above the middle with minute teeth, and sometimes, especially on vigorous shoots, more or less incisely lobed; when they unfold thickly covered below with pale hairs and pilose above, about half-grown when the flowers open from the middle of May until early in June and then pilose on the midribs and veins below and nearly glabrous above, and at maturity thick and firm, pale gray-green and glabrous on the upper surface, more or less villose on the lower surface, 5-7.5 cm. long and 2-4 cm. wide, and on vigorous shoots sometimes 8.10 cm. long and 4-5 cm. wide, with broad prominent midribs and primary veins deeply impressed on the upper surface of the leaf, turning bright orange or orange and scarlet in the autumn; petioles stout, wing-margined at the apex, at first villose or tomentose, becoming pubescent or glabrous, 6-12 mm. in length. Flowers 1.2-1.6 cm. in diameter, in broad tomentose or villose compound many-flowered corymbs; calyx-tube narrowly obconic, villose or tomentose, the lobes narrow,

acuminate, nearly entire or minutely glandular-serrate, glabrous on the outer, villose on the inner surface; stamens 20; anthers rose color or yellow; styles 4 or 5, surrounded at the base by conspicuous tufts of white hairs. Fruit ripening and falling in October, on stout stems, in many-fruited drooping clusters, short-oblong to subglobose, usually truncate at the ends, dull red or sometimes bright yellow, the fruit usually agreeing in color with the anthers, marked by numerous small white dots, 1.3-2.5 cm. long; calyx little enlarged with a deep narrow cavity, and small closely appressed lobes; flesh thin and dry; nutlets 4 or 5, gradually narrowed and rounded at the ends; rounded and slightly ridged on the back; 7-8 mm. long and 4-4.5 mm. wide.

A tree 7-10 m. high, with a trunk occasionally 3 dm. in diameter, stout branches spreading nearly at right angles and forming a broad open irregular head, and stout branchlets coated when they first appear with pale deciduous pubescence, becoming light orange-brown or ashy gray, and armed with slender straight light orange-brown or gray spines 5-7.5 cm. long, long-persistent and compound on old stems and branches.

Southern Michigan, common; near Port Huron, *C. K. Dodge* (No. 3), May 29 and Oct. 24, 1903; (No. 92), June 1, 1905; Jackson County, *S. H.* and *D. R. Camp* (No. 6), May 22 and Sept. 16, 1902; also from the valley of the Chateaugay River, Quebec, through western New England and along the Appalachian Mountains to northern Georgia and Tennessee, and through New York, Ohio and southern Michigan to Illinois.

2. **Crataegus nitidula**, n. sp.

Leaves obovate-cuneate, acute or acuminate at the apex, gradually narrowed to the entire base, sharply doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 4 or 5 broad acuminate lobes; more than half-grown when the flowers open about the 20th of May and then thin, yellow-green, covered above by short soft white hairs, and slightly villose along the midribs and veins below, and at maturity thin but firm in texture, dark green, lustrous and glabrous on the upper surface, pale and nearly glabrous on the lower surface, 5-5.5 cm. long and 3-4 cm. wide, with thin yellow midribs and primary veins; petioles slender, wing-margined at the apex, villose on the upper side, 2-3 cm. in length. Flowers 1.2-1.3 cm. in diameter, on slender glabrous pedicels, in small mostly 5-7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, finely glandular-serrate, glabrous, reflexed after anthesis; stamens 20; anthers dark rose color; styles 3-5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the 1st of October and persistent until the end of the month, on slender erect or spreading stalks, in few-fruited clusters, short-oblong, full and rounded at the apex, abruptly narrowed at the base, dark yellow blotched with red, marked by dark dots, 1-1.2 cm. long and nearly as broad; calyx only slightly enlarged, with a wide shallow cavity, and spreading appressed usually persistent lobes; flesh thin, yellow-green; nutlets 3-5, thin and rounded at the ends, rounded and obscurely grooved on the back, 7-7.5 mm. long and about 5 mm. wide.

An arborescent shrub 6-7 cm. high, with numerous small stems spreading into broad thickets, small ascending branches, and slender nearly straight glabrous branchlets dark orange-green and marked by numerous pale lenticels when they first appear, becoming light orange-

brown and lustrous in their first season and dull reddish brown the following year, and armed with many stout or slender straight or slightly curved purplish shining spines 2.5-4 cm. long, and very numerous and persistent on old stems.

Fields near St. Clair, St. Clair County, *C. K. Dodge* (No. 69 type), May 27 and Sept. 24, 1902, May 21 and Sept. 24, 1903, *C. K. Dodge* and *C. S. Sargent,* Sept., 1906.

3. **Crataegus compacta**, n. sp.

Glabrous with the exception of a few caducous hairs on the upper side of the unfolding leaves. Leaves rhombic to ovate or rarely to obovate, acuminate, gradually narrowed and entire at the base, finely doubly serrate above, with incurved glandular teeth, and slightly divided above the middle into 2 or 3 pairs of broad acuminate lobes; bright bronze-red when they unfold, about half-grown when the flowers open during the last week of May and then membranaceous and yellow-green, and at maturity thick, very smooth, bluish-green on the upper surface and pale blue-green on the lower surface, 4-5.5 cm. long and 3-3.5 cm. wide, with thin midribs and primary veins; petioles slender, wing-margined at the apex, glabrous while young, with many minute deciduous red glands, 2-3 cm. in length; stipules linear, elongated, glandular, fading brown, caducous; leaves on vigorous shoot sometimes broadly ovate and rounded at the base, coarsely serrate and more deeply lobed. Flowers 1.5 cm. in diameter, on slender glabrous pedicels, in very compact usually 6-8-flowered corymbs, with linear glandular caducous bracts and bractlets; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, entire or occasionally sparingly glandular, acuminate and red at the glandular apex, reflexed after anthesis; stamens 18-20; filaments usually persistent on the ripe fruit; anthers small, pink; styles 3-5. Fruit ripening at the end of September, on slender reddish pedicels, in few-fruited clusters, short-oblong, orange-red, lustrous, marked by large pale dots, 1-1.2 cm. long and 9-10 mm. wide; calyx little enlarged, with a deep narrow cavity and spreading and reflexed lobes, their tips usually deciduous from the ripe fruit; flesh thin, yellow-green, dry and mealy; nutlets 3-5, full and rounded at the base, narrowed and often acute at the apex, ridged on the back, with a broad grooved ridge, 6-7 mm. long and about 5 mm. wide.

An arborescent shrub sometimes 3 m. high, with slender stems covered with pale gray bark, small ascending branches, forming a narrow pyramidal head, and slender nearly straight branchlets, light orange-green and marked by numerous oblong pale lenticels when they first appear, becoming bright red-brown or orange-brown and lustrous in their first season and dull gray-brown the following year, and armed with few slender straight purplish ultimately ashy gray spines 2.5-3 cm. long.

Very common in dry sandy soil near Atkins Station, northwest of Port Huron, *C. K. Dodge* (No. 26), June 3 and Sept. 17, 1902, May 24 and Oct. 20, 1903; ten miles northwest of Port Huron (No. 130), Sept. 21, 1905, May 29, 1906; St. Clair (No. 129), Sept. 19, 1905; also near London, Ontario, where the type plants occur.

4. **Crataegus tenax**, Ashe, *Jour. Elisha Mitchell Sci. Soc.* xviii. 21 (1902).

Leaves oblong-obovate, short-pointed and acute at the apex, gradually narrowed to the slender entire base, and finely serrate above, with

straight or incurved gladular teeth; more than half grown when the flowers open about the first of June and then thin, yellow-green and sparingly hairy along the midribs above and nearly glabrous below, and at maturity thin but firm in texture, glabrous, dark yellow-green and lustrous on the upper surface, pale and lustrous on the lower surface, 4-6 cm. long and 2-3 cm. wide, with prominent slender midribs and 4 or 5 pairs of thin primary veins; petioles slender, wing-margined to below the middle, slightly hairy on the upper side while young, soon glabrous, often rose color in the autumn, 8-10 mm. in length; leaves on vigorous shoots rhombic to oval, long-pointed at the apex, more coarsely serrate, usually divided above the middle into 3 or 4 pairs of short acuminate spreading lobes, often 7-9 cm. long and 4-5 cm. wide, with thick prominent midribs and veins, and stout broadly winged rose-colored petioles. Flowers 1.8-2 cm. in diameter, on long slender glabrous pedicels, in wide lax usually 10-15-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, mostly entire, glabrous on the outer, villose-pubescent on the inner surface, reflexed after anthesis; stamens 18-20, or occasionally only 10-15; anthers rose color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September and long persistent, on slender drooping pedicels, in many-fruited clusters, short-oblong, full and rounded at the ends, or slightly obovate, crimson, lustrous, marked by numerous large pale dots, 1.5-1.6 cm. long and 1.4-1.5 cm. in diameter; calyx little enlarged, with a wide deep cavity and slender spreading or appressed usually persistent lobes; flesh thick, yellow-green, dry and mealy; nutlets 2 or 3, usually 3, full and rounded at the ends, or, when 3, narrowed at the ends, ridged on the back, with a wide deeply grooved ridge, 8-9 mm. long and about 5 mm. wide.

An arborescent shrub 5-7 m. high, with numerous stout stems covered with dark brown scaly bark, spreading branches forming a round-topped symmetrical head, and stout slightly zigzag branchlets dark orange-green and slightly hairy when they first appear, becoming orange color, lustrous and nearly glabrous in their first season and light gray-brown the following year, and armed with many nearly straight orange-brown ultimately dark gray spines 5-6 cm. long.

Port Huron, *C. K. Dodge* (No. 44), June 3 and Sept. 18, 1902, June 3 and Oct. 18, 1903, Sept. 24, 1905, (No. 114), Sept. 25, 1904, June 11 and Sept. 22, 1905, (No. 144), Sept. 29, 1906, (No. 111), Oct. 2, 1904; also near London, Ontario.

5. **Crataegus incerta**, n. sp.

Leaves oval to obovate, acuminate, gradually narrowed to the concave-cuneate acuminate entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into three or four pairs of small acuminate lobes; more than half grown when the flowers open about the 20th of May and then thin, glabrous with the exception of a few soft hairs on the upper side of the midribs, yellow-green above and pale bluish-green below, and at maturity thin but firm in texture, dark yellow-green, smooth and glabrous on the upper surface, pale bluish-green on the lower surface, 5-5.7 cm. long and 4-5 cm. wide, with slender yellow midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, wing-margined at the apex, glabrous, 2-3 cm. in length; leaves on

vigorous shoots abruptly cuneate at the base, more coarsely serrate, more deeply lobed and often 8-9 cm. long and 6-7 cm. wide, with stout petioles often winged to below the middle. Flowers 1.8-2 cm. in diameter, on slender glabrous pedicels, in narrow, mostly 7-10-flowered corymbs, with lanceolate to linear acuminate glandular caducous bracts and bractlets fading brown; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from wide bases, acuminate, glandular-serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening in October, on short stout pedicels in few-fruited clusters, subglobose to short-oblong, rounded at the apex, rounded or truncate at the base, crimson, slightly pruinose, 1-1.1 cm. long and 8-10 mm. in diameter; calyx little enlarged, with a broad shallow cavity and spreading or erect lobes usually persistent on the ripe fruit; flesh green, dry and mealy; nutlets 3 or 4, narrowed and rounded at the ends, very prominently ridged on the back, with a broad rounded ridge, 7-8 mm. long and 5-5.5 mm. wide.

A tree 8-10 m. high with a tall stem often 1.5 dm. in diameter, and covered with dark scaly bark, stout ascending branches, forming an open irregular head, and slender glabrous branchlets light orange-yellow and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous and marked with pale lenticles in their first season and dull red-brown and lustrous the following year, and armed with slender nearly straight purplish spines 2.5-3 cm. long, and very numerous and branched on old stems.

On bluffs of Black River ten miles northwest of Port Huron, *C. K. Dodge* (No. 84 type), May 23 and October 22, 1903, September 28, 1904.

III. PRUINOSAE.

Stamens 20.
- Anthers rose color or pink.
  - Leaves mostly rounded at the broad base.
    - Leaves thick, usually longer than broad, blue-green; anthers pink; fruit short-oblong. 1. C. perampla.
    - Leaves thin, usually not longer than broad; anthers dark rose color; fruit obovate.
      - Leaves blue-green; flowers in 5-7-flowered corymbs; fruit green, pruinose, becoming dull red. 2. C. horridula.
      - Leaves yellow-green; flowers in 3-5-flowered corymbs; fruit dull green blotched with black. 3. C. sitiens.
  - Leaves cuneate at the base (sometimes rounded in No. 5).
    - Fruit short-oblong to ovate or slightly obovate.
      - Leaves thin, deeply lobed, yellow-green; anthers only slightly tinged with pink; fruit ovate to obovate. 4. C. parvula.
      - Leaves thicker, only slightly lobed, dark blue-green; anthers rose color; fruit short-oblong. 5. C. ater.

Fruit depressed-globose, often broader than high; leaves thin, slightly lobed; anthers pink. 6. C. immanis.

Anthers pale yellow.

Fruit obovate, green, finally becoming crimson and lustrous; leaves subcoriaceous, dark blue-green. 7. C. latisepala.

Fruit subglobose to short-oblong, dull red; leaves thin, yellow-green. 8. C. glareosa.

Stamens 10 or less; anthers rose color or purple.

Young leaves smooth above.

Fruit subglobose, often broader than high, crimson, pruinose; leaves subcoriaceous, dull blue-green. 9. C. bellula.

Fruit obovate, dull orange-red, not pruinose; leaves thin, light yellow. 10. C. prona.

Young leaves scabrate above.

Leaves blue-green.

Fruit subglobose, often broader than high. 11. C. opulens.

Fruit obovate.

Leaves deeply divided into narrow acuminate spreading lobes. 12. C. filipes.

Leaves slightly lobed, with short broad lobes. 13. C. allecta.

Leaves yellow-green; fruit short-oblong. 14. C. gravis.

1. **Crataegus perampla**, n. sp.

Glabrous with the exception of a few soft caducous hairs on the upper surface of the young leaves. Leaves ovate, acuminate, rounded or truncate at the broad entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of broad acuminate lateral lobes; not more than one-third grown when the flowers open from the middle to the 20th of May and then thin, yellow-green and almost glabrous, and at maturity thick to subcoriaceous, dull bluish green and lustrous on the upper surface, pale blue-green on the lower surface, 6-7 cm. long and 4.5-6.5 cm. wide, with stout midribs and 4 or 5 pairs of thin prominent primary veins; petioles stout, slightly wing-margined at the apex, glandular, 2.5-3 cm. in length. Flowers 2 to 2.2 cm. in diameter, on short stout pedicels, in compact mostly 5-7-flowered corymbs, with lanceolate often falcate rose-colored glandular bracts and bractlets often persistent until the flowers open, the lowest peduncle from the axil of an upper leaf; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, acuminate, entire or occasionally irregularly dentate, reflexed after anthesis; stamens 20; anthers pink; styles 4 or 5. Fruit ripening late in October after the leaves fall, on stout erect pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, dull red, pruinose, 1-1.2 cm. in diameter; calyx prominent with a short tube, a wide deep cavity, and spreading often persistent lobes dark red on the upper side below the middle; flesh thin, yellow-green, dry and hard; nutlets 4 or 5, narrowed at the ends,

rounded at the base, acute at the apex, ridged on the back, with a low narrow ridge, 6.5-7 mm. long and about 5 mm. wide.

An arborescent shrub sometimes 6-7 m. high, with numerous stems covered with black scaly bark, and stout nearly straight branchlets, dark yellow-green marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with stout nearly straight bright red-brown shining spines 3-4.5 cm. long.

Low moist clay soil near Grand Rapids, *E. J. Cole* (No. 76 type), May 18, 1901, September 20, 1902, May 17, 1903, September 19, 1904, *E. J. Cole* and *C. S. Sargent*, September 25, 1901.

2. **Crataegus horridula**, n. sp.

Glabrous. Leaves ovate, acuminate, rounded or occasionally cuneate at the base, finely doubly serrate, with straight or incurved glandular teeth, and divided into 4-6 pairs of short acuminate spreading lobes; more than half grown when the flowers open about the 20th of May and then thin, yellow-green, paler below than above, and at maturity thin but firm in texture, dark blue-green and lustrous on the upper surface, pale bluish green on the lower surface, 4-5 cm. long and 3.5-5 cm. wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, often glandular toward the apex, 2-2.5 cm. in length; leaves on vigorous shoots subcoriaceous, broadly ovate to suborbicular, rounded at the base, coarsely serrate, deeply lobed, often 5-6 cm. long and wide. Flowers 2-2.1 cm. in diameter, on stout pedicels, in compact mostly 5-7-flowered corymbs, the lowest peduncle from an axil of an upper leaf; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, slender, elongated, acuminate, entire or irregularly dentate, reflexed after anthesis; stamens 20; anthers dark rose color; styles 3-5, usually 4, surrounded at the base by few pale hairs. Fruit ripening late in October after the leaves have fallen, on stout erect or spreading red pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the base, green and pruinose when fully grown, finally becoming dull red, marked by large dark dots, 1-1.2 cm. long and about 1 cm. in diameter; calyx prominent, with a long tube, a very deep narrow cavity, and small spreading lobes dark red on the upper side below the middle and often deciduous from the ripe fruit; flesh thin, yellow-green, dry and hard; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a high narrow ridge, 7-7.5 mm. long and 5-5.5 mm. wide.

A shrub 2-3 m. high, with numerous intricately branched stems spreading into thickets, and stout zigzag branchlets light orange-green when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with very numerous stout slightly curved purplish shining spines 3.5-6 cm. in length.

Near Grand Rapids, *E. J. Cole* (No. 138 type), May 21 and September 17, 1902, May 20, 1903, September 19, 1904, (No. 79), September 20, 1902, May 30, 1903, May 24, 1905.

3. **Crataegus sitiens**, Ashe, *Jour. Elisha Mitchell Sci. Soc.* xx, 8 (1904).

Glabrous with the exception of a few soft hairs on the upper surface of the young leaves and in the axils of their veins below. Leaves ovate, acute, rounded, cordate or abruptly cuneate at the broad entire base,

sharply doubly serrate above, with straight glandular teeth, and deeply divided usually only above the middle into 4 or 5 pairs of narrow acuminate lobes; more than half grown when the flowers open about the 20th of May and then thin, nearly glabrous, dark yellow-green above and pale bluish green below, and at maturity very thin, dark yellow-green and glabrous on the upper surface, pale bluish green and still slightly villose below, 4-6 cm. long and broad, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute occasional persistent glands, 2.5-3.5 cm. in length; leaves on vigorous shoots usually truncate or cordate at the base, more coarsely serrate, deeply lobed and often 6-7 cm. long and broad. Flowers 1.8-2 cm. in diameter, on long slender pedicels, in mostly 3-5-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, the lobes gradually narrowed from broad bases, slender, acuminate, minutely dentate or entire, reflexed after anthesis; stamens 20; filaments persistent on the fruit; anthers dark rose color. Fruit ripening the end of October, on slender erect pedicels, in 2 or 3-fruited clusters, broadly obovate, slightly narrowed to the rounded apex, abruptly narrowed at the base, dull green blotched with black, 1-1.2 cm. long, 8.5-9 cm. in diameter; calyx prominent, with a long tube, a wide deep cavity, and large spreading lobes often deciduous from the ripe fruit; flesh green, thin and very hard; nutlets 4 or 5, usually 5, gradually narrowed and rounded at the base, acute at the apex, slightly ridged or rounded and obscurely grooved on the back, 7-7.5 mm. long and 5-5.5 mm. wide.

A shrub 3-4 m. high, with small stems covered with dark scaly bark, slender erect branches forming a thin open head, and very slender nearly straight branchlets dark orange color when they first appear, becoming light orange-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with slender nearly straight purplish shining spines 3-4 cm. long, persistent and very numerous on old stems.

Borders of low rich woods ten miles northwest of Port Huron, *C. K. Dodge* (No. 83), May 23 and October 22, 1903, September 21, 1905.

4. **Crataegus parvula,** n. sp.

Glabrous with the exception of a few caducous hairs on the upper surface of the young leaves. Leaves ovate, acuminate, gradually narrowed and cuneate or rarely rounded at the base, sharply doubly serrate above, with straight glandular teeth, and slightly divided only above the middle into 4 or 5 small acuminate spreading lobes; nearly fully grown when the flowers open about the 20th of May and then thin and yellow-green, and at maturity thin, dark yellow-green and lustrous on the upper surface, pale bluish green on the lower surface, 4-5 cm. long and 3.5-4 cm. wide, with slender yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, 1.5-2 cm. in length; leaves on vigorous shoots thicker, abruptly cuneate at the base, more coarsely serrate, 6-7 cm. long and 4.5-5 cm. wide, with linear acuminate glandular caducous stipules fading brown. Flowers 1.8-2 cm. in diameter, on long slender pedicels, in compact mostly 5-6-flowered corymbs, the lowest peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, slender, acuminate, entire or obscurely dentate, reflexed after anthesis; stamens 20;

anthers faintly tinged with pink; styles 2-5. Fruit ripening late in October, on long drooping pedicels, in few-fruited clusters, ovate and full and rounded at the ends to slightly obovate and somewhat narrowed at the base, crimson, pruinose, marked by large pale dots, 1-1.2 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity, and small spreading often slightly incurved lobes, their tips frequently deciduous from the ripe fruit; flesh thin, yellow-green, dry and hard; nutlets 3 or 4, gradually narrowed and acute at the ends, ridged on the back, with a high narrow ridge, 6-6.5 mm. long and 4.5-5 mm. wide.

A shrub 2-3 m. high, with small stems spreading into thickets, small branches and stout nearly straight branchlets light orange-green when they first appear, becoming light red-brown, lustrous and marked by large dark lenticels in their first season and dull gray-brown the following year, and armed with very numerous stout nearly straight purplish shining spines 4.5-5 cm. long and often pointing toward the base of the branch.

Near Grand Rapids, in moist soil, *E. J. Cole* (No. 120 type), September 20, 1902, May 21, 1903; near Port Huron, *C. K. Dodge* (No. 126), September 21, 1905, May 29, 1906 (No. 132), September 21, 1905.

5. **Crataegus ater,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xix, 21 (1903).

Glabrous with the exception of a few caducous hairs on the upper surface of the young leaves, in the axils of their veins below and on the petioles. Leaves ovate to rhombic, acuminate, gradually or abruptly narrowed and cuneate or rounded at the base, sharply often doubly serrate with straight or incurved glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate lateral lobes; more than half grown when the flowers open about the 20th of May and then thin, yellow-green above and paler below, and at maturity thick and firm to subcoriaceous, dark blue-green on the upper surface, pale bluish green on the lower surface, 5-6 cm. long and 3.5-4.5 cm. wide, with thin prominent midribs and primary veins; petioles slender, slightly wing-margined at the apex, occasionally glandular, 2-3 cm. in length. Flowers 2 cm. in diameter, on slender pedicels, in mostly 5-7-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, slender, acuminate, entire or minutely dentate, reflexed after anthesis; stamens 20; filaments often persistent on the fruit; anthers light rose color; styles 2-5, usually 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening at the end of October, on stout pedicels, in few-fruited drooping or spreading clusters, short-oblong, full and rounded at the ends or slightly obovate, dark green flushed with red, pruinose, 1-1.2 cm. long and broad; calyx prominent, with a short tube, a wide shallow cavity, and small spreading or slightly incurved persistent or deciduous lobes; flesh thin, green, rather juicy; nutlets usually 3 or 4, gradually narrowed and rounded at the ends, or when 5 acute at the ends, ridged on the back, with a high narrow ridge, 7-8 mm. long and 4.5-5 mm. wide.

An arborescent shrub 4-5 m. high, with stout stems covered with close gray bark, small ascending branches forming an open irregular head, and stout slightly zigzag branchlets light orange-green when they first appear, becoming dark orange-green tinged with red or chestnut-brown, lustrous, and marked by dark lenticels in their first season

and dull light gray-brown the following year, and armed with slender nearly straight light chestnut-brown shining spines 3-4 cm. long.

Fields near St. Clair, St. Clair county, *C. K. Dodge* (No. 14), May 21 and October 24, 1903.

6. **Crataegus immanis,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xix. 22 (1903).

Glabrous with the exception of a few caducous hairs on the upper surface of the young leaves. Leaves ovate, acuminate, cuneate or rounded at the entire base, finely glandular-serrate above, and slightly divided above the middle into 3 or 4 pairs of small acuminate lobes; nearly half-grown when the flowers open about the 20th of May and then membranaceous, dark yellow-green and covered above by short soft white hairs and pale bluish green below, and at maturity thin but firm in texture, yellow-green, dull on the upper surface, pale on the lower surface, 3.5-4 cm. long and 2.5-3 cm. wide, with slender midribs and thin obscure primary viens extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly hairy along the upper side while young, soon glabrous, glandular, 1-1.5 cm. in length. Flowers 1.8 cm. in diameter, on long slender spreading pedicels, in wide mostly 6-8 flowered corymbs, with linear glandular rose-colored caducous bracts and bractlets, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes wide, acuminate, obscurely glandular-serrate near the middle, reflexed after anthesis; stamens 20; filaments persistent on the fruit; anthers pink; styles 4 or 5, surrounded at the base by a broad ring of pale tomentum. Fruit ripening at the end of October, on long erect or spreading pedicels, in few-fruited clusters, depressed globose, often broader than high, green with a rose-colored cheek, becoming dull red late in the season, 1-1.2 cm. in diameter; calyx prominent, with a short tube, a deep wide cavity, and small erect or reflexed persistent lobes dark red on the upper side below the middle; the whole calyx often deciduous; flesh-thick, green, dry and hard; nutlets 4 or 5, gradually narrowed and acute at the ends, rounded or grooved on the back, about 7 mm. long and 4 mm. wide.

A shrub 3-4 m. high, with numerous small stems covered with dark scaly bark and spreading into large thickets, small ascending branches, and slender nearly straight branchlets purple covered with a glaucous bloom and marked by numerous pale lenticels when they first appear, becoming bright chestnut brown and lustrous in their first season and dull reddish brown the following year, and armed with slender nearly straight purplish spines 2.5-3 cm. long, persistent and becoming branched on old stems.

Low rich woods ten miles northwest of Port Huron, *C. K. Dodge* (No. 82 type plant), May 22 and October 22, 1903, (No. 79), May 23 and September 22, 1903.

7. **Crataegus latisepala,** Ashe, Bull. *N. Car, College of Agriculture and Mechanic Arts,* clxxv, 109 (1900).

Glabrous with the exception of a few soft hairs on the upper side of the young leaves. Leaves ovate, acuminate, gradually or abruptly narrowed to the concave-cuneate entire base, doubly serrate above, with broad glandular teeth, and usually slightly divided above the middle into 3 or 4 pairs of broad spreading lobes; about half-grown when the

flowers open the middle of May and then thin, yellow-green and lustrous above, paler below, and at maturity subcoriaceous, dark green and lustrous on the upper surface, pale bluish green on the lower surface, 5-6 cm. long and 4-4.5 cm. wide, with stout yellow midribs, and slender veins extending obliquely to the points of the lobes; late persistent in the autumn and finally falling without change of color; petioles stout, wing-margined often nearly to the middle, sparingly glandular while young, 2.5-3 cm. in length; leaves on vigorous shoots usually rounded at the base, often 5-6 cm. long and wide, with stouter purplish glandular petioles. Flowers 1.6-1.8 cm. in diameter, on slender pedicels, in compact usually 5-7-flowered corymbs, with oblong-obovate to linear rose-colored bracts and bractlets; calyx-tube broadly obconic, the lobes abruptly narrowed from the base, short, acuminate, entire, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5. Fruit ripening at the end of October or early in November, on stout pedicels, in few-fruited erect or spreading clusters, obovate, gradually narrowed from above the middle to the base, slightly narrowed to the rounded apex, dull green when fully grown, later becoming crimson and lustrous, marked by large dark dots, 1.2-1.3 cm. long, 1.1-1.2 cm. in diameter; calyx little enlarged, with a short tube, a deep narrow cavity, and small spreading or closely appressed, mostly persistent lobes; flesh thick, deeply tinged with pink, hard, dry and mealy; nutlets 4 or 5, acute at the ends, ridged on the back, with a narrow often slightly grooved ridge, 7-8 mm. long and 4-5 mm. wide.

A shrub 4-5 m. high, with numerous small stems covered with dark scaly bark, spreading branches forming an open irregular head, and slender nearly straight branchlets light orange-green when they first appear, becoming dark chestnut-brown or purplish, lustrous, and marked by pale lenticels in their first season and dull red-brown the following year, and armed with slender nearly straight purplish shining spines 2.5-4 cm. long, persistent, very numerous and compound on old stems.

Near Port Huron; common. *C. K. Dodge* (No. 1 type), 1902-1905; also Nos. 5, 15, 32, 97 and 104; near Grand Rapids, *E. J. Cole,* (No. 170), May 27 and September 30, 1905, (No. 170-1), May 31 and September 30, 1905.

8. **Crataegus glareosa,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xviii, 21 (1902).

Leaves ovate to oval, acuminate, rounded or concave-cuneate at the broad base, very coarsely doubly serrate above, with spreading glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acuminate lobes; nearly half-grown when the flowers open about the 25th of May and then thin, dark yellow-green, lustrous and slightly hairy above and pale and furnished below with small axillary persistent clusters of soft hairs, and at maturity thin but firm in texture, dark yellow-green, lustrous and glabrous on the upper surface, pale bluish green on the lower surface, 5-6 cm. long and 4-4.5 cm. wide, with stout yellow midribs, prominent primary veins extending obliquely to the points of the lobes, and conspicuous reticulate veinlets; petioles stout, slightly wing-margined at the apex, sparingly hairy along the upper side while young, soon glabrous, minutely glandular, often rose-colored in the autumn, 2.5-3 cm. in length; leaves on vigorous shoots sub-

coriaceous, broadly ovate to suborbicular, rounded or slightly cordate at the base, more coarsely serrate, and often 6-7 cm. long and broad, with stout broadly winged glandular petioles. Flowers 2 cm. in diameter, on long slender glabrous pedicels, in mostly 8-12-flowered compact corymbs, with linear to linear-obovate glandular caducous bracts and bractlets fading brown, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, glabrous, the lobes wide, foliaceous, acuminate, laciniately glandular-serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3 or 4, surrounded by a narrow ring of pale tomentum. Fruit ripening late in October and persistent after the leaves fall, on short stout erect pedicels, in broad few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dark red, lustrous, marked by pale dots, 1-1.2 cm. long, 9-10 mm. in diameter; calyx prominent, with a long tube, a wide deep cavity, and elongated slightly reflexed persistent lobes dark red on the upper side below the middle; flesh yellow, sweet and rather juicy; nutlets usually 3 or 4, full and rounded at the ends or, when 4 narrowed at the ends, ridged on the back, with a broad grooved ridge, 6-7 mm. long and 4-5 mm. wide.

A broad shrub 4-5 m. high, with numerous stout stems, ascending and slightly spreading branches forming an open irregular head, and slender nearly straight glabrous branchlets, orange-yellow and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull brown in their second year, and armed with slender nearly straight chestnut-brown shining spines 3.5-4 cm. long, persistent and becoming branched on old stems.

Sandy shores of the St. Clair River at Port Huron, *C. K. Dodge* (No. 39 type plant), May 25 and September 15, 1902, May 14 and October 15, 1903, (No. 88), May 24 and October 18, 1903, (No. 117), May 31st and September 23, 1905.

Ashe describes his C. glareosa as having pubescent corymbs and ten stamens; there is some mistake perhaps in Mr. Dodge's reference of these numbers to C. glareosa.

9. **Crataegus bellula**, Sargent, *Trees and Shrubs,* i 111, t. 56 (1903); *Rhodora,* vii, 195.

Glabrous with the exception of a few caducous hairs on the upper surface of the unfolding leaves. Leaves ovate, acuminate, broadly cuneate, truncate or on leading shoots often cordate at the glandular base, sharply doubly serrate above, with straight glandular teeth, and deeply divided into 4 or 5 pairs of narrow acuminate spreading lateral lobes; more than half-grown when the flowers open at the end of May and then thin and pale yellow-green, and at maturity subcoriaceous, dark bluish green and very lustrous on the upper surface, pale blue-green on the lower surface, 5-7 cm. long and 4-6 cm. wide, with thin prominent pale yellow midribs deeply impressed on the upper side of the leaf, and slender primary veins arching obliquely to the points of the lobes; petioles stout, narrowly wing-margined at the apex, glandular, with numerous small dark red stipitate persistent glands, 2-3 cm. in length; stipules lunate to linear-falcate, lobed at the base, coarsely glandular-serrate, tinged with red, often large and conspicuous, mostly persistent until the flowers open. Flowers 1.6 cm. in diameter, on long slender pedicels, in lax usually 5-7-flowered corymbs, with oblong-

obovate to linear glandular reddish bracts and bractlets often persistent until after the flowers open, the long lower peduncles form the axils of upper leaves; calyx-tube broadly obconic, the lobes small, separated by wide rounded sinuses, acuminate, entire or rarely sparingly glandular-serrate, reflexed after anthesis; stamens 8-10, usually 10; anthers light rose color; styles 2-5. Fruit ripening late in September, on slender stems, in compact drooping clusters, subglobose, often somewhat broader than high to broadly obovate, dull crimson, pruinose, marked by many small pale dots, 1.5-1.8 cm. in diameter; calyx prominent, without a tube, and with a narrow shallow cavity, and small erect lobes, their tips mostly deciduous from the ripe fruit; flesh thick, yellow, dry and mealy; nutlets 2-5, usually 4, full and rounded at the apex, gradually narrowed and acute at the base, ridged on the back, with a high broad and grooved, or narrow rounded ridge, about 7 mm. long and 6 mm. wide.

A shrub 3-4 m. high and nearly as broad, with numerous stout intricately branched ascending stems, and slender only slightly zigzag branchlets, bright orange-green when they first appear, becoming bright red, lustrous, and marked by occasional small dark lenticels in their first season and dark brown tinged with purple in their second year, and armed with numerous slender nearly straight bright red-brown shining spines often pointed toward the base of the branch, becoming branched and long-persistent on old stems, and ultimately ashy gray.

Grand Rapids, Michigan, common, *E. J. Cole* (No. 136 type), May and September, 1901, 1902, *E. J. Cole* and *C. S. Sargent,* September, 1901; also in southern Massachusetts.

10. **Crataegus prona,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xix. 17 (1903).

Leaves oblong-ovate, acuminate, rounded, truncate or concave-cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and deeply divided into 5 or 6 pairs of narrow acuminate spreading or incurved lobes, deeply tinged with red when they unfold, about one-third grown when the flowers open the last week of May, and then membranaceous, yellow-green, smooth and sparingly hairy above and pale and glabrous below, and at maturity very thin, light yellow green and glabrous on the upper surface, pale on the lower surface, 5-6.5 cm. long and 3-4 cm. wide, with slender yellow midribs and thin primary viens arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, 2-2.5 cm. in length. Flowers 1.4-1.5 cm. in diameter, on long slender glabrous pedicels, in wide lax mostly 4-7-flowered corymbs, with oblong-ovate to linear-obovate glandular caducous bracts and bractlets fading rose color, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, rose-colored at the apex, glabrous, reflexed after anthesis; stamens 5-10, rarely 10; anthers purple; styles 2-4. Fruit ripening late in September, on slender drooping pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed and acute at the base, dull orange-red, lustrous, marked by small pale dots, 1-1.2 cm. long and 8-9 mm. in diameter; calyx little enlarged, with a narrow deep cavity, and slender recurved lobes, their tips often deciduous from the ripe fruit; flesh thin, yellow-green; nutlets 2-4, narrowed and rounded at the ends, or, when 4, acute

at the apex, ridged on the back, with a broad low grooved ridge, 7-8 mm. long and 5-6 mm. wide.

A slender shrub, with small stems covered with dark bark broken into large loose scales, and slender nearly straight glabrous branchlets dark orange-yellow and marked by pale lenticels when they first appear, becoming dull chestnut-brown in their first season and reddish-brown the following year, and armed with many slender straight or slightly curved light chestnut-brown shining ultimately gray spines; 2.5-3 cm. long, becoming branched, and very numerous on old stems.

Near Port Huron, *C. K. Dodge* (No. 81), May 23 and October 22, 1903, May 26 and September 21, 1905, (No. 7), May 24 and October 11, 1902, May 28 and September 19, 1905.

11. **Crataegus opulens,** Sargent, *Proc. Rochester Acad. Sci.* iv. 104 (1903).

Glabrous with the exception of the hairs on the upper surface of the young leaves and petioles. Leaves oblong-ovate to oval, acuminate, full and rounded or broadly cuneate at the entire base, sharply doubly serrate above, with straight gland-tipped teeth, and slightly divided into 3 or 4 pairs of broad acuminate spreading lobes; about half-grown when the flowers open at the end of May and then very thin, light yellow-green and roughened above by short pale hairs and paler below, and at maturity coriaceous, glabrous, dark bluish green and lustrous on the upper surface, very pale blue-green on the lower surface, 4-7 cm. long and 3-5 cm. wide, with thin yellow midribs sometimes tinged with rose color in the autumn, and 4 or 5 pairs of slender primary veins arching obliquely to the points of the lobes; petioles slender, more or less wing-margined at the apex, sparingly hairy when they first appear, soon becoming glabrous, occasionally glandular early in the season, 2-4 cm. in length; stipules linear to linear-falcate, acuminate, sometimes lobed at the base, glandular, mostly deciduous before the flowers open; leaves on vigorous shoots coarsely serrate, often 3-lobed, the lateral lobes frequently divided into 2 or 3 pairs of secondary lobes, 6-8 cm. long and often as wide or wider than long, with stout conspicuously glandular petioles. Flowers 1.2-1.4 cm. in diameter, on long slender pedicels, in compact mostly 5-8-flowered compound corymbs, with oblong-obovate to linear acuminate glandular bracts and bractlets mostly deciduous before the flowers open; calyx-tube broadly obconic, the lobes gradually narrowed from the base, acuminate, tipped with minute dark glands, sparingly glandular-serrate usually only above the middle or nearly entire, reflexed after anthesis; stamens 10; anthers pale rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit on long slender reddish pedicels, in few-fruited drooping clusters, subglobose and rather broader than high to short-obovate, obscurely angled, crimson, slightly pruinose, lustrous, marked by few large dark dots, 1.3-1.5 cm. in diameter; calyx without a tube, with a deep narrow cavity, and erect or spreading entire or slightly serrate lobes dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh thin, nearly white, dry, firm and sweet, nutlets 3 or 4, usually 4, full and rounded at the apex, gradually narrowed to the rounded base, prominently ridged on the back, with a high rounded ridge, 8-9 mm. long and often 6 mm. wide.

A shrub 3-5 m. high, with dull olive green stems ashy gray at the

base, and slender only slightly zigzag branchlets, light red or green tinged with red and marked by small pale lenticels when they first appear, becoming dark olive brown and lustrous in their first season and light gray-brown the following year, and armed with many straight or slightly curved lustrous purple-brown spines 3.5-5 cm. long.

Near Port Huron, *C. K. Dodge* (No. 40), May 25 and September 15, 1902, May 28 and October 15, 1903; also through Ontario to western New York.

12. **Crataegus filipes,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xix. 18 (1903).

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves ovate, long-pointed and acuminate at the apex, rounded, truncate or abruptly concave-cuneate at the broad entire base, finely doubly serrate above, with straight glandular teeth, and deeply divided into 4 or 5 pairs of narrow acuminate spreading lobes; more than half-grown when the flowers open about the 20th of May and then membranaceous, light yellow-green and slightly roughened above by short white hairs and pale below, and at maturity very thin, dark bluish green and smooth on the upper surface, pale blue-green on the lower surface, 4-5 cm. long and 3.5-4 cm. wide, with prominent yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with minute scattered glands, 2-2.5 cm. in length. Flowers 2 cm. in diameter, on long slender pedicels, in mostly 6-10-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, slender, acuminate, entire or obscurely dentate near the middle, reflexed after anthesis; stamens 5-7; anthers dark rose color; styles 4 or 5. Fruit ripening early in October and persistent on the branches until after the leaves fall, on slender drooping pedicels, in few-fruited clusters, obovate, slightly narrowed at the apex, gradually narrowed to the slender base, orange-red pruinose, becoming lustrous, marked by small pale dots, 1-1.2 cm. long and 7-8 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and erect or incurved lobes; flesh thin, yellow-green, dry and mealy; nutlets 4 or 5, acute at the ends, ridged on the back; with a broad grooved ridge, 7-8 mm. long and about 4 mm. wide.

A shrub, with erect stems covered with dark scaly bark, small erect and spreading branches forming a broad compact round-topped head, and slender nearly straight branchlets, dark orange-yellow and marked by pale lenticels when they first appear, becoming purple and lustrous in their first summer and pale red-brown the following year, and armed with slender straight or slightly curved light chestnut-brown shining spines 3.5-4.5 cm. long, very numerous and branched on old stems.

Near Port Huron, *C. K. Dodge* (No. 78), May 23 and September 29, 1903, September 21, 1905.

13. **Crataegus allecta,** n. sp.

Leaves ovate, acuminate and long-pointed at the apex, rounded cordate, or occasionally cuneate at the broad base, sharply doubly serrate, with straight glandular teeth, and divided into 4 or 5 pairs of short broad acuminate lateral lobes, about half-grown when the flowers open the middle of May and then thin, yellow-green, and roughened above by short white hairs and pale and glabrous below, and at maturity thick,

dark blue-green, smooth and lustrous above, pale bluish green below, 6-7 cm. long and 4.5-5.5 cm. wide, with stout orange-colored midribs, and 4 or 5 pairs of thin primary veins; petioles slender, wing-margined at the apex, glabrous, glandular, with minute red glands, often dark rose color in the autumn, 3-3.5 cm. in length. Flowers 1.5-1.6 cm. in diameter, on long slender glabrous pedicels, in compact mostly 6-8-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, glabrous, the lobes broad, short, acuminate, entire or glandular-serrate near the middle, glabrous on the outer surface, covered on the inner surface with short white hairs, reflexed after anthesis; stamens 5-7; anthers dark rose color; styles 3 or 4, rarely 5, surrounded at the base by a narrow ring of long white hairs. Fruit ripening the first of October, on long drooping pedicels, in lax clusters, obovate, bright orange-red, marked by numerous dark dots, 1-1.2 cm. long, 8-10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and spreading or incurved usually persistent lobes pubescent on the upper surface; flesh thin, orange color, dry and mealy; nutlets 3-5, gradually narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad high deeply grooved ridge, 6.5-7 mm. long and 4.5-5 mm. wide.

A shrub 3-4 m. high, with stems covered with smooth olive green bark, stout zigzag glabrous branchlets dark orange-green tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and pale gray-brown the following year, and armed with numerous stout straight or slightly curved light chestnut-brown shining spines 3-4 cm. long.

Low moist soil near Grand Rapids, *E. J. Cole* (No. 18 type), May 16, 1901, May 18 and September 10, 1902, September 27, 1904, (No. 70), May 18 and 23, 1901, September 7, 1902, October 1, 1904, (No. 139), May 20 and September 16, 1902, (No. 146, with 10 stamens), May 21 and September 30, 1902; fields near St. Clair, St. Clair County, *C. K. Dodge*, (No. 70), May 19 and September 6, 1903, May 28 and September 19, 1905.

14. **Crataegus gravis**, Ashe, *Jour. Elisha Mitchell Sci. Soc.* xx. 3 (1904).

Leaves broadly ovate, acuminate, abruptly concave-cuneate or rarely rounded at the wide entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acuminate lobes; deeply tinged with red when they unfold, more than half-grown when the flowers open at the end of May and then thin, yellow-green and roughened above by short white hairs, and glabrous below, and at maturity thin but firm in texture, smooth, glabrous and yellow-green on the upper surface, pale on the lower surface, 5-6 cm. long and 4-5 cm. wide, with stout midribs, and slender primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, minutely glandular, 2-3 cm. in length. Flowers 1.5 cm. in diameter, on slender glabrous pedicels, in compact mostly 5-10-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, slender, acuminate, entire or minutely dentate near the middle, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5-10; anthers dark rose color; styles 2 or 3, rarely 4 or 5, surrounded

at the base by a broad ring of pale tomentum. Fruit ripening from the middle to the end of October, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, crimson, pruinose, becoming lustrous 1-1.2 cm. long and 8-9 mm. in diameter; calyx little enlarged, without a tube, with a narrow shallow cavity, and spreading or slightly incurved lobes dark red on the upper side below the middle, often deciduous from the ripe fruit; flesh thin, yellow-green, hard and dry; nutlets usually 2 or 3, narrowed and rounded at the ends, prominently ridged on the back, with a broad deep groove, or, when 5, only slightly ridged, 6-7 mm. long and 4-5 mm. wide.

A slender shrub 2-3 m. high, with small stems covered with dark scaly bark, small ascending branches, slender nearly straight glabrous branchlets dark orange-yellow marked by pale lenticels when they first appear, becoming dull light chestnut-brown in their first season and light reddish brown the following year, and armed with stout nearly straight light chestnut-brown shining spines 2.5-3 cm. long, persistent and becoming branched on old stems.

Port Huron, *C. K. Dodge* (No. 28), May 26 and October 17, 1902, May 24 and October 20, 1903, May 31, and September 25, 1905 (No. 28 A), May 26 and October 17, 1903 (No. 28 B), May 20 and October 20, 1903 (No. 25), May 26 and October 17, 1902, May 26 and October 17, 1903 (No. 89), May 24 and October 18, 1903.

IV. TENUIFOLIAE.

Stamens 10 or less.
- Young leaves scabrate above.
  - Leaves yellow-green.
    - Flowers in more than 10-flowered corymbs.
      - Leaves usually rounded at the base.
        - Leaves deeply lobed. 1. C. glaucophylla.
        - Leaves slightly lobed. 2. C. otiosa.
      - Leaves usually cuneate at the base, deeply lobed. 3. C. Streeteræ.
    - Flowers in fewer than 10-flowered corymbs. 4. C. retrusa.
    - Leaves blue-green, slightly lobed. 5. C. uber.
- Young leaves smooth above.
  - Leaves deeply lobed; flowers in 7-12-flowered corymbs; calyx-lobes villose on the inner surface. 6. C. merita.
  - Leaves slightly lobed; flowers in 5-7-flowered corymbs; calyx-lobes glabrous. 7. C. perlæta.

Stamens 20.
- Pedicels glabrous; leaves usually oval; fruit oval, gradually narrowed at the ends. 8. C. tætrica.
- Pedicels villose; leaves oblong-ovate; fruit obovate, becoming short-oblong. 9. C. asperata.

1. **Crataegus glaucophylla,** Sargent, *Rhodora,* v. 140 (1903); *Proc. Rochester Acad. Sci.* iv, 12.

Leaves broadly ovate, acute or short-pointed at the apex, rounded or broadly cuneate at the entire base, sharply and often doubly serrate

above, with straight or incurved glandular teeth, and divided into 4 or 5 pairs of narrow acute or long-pointed lateral lobes; tinged with red, and roughened above by short pale caducous hairs when they unfold, more than half-grown when the flowers open during the last week of May and then smooth, light yellow-green and covered above by a glaucous bloom, pale and glaucous below, and at maturity thin but firm in texture, light yellow-green on the upper surface, pale bluish green on the lower surface, about 6 cm. long and 4.5 cm. wide, or on vigorous shoots 7-8 cm. long and 6 cm. wide, with thin yellow midribs deeply impressed above and slender veins extending to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, 2-2.5 cm. in length. Flowers 1-2-1.4 cm. in diameter, on short slender glabrous pedicels, in broad mostly 8-10-flowered compound corymbs, with linear glandular caducous bracts and bractlets; calyx narrowly obconic, glabrous, green tinged with red, the lobes slender, elongated, entire or occasionally glandular-serrate near the middle, glabrous, reflexed after anthesis; stamens 5-10, usually 10; anthers small, dark rose color; styles 3 or 4. Fruit ripening early in September and sometimes persistent until the middle of October, on short stalks, in drooping few-fruited clusters, short-oblong or rarely ovate, full and rounded at the ends, bright scarlet, very lustrous, marked by few large dots, 1.2-1.4 cm. long and about 1 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and minutely glandular-serrate closely appressed persistent lobes; flesh thick, yellow, juicy, of a pleasant flavor; nutlets 3 or 4, thin, acute at the ends or rounded at the apex, ridged on the back, with a high narrow sometimes slightly grooved ridge, about 7 mm. long and 4 mm. wide.

A round-topped shrub 2-3 m. high, with numerous thick stems covered with ashy gray bark, stout zigzag glabrous branchlets yellow-green and marked by pale lenticels when they first appear, becoming bright red-brown and lustrous during their first season, and dull light reddish brown the following year, and armed with many slender straight or slightly curved red-brown spines 2-7 cm. in length.

Near Port Huron, *C. K. Dodge* (No. 115), September 25, 1904, May 27, 1905; also through Ontario and New York to western New England.

2. **Crataegus otiosa,** Ashe, *Jour. Elisha Mitchell, Sci. Soc.,* xx. 2 (1904). Leaves ovate, acuminate, rounded, slightly cordate or abruptly cuneate at the broad base, finely doubly serrate above, with straight glandular teeth, and divided into 7 or 8 pairs of small acuminate spreading or recurved lateral lobes; about half-grown when the flowers open at the end of May and then very thin, yellow-green and roughened above by short white hairs and pale and glabrous below, and at maturity thin, yellow-green, smooth, and glabrous on the upper surface, pale on the lower surface, 4.5-5.5 cm. long and 3-4 cm. wide, with slender yellow midribs, and generally 5 pairs of primary veins extending obliquely to the points of the principal lobes; petioles very slender, slightly wing-margined at the apex, glabrous, 2-3 cm. in length. Flowers 1.4-1.5 cm. in diameter, on long slender glabrous pedicels, in lax mostly 10-12-flowered corymbs, with linear acuminate rose-colored caducous bracts and bractlets; calyx-tube narrowly obconic, glabrous, the lobes long, slender, acuminate, entire or minutely dentate, glabrous on the outer, furnished with a few hairs on the inner surface, reflexed after anthesis;

stamens 5-10, usually 5-7; anthers rose color; styles 4 or 5 surrounded at the base by a narrow ring of pale tomentum. Fruit ripening at the end of September, on long slender drooping pedicels, in wide lax many-fruited clusters, short-oblong, full and rounded at the ends, or occasionally narrowed at the apex, 8-9 mm. long and 5-6 mm. in diameter; calyx small, with a deep narrow cavity, and small closely appressed often deciduous lobes; flesh yellow, sweet and juicy; nutlets 4 or 5, thin, narrowed and rounded at the base, acute at the apex, slightly ridged or rounded and grooved on the back, 5.5-6 mm. long and 3-4 mm. wide.

A shrub 6-7 m. high, with several wide-branched stems forming a compact round-topped head, slender glabrous branchlets, light orange yellow when they first appear, becoming light chestnut-brown, lustrous and marked by small dark lenticels in their first season and pale gray-brown the following year, and armed with stout nearly straight light chestnut-brown lustrous ultimately ashy gray spines 1.5-2.5 cm. long.

Fields near St. Clair, St. Clair County, *C. K. Dodge* (Nos. 72 and 72A), May 29 and September 18, 1904.

3. **Crataegus Streeteae,** Sargent, *Proc. Rochester Acad. Sci.* iv, 119 (1903).

Leaves ovate, acuminate and often long-pointed at the apex, rounded, truncate or abruptly cuneate at the wide entire base, sharply and often doubly serrate above, with long slender spreading glandular teeth, and slightly divided into 3 or 4 pairs of small acuminate lobes; more than half-grown when the flowers open about the 20th of May and then very thin, light yellow-green and roughened above by short white hairs, and at maturity thin, conspicuously wrinkled, dark green and scabrate on the upper surface, pale and glaucous on the lower surface, 3.5-5 cm. long and 3-4.5 cm. wide, with very thin midribs and primary veins; petioles slender, pubescent when they first appear, soon becoming glabrous, 2.5-3 cm. in length; leaves on vigorous shoots long-pointed, cordate at the base, often 6 cm. long and broad, with short stout conspicuously glandular petioles. Flowers 1.2-1.4 cm. in diameter, on long very slender puberulous pedicels, in compact many-flowered thin-branched compound corymbs; calyx-tube narrowly obconic, the lobes slender, acuminate, entire, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 7-10; anthers small, rose-colored; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September or early in October, on slender pedicels, in drooping many-fruited clusters, short-oblong, full and rounded at the ends, scarlet, lustrous, marked by numerous small pale dots, about 1 cm. long and 8 mm. in diameter; calyx only slightly enlarged, with a broad shallow cavity, and reflexed closely appressed lobes, their tips often deciduous from the ripe fruit; flesh thick, yellow, dry and mealy; nutlets 3 or 4, full and rounded at the ends, ridged on the back, with a broad high ridge, 6.5-7 mm. long.

A dense shrub with numerous stems covered with smooth dull gray bark, the lower horizontal, the upper ascending, and slender nearly straight glabrous branchlets tinged with red when they first appear, becoming dull gray or reddish brown and marked by numerous small pale lenticels in their first season and ashy gray the following year, and armed with few slender slightly curved dark red shining spines 3-4 cm. in length.

Sandy shore of the St. Clair River at Port Huron, *C. K. Dodge* (No. 43), May 25 and September 9, 1902, May 18 and September 4, 1903; also through Ontario and New York to western New England.

4. **Crataegus retrusa,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xx, 3 (1904).

Leaves ovate, rounded or abruptly cuneate at the broad entire base, sharply doubly serrate above, with straight glandular teeth, and deeply divided into 6 or 7 pairs of narrow acuminate spreading lateral lobes, about half-grown when the flowers open the middle of May and then membranaceous, yellow-green and slightly roughened above by short white hairs and pale and glabrous below; and at maturity thin, light yellow-green and scabrate on the upper surface, paler on the lower surface, 4.5-5 cm. long and 3-3.5 cm. broad, with thin midribs, and primary veins extending obliquely to the points of the lobes; petioles slender, glabrous, glandular, with minute usually deciduous glands, 1.5-2 cm. in length; leaves on vigorous shoots long-pointed, rounded or slightly cordate at the base, more deeply lobed, often 6-7 cm. long and 5-6 cm. wide. Flowers 1.2-1.5 cm. in diameter, on slender glabrous pedicels, in few-flowered compact corymbs; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed, acuminate and rose-colored at the apex, minutely glandular-dentate near the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 5-7; anthers dark rose color; styles 3 or 4. Fruit ripening at the end of September, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, or obovate and abruptly narrowed at the base, orange-scarlet, lustrous, 1-1.2 cm. long and 8-10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and slender closely appressed persistent lobes dark red on the upper side below the middle, their tips often deciduous from the ripe fruit; flesh thick, pale yellow, sweet and juicy; nutlets 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a broad grooved ridge, 5-5.5 mm. long and about 4 mm. wide.

A slender shrub, with small stems and branches forming an irregular open head, and slender nearly straight glabrous branchlets, dark red and marked by numerous small pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull light gray the following year, and armed with slender nearly straight chestnut-brown shining spines 2-2.5 cm. long, persistent and becoming branched on old stems.

Fields near St. Clair, St. Clair County, *C. K. Dodge* (No. 10), May 19 and October 24, 1903.

5. **Crataegus uber,** Ashe, *Jour. Elisha Mitchell Sci. Soc.* xx, (1904).

Leaves ovate, acuminate, rounded or abruptly concave-cuneate at the broad entire base, finely doubly serrate above, with straight glandular teeth, and divided into 6 or 7 pairs of broad acuminate lateral lobes; nearly fully grown when the flowers open at the end of May and then membranaceous, yellow-green, roughened above by short white hairs, and paler and glabrous below, and at maturity thin, but firm, dark bluish-green, smooth and glabrous on the upper surface, pale blue green on the lower surface, 5-6 cm. long and 4-5 cm. wide, with thin midribs and primary veins; petioles slender, slightly wing-margined at the apex, glabrous, 2.5-3.5 cm. in length; leaves on vigorous shoots thicker, cordate

at the broad base, often 7.5-8 cm. long and 6-6.5 cm. wide. Flowers 1.2-1.4 cm. in diameter, on long slender slightly villose pedicels, in broad lax mostly 5-10-flowered corymbs, the lower peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed, acuminate, coarsely glandular-dentate near the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5-8; anthers dark rose color; styles 4 or 5. Fruit ripening the middle of September, on short drooping pedicels, in 5 or 6 fruited clusters, short-oblong, full and rounded on the ends, crimson, very lustrous, marked by large pale dots, 1.4-1.6 cm. long and 1.2-1.4 cm. in diameter; calyx small, with a deep narrow cavity, and small spreading or erect persistent lobes villose on the upper side; flesh thick, pale, sweet and juicy; nutlets 4 or 5, narrowed and rounded at the base, acute at the apex, slightly ridged or rounded and grooved on the back, 6-7 mm. long and 4-5 mm. wide.

An arborescent shrub 5-6 m. high, with stout stems covered with dark scaly bark, large ascending and spreading branches forming a wide open head, and slender glabrous branchlets light orange color when they first appear, becoming light chestnut-brown, lustrous and marked by small pale lenticels in their first season and dull gray the following year, and armed with slender nearly straight light chestnut-brown shining spines 3.5-4 cm. long.

Roadsides near St. Clair, St. Clair County, *C. K. Dodge* (No. 10 A, type tree), May 29 and September 18, 1904, (No. 71), May 21 and September 6, 1903, May 19, 1905.

6. **Crataegus merita,** n. sp.

Leaves oblong-ovate, acuminate, rounded, subcordate or abruptly cuneate at the broad entire or glandular base, sharply doubly serrate above, with straight glandular teeth, and deeply divided into 5 or 6 pairs of narrow acuminate lateral lobes; more than half-grown when the flowers open from the 10th to the middle of May, and then thin, light yellow-green, very smooth and furnished above with a few soft caducous hairs and paler and glabrous below, and at maturity thick, dark green and very lustrous on the upper surface, pale on the lower surface, 5-7 cm. long and 5-6 cm. wide, with stout yellow midribs, and 5 or 6 pairs of prominent primary veins; petioles slender, slightly wing-margined at the apex, occasionally glandular, with persistent glands, 2-2.5 cm. in length. Flowers 1.5-1.6 cm. in diameter, on short slender glabrous pedicels, in compact mostly 7-12-flowered corymbs, with narrow-obovate to lanceolate acuminate glandular bracts and bractlets fading brown, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, minutely glandular-dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 5 or 6; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of thick white tomentum. Fruit ripening late in October, on short stout red pedicels, in few-fruited spreading clusters, short-oblong to slightly obovate, full and rounded at the ends, crimson, lustrous, conspicuously blotched with green at the apex, marked by small pale dots, 1-1.2 cm. long, 9-10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and long erect and slightly incurved lobes, their tips often deciduous from the ripe fruit; flesh thick and yellow; nutlets 3 or 4, gradually narrowed and acute at

the ends, only slightly ridged on the back, 5.5-6 mm. long and 3-4 mm. wide.

A shrub 3-5 m. high, with stout stems covered with dark scaly bark, ascending branches forming a narrow head, and slender glabrous branchlets dark green tinged with red when they first appear, becoming light orange-brown or chestnut-brown, lustrous and marked by small pale lenticels in their first season and dull gray-brown the following year, and armed with numerous slender nearly straight light chestnut-brown shining spines 3-5 cm. long.

Low moist soil near Grand Rapids, *E. J. Cole* (No. 29 type), September 20, 1901, May 15, 1903, September 4, 1905, (No. 30), May 15, 1901, (No. 31), May 15, 1901, September 19, 1902.

7. **Crataegus perlaeta**, n. sp.

Glabrous with the exception of a few soft caducous hairs on the upper surface of the young leaves. Leaves ovate, acuminate, rounded, cordate or occasionally abruptly cuneate at the broad entire base, finely doubly serrate above, with straight glandular teeth, and very slightly divided into 3 or 4 pairs of small acuminate spreading lobes; more than half-grown when the flowers open about the 20th of May and then dark yellow-green, very smooth and nearly glabrous above and pale below, and at maturity thin but firm in texture, yellow-green and lustrous on the upper surface, paler on the lower surface, 4.5-6 cm. long and 3.5-4 cm. wide, with slender yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, glandular, with minute persistent glands, 2.5-3 cm. in length. Flowers 1.5-1.6 cm. in diameter, on long slender pedicels, in very compact mostly 5-7-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, tinged with red, the lobes slender, acuminate, entire or finely glandular-serrate above the middle, reflexed after anthesis; stamens 5-7, usually 5; anthers dark rose color; styles 3 or 4. Fruit ripening at the end of September, on stout spreading stems, in few-fruited clusters, short-oblong to slightly obovate, scarlet, lustrous, marked by small pale dots, 1-1.1 cm. long, 8-9 mm. in diameter; calyx prominent, with a wide shallow cavity and spreading closely appressed lobes, their tips sometimes deciduous from the ripe fruit; flesh thin, yellow, rather juicy; nutlets 3 or 4, gradually narrowed and acute at the ends, rounded and sometimes grooved or slightly ridged on the back, 6.5-7 mm. long and 4.5-5 mm. wide.

A broad shrub 3-4 m. high, with slender nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with numerous stout nearly straight dark chestnut-brown shining spines 2.5-5 cm. long.

Pastures in moist soil near Grand Rapids, *E. J. Cole* and *C. S. Sargent* (No. 132), September 25, 1901, *E. J. Cole,* May 17, 1903, May 23 and September 28, 1904.

8. **Crataegus taetrica**, n. sp.

Leaves oval and gradually narrowed and cuneate at the base, or rarely ovate and broad and rounded at the base, acuminate, finely doubly serrate, with straight glandular teeth, and slightly divided usually only above the middle into 4 or 5 pairs of small spreading acuminate lobes; almost half-grown when the flowers open about the 20th

of May and then membranaceous, light yellow-green, roughened above by rigid white hairs and pale and glabrous below, at maturity thin, light yellow-green and scabrate on the upper surface and paler on the lower surface, 4-4.5 cm. long and 3-3.5 cm. wide, with slender midribs and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, glandular, with minute often persistent glands, 1.5-2.5 cm. in length. Flowers 1.3-1.4 cm. in diameter, on long slender glabrous pedicels, in wide lax mostly 10-14-flowered corymbs, with linear to lanceolate glandular caducous bracts and bractlets fading rose color, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate and rose-colored at the apex, entire, or minutely dentate near the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers purple; styles 4 or 5. Fruit ripening the middle of October, on short spreading stems, in few-fruited clusters, oval and gradually narrowed at the ends, scarlet, lustrous, blotched with yellow, marked by large pale dots, 1-1.2 cm. long and 9-10 mm. wide; calyx little enlarged, with a shallow narrow cavity and spreading lobes, their tips usually deciduous from the ripe fruit; flesh pale yellow, rather juicy; nutlets 4 or 5, acute at the ends, rounded and slightly grooved on the back, about 7 mm. long and 4-5 mm. wide.

A shrub 4-5 m. high, with small stems covered with dark scaly bark and spreading into large thickets, small ascending branches forming an open narrow head, and slender, slightly zigzag glabrous branchlets dark orange color and marked by small pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with stout nearly straight chestnut-brown shining ultimately dull gray spines 2-3 cm. long, and persistent and branched on old stems.

Low moist woods north of Port Huron, *C. K. Dodge* (No. 87 type), May 17 and October 22, 1903, May 26, 1905.

9. **Crataegus asperata,** n. sp.

Leaves oblong-ovate, acuminate, rounded or cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 6 or 7 pairs of short broad acuminate lateral lobes, deeply tinged with red when they unfold, nearly half-grown when the flowers open from the 15th to the 20th of May and then membranaceous, yellow-green and roughened above by short, rigid white hairs and pale and glabrous below, and at maturity thin, dull bluish green and scabrous on the upper surface and pale blue-green on the lower surface, 4.5-5 cm. long and 2.5-4 cm. wide, with thin midribs and primary veins; petioles slender, narrowly wing-margined at the apex, slightly hairy on the upper side while young, becoming glabrous, glandular, with minute often persistent glands, 2-2.5 cm. in length; leaves on vigorous shoots broadly ovate, cordate or truncate at the base, more coarsely serrate and more deeply lobed, often 6-7 cm. long and nearly as broad, with stout conspicuously glandular petioles. Flowers 1.5 cm. in diameter, on long slender slightly villose pedicels, in wide lax hairy mostly 12-15-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube broadly obconic, glabrous, the lobes gradually narrowed from wide bases, acuminate, glandular-serrate, glabrous on the outer, slightly

villose on the inner surface, reflexed after anthesis; stamens 20; anthers dark rose color; styles 4 or 5. Fruit ripening at the end of September on slender nearly glabrous pedicels, in few-fruited drooping clusters, at first; when fully grown obovate, slightly narrowed at the apex, gradually narrowed to the long slender base, becoming at maturity short-oblong and full and rounded at the ends, scarlet, lustrous, marked by large pale dots, 1-6-1.8 cm. long and 1.4-1.6 cm. in diameter; calyx little enlarged, with a narrow deep cavity, and closely appressed persistent lobes dark red on the upper side below the middle and villose above; flesh thick and yellow; nutlets 4 or 5, thin, narrowed and rounded at the base, acute at the apex, rounded and slightly grooved or obscurely ridged on the back, 6-7 mm. long and 4-5 mm. wide.

An arborescent shrub, 4-5 m. high, with slender nearly straight glabrous branchlets, purple when they first appear, becoming bright chestnut-brown, lustrous and marked by many pale lenticels in their first season and dull reddish brown the following year, and armed with stout nearly straight purplish spines 2-2.5 cm. long.

Port Huron, *C. K. Dodge* (No. 19 type), May 25 and October 10, 1902, May 18 and October 3, 1903.

V. MOLLES.

Stamens 20; anthers pale yellow.
- Leaves broadly ovate.
  - Fruit short-oblong to subglobose; flowers at least 2 cm. in diameter.
    - Fruit scarlet, ripening in August or early September; pedicels stout, short, densely tomentose; leaves thick to subcoriaceous. 1. C. mollis.
    - Fruit orange-red, ripening late in October or in November; pedicels slender, elongated, villose; leaves very thin. 2. C. nutans.
  - Fruit obovate; flowers not more than 1 cm. in diameter. 3. C. mollipes.
- Leaves oblong-ovate, thin; fruit obovate-oblong, dull dark red, ripening in October. 4. C. sera.

Stamens 10; anthers rose color; leaves oval. 5. C. Ellwangeriana.

1. **Crataegus mollis**, Scheele, *Linnaea*, xxi. 569 (1848).—Sargent, *Silva N. Am.* xiii. 83, t. 659; *Bot. Gazette*, xxxv. 379; *Man.* 423, f. 341.

Leaves broadly ovate, acute, usually cordate or rounded at the broad base, coarsely and generally doubly serrate, with straight glandular teeth, and more or less deeply divided into 4 or 5 pairs of acute lateral lobes; when they unfold covered above with short pale hairs and hoary-tomentose below, about half-grown when the flowers open early in May and then thin, light yellow-green and hairy above, pubescent or tomentose below, and at maturity thick and firm in texture, dark yellow-green and slightly rugose on the upper surface and paler and pubescent or puberulous on the lower surface along the stout midribs, and 4 or 5 pairs of primary veins extending to the points of the lobes, 8-10 cm. long and broad; petioles stout, at first tomentose, becoming pubescent

or nearly glabrous, often slightly glandular, with small dark caducous glands, 2.5-3 cm. in length; leaves on vigorous shoots thicker, more deeply lobed, with a deeper basal sinus, and frequently 12-14 cm. long and broad, with foliaceous lunate coarsely serrate stipules sometimes 2.5 cm. in length. Flowers 2.2 to 2.5 in diameter, on stout tomentose pedicels, in broad compound many-flowered tomentose corymbs, with conspicuous bracts and bractlets; calyx-tube narrowly obconic, hoary-tomentose, the lobes narrow, acuminate, coarsely glandular-serrate, villose on the outer, tomentose on the inner surface, reflexed after anthesis; stamens 20; anthers large, light yellow; styles 4 or 5, surrounded at the base by a broad ring of hoary tomentum. Fruit ripening late in August and early in September, on stout villose pedicels, in drooping few-fruited clusters, short-oblong to subglobose, full and rounded at the ends, more or less pubescent, scarlet, marked by occasional large dark dots, 2-2.5 cm. in diameter; calyx prominent, hairy, with a broad shallow cavity, and large erect incurved lobes usually deciduous before the fruit ripens; flesh thick, yellow, subacid, dry and mealy; nutlets 4 or 5, thin, acute at the ends, rounded and slightly grooved or irregularly ridged on the back with a high narrow ridge 6-6.5 mm. long and 4-4.5 mm.wide.

A tree sometimes 12-14 m. high, with a tall trunk often 4.5 dm. in diameter, heavy wide-spreading smooth ashy gray branches forming a broad round-topped often symmetrical head, and stout branchlets covered when they first appear with a thick coat of long white hairs, villose during their first season, becoming glabrous in their second year, and armed with occasional thick straight bright chestnut-brown shining spines 2.5-5 cm. long.

Low rich soil usually on the bottom-lands of streams, near St. Clair, St. Clair County, *C. K. Dodge* (Nos. 16 and 16 B); Ypsilanti, *O. A. Farwell* (No. 1078), May 27, 1891, Hubbardston, *E. F. Smith* (No. 2); also Ohio to Nebraska, Missouri and Kansas.

2. **Crataegus nutans**, n. sp.

Leaves broadly ovate, acute, rounded or truncate at the entire base, coarsely serrate above with straight glandular teeth, and divided into 4 or 5 pairs of broad acute lateral lobes; about half-grown when the flowers open from the 20th to the 25th of May and then membranaceous, yellow-green and roughened above by short white hairs and villose-pubescent below especially along the midribs, and at maturity very thin, yellow-green and scabrate on the upper surface, pale and still villose on the lower surface along the slender midribs and primary veins, 6-7.5 cm. long and 6-7 cm. wide. Flowers 2 cm. in diameter, on short slender hoary-tomentose pedicels on very long slender villose peduncles, in wide lax mostly 10-12-flowered corymbs, with oblong-obovate acute glandular bracts and bractlets fading brown and often persistent until the petals fall, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with long matted pale hairs, the lobes slender, acuminate, finely glandular-serrate, glabrous on the outer, hoary-tomentose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in October or early in November, on short stout hairy pedicels on very long stout drooping villose stems, in many-fruited clusters, short-oblong to subglobose or slightly obovate, full and rounded at the ends, orange-red, lustrous, marked by

occasional large dark lenticels, 1-1.2 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity and erect or incurved lobes, usually deciduous before the fruit ripens; flesh thin, yellow, hard and dry; nutlets 4 or 5, thin, acute at the ends, rounded and slightly grooved on the back, about 7 mm. long and 5 mm. wide.

An arborescent shrub 5-7 m. high, with several stems covered with dark gray scaly bark, large spreading branches forming an open irregular head, slender branchlets, dull orange color, villose and marked by pale lenticels when they first appear, becoming light chestnut-brown covered with matted pale hairs and lustrous in their first season, lighter-colored and glabrous the following year and ultimately pale gray-brown.

Near Algonac, St. Clair County, *C. K. Dodge* (No. 47 type), Oct. 29, 1902, May 27, 1904; a single plant in an old and neglected hedge and no doubt brought from the neighborhood.

3. **Crataegus mollipes**, n. sp.

Leaves ovate, acute, rounded or occasionally slightly cordate or cuneate at the entire base, sharply serrate above, with long glandular teeth, and often slightly divided into 4-6 pairs of broad acute lateral lobes; more than half-grown when the flowers open usually about the 20th of May and then thin, dark yellow-green and slightly roughened above by short white hairs and pale and villose below along the midribs and veins, and at maturity thin, dark yellow-green, lustrous and scabrate on the upper surface, light yellow-green and soft-pubescent on the lower surface, 5-7 cm. long and 4-6.5 cm. wide, with stout villose midribs and thin villose primary veins extending obliquely to the points of the lobes; petioles slender, villose, 2.5-3.5 cm. in length; leaves on vigorous shoots thin, broad or abruptly narrowed, and rounded at the base, coarsely serrate, more deeply lobed and often 9-10 cm. long and 8-9 mm. wide, with slender petioles 4-4.5 cm. in length. Flowers not more than 1-1.1 cm. in diameter, on short stout pedicels coated with long matted white hairs, in compact mostly 7-10-flowered hairy corymbs, with obovate to linear glandular bracts and bractlets persistent until after the flowers open, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely coated with hoary tomentum, the lobes short, acute, laciniately glandular-serrate, tomentose on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5. Fruit ripening late in September, on short stout hairy pedicels, in few-fruited drooping clusters, obovate, slightly narrowed at the apex, gradually narrowed to the often unsymmetrical base, scarlet, lustrous, marked by occasional large pale dots, densely pubescent at the ends, 1.4-1.5 cm. long and 8-9 mm. in diameter; calyx prominent, with a deep narrow cavity, and erect and incurved persistent lobes; flesh thin, yellow, rather hard; nutlets 4 or 5, acute at the ends or rounded at the apex, rounded and slightly grooved or obscurely ridged on the back, 6-6.5 mm. long and 4-4.5 mm. wide.

A bushy tree 6-7 m. high, with slender slightly zigzag branchlets, dark yellow-green, pubescent and marked by pale lenticels when they first appear, becoming chestnut-brown and lustrous in their first season and light orange-brown the following year, and armed with numerous slender nearly straight purplish shining spines 3-3.5 cm. long.

Moist soil near Grand Rapids, *E. J. Cole* (No. 121 type), May 25 and September 30, 1903, September 19, 1904.

This plant seems to be well distinguished from the other species of this group by its small, later flowers produced in small few-flowered corymbs, and from the other Michigan species of the group by its small leaves and distinctly obovate fruit.

4. **Crataegus sera**, Sargent, *Bot. Gazette*, xxxiii, 115 (1902); xxxv, 379; *Silva N. Am.*, xiii, 87, t. 661; *Man.*, 424, f. 342.

Leaves oblong-ovate, acute or acuminate, rounded, truncate or slightly cordate at the broad base, sharply and sometimes doubly serrate, with straight glandular teeth, and irregularly divided into 4 or 5 pairs of short acute lateral lobes; unfolding about the 1st of May with the opening of the flowers and then covered above with short soft white hairs and tomentose below, and at maturity thin, dark yellow-green and glabrous on the upper surface, pubescent on the lower surface, 5-10 cm. long and 6.5-7.5 cm. wide, with slender midribs, and thin remote primary veins extending to the points of the lobes; petioles slender, tomentose, ultimately pubescent, 2.5-3.5 cm. in length; leaves on vigorous shoots more deeply lobed and often 10-12.5 cm. long and 7-10 cm. wide. Flowers 1.8-2 cm. in diameter, on stout tomentose pedicels, in compact compound many-flowered tomentose corymbs; calyx-tube broadly obconic, coated with matted pale hairs, the lobes broad, acute or acuminate, glandular-serrate, with large dark glands, tomentose on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or usually 5. Fruit ripening about the 1st of October, on stout puberulous petioles, in drooping few-fruited clusters, obovate to short-oblong, dull dark red, marked by small pale dots, usually slightly villose or pubescent at the ends, 2-2.5 cm. long and 1.7-1.4 cm. in diameter; calyx prominent, with a wide deep cavity, and erect and incurved coarsely glandular-serrate lobes often deciduous before the ripening of the fruit; flesh thick, dry and mealy; nutlets usually 5, or 4, thin, acute at the ends, rounded and slightly grooved on the back, 7-7.5 mm. long and 4.5-5 mm. wide.

A tree 10-12 m. high, with a tall straight trunk 3-4.5 dm. in diameter; thick branches forming a broad round-topped symmetrical head, and stout branches hoary-tomentose when they first appear, becoming light red-brown and puberulous in their first season and ultimately pale orange-brown, and armed with occasional straight or slightly curved chestnut-brown lustrous spines 3-4 cm. long.

Low moist soil in the neighborhood of streams; Belle Isle, *C. S. Sargent*, (No. 2), May 23, 1899, September 25, 1901, *O. A. Farwell*, September, 1901, May 17, 1902; near Port Huron, *C. K. Dodge*, (Nos. 2, 2A, 33, 45, 46, 48, 50, 73, 86, 117, 123), 1901-1905; Grand Rapids, *E. J. Cole* and *C. S. Sargent*, September 25, 1901, *E. J. Cole*, (No. 130), May 9 and September 2, 1902, *E. J. Cole* and *C. S. Sargent*, September 25, 1901, *E. J. Cole*, May 14 and September 20, 1902; also in northern Illinois and western Ontario.

5. **Crataegus Ellwangeriana**, Sargent, *Bot. Gazette* xxxiii. 118 (1902); *Silva N. Am.* xiii. 109, t. 671; *Proc. Rochester Acad. Sci.* iv. 112; *Man.* 441, f. 359.

Leaves oval, acute, full and rounded or broadly cuneate at the entire base, coarsely and often doubly serrate above, with straight or incurved glandular teeth, and irregularly divided usually only above the middle into numerous short acute lobes; about half-grown when the flowers

open the middle of May and then roughened above by short pale hairs and villose below along the slender midribs and primary veins, and at maturity thin, light green and scabrous on the upper surface, pale and nearly glabrous on the lower surface, 6-7 cm. long and 5-6 cm. wide; petioles slender, at first villose, becoming glabrous, 3.5-5 cm. in length; stipules oblong-obovate, acute, villose, coarsely glandular-serrate, often 3 cm. long, those of the upper leaves mostly persistent until after the ripening of the fruit. Flowers 2-7.4 cm. in diameter, on short stout hairy pedicels, in many-flowered densely villose corymbs; calyx-tube broadly obconic, the lobes elongated, lanceolate, glandular, with small pale stalked glands, villose; stamens 10, sometimes 8; anthers small, rose color; styles 3-5. Fruit ripening and falling at the end of September, on slender glabrous stems, in drooping slightly hairy many-fruited, crowded clusters, short-oblong, full and rounded at the ends, bright crimson, covered at the ends with scattered pale hairs, about 2.5 cm. long and 1.5-2 cm. in diameter; calyx little enlarged, the lobes elongated, glandular-serrate above the middle, villose on the inner surface, spreading or erect and incurved; flesh thin, yellow, juicy and acid; nutlets 3-5, gradually narrowed and acute at the ends and irregularly ridged or rounded and slightly grooved on the back, 6-6.5 mm. long and 4.4-5 mm. wide.

A tree sometimes 7 or 8 m. high, with a trunk often 3 dm. in diameter, covered with pale gray scaly bark, stout ascending branches forming a broad symmetrical head, and slender zigzag branchlets dark green and covered when they first appear with long matted pale hairs, becoming light chestnut-brown and slightly villose in their first season and dark chestnut-brown and very lustrous the following year, and armed with stout straight or somewhat curved dark chestnut-brown shining spines 4-5 cm. long.

Near Port Huron, *C. K. Dodge* (No. 22), May 25 and October 9, 1902, September 12, 1905, (No. 75), May 13 and 21 and September 6, 1903; also through Ontario to western New York.

VI. FLABELLATAE.

Stamens 20; leaves ovate; pedicels glabrous; fruit obovate. 1. C. miranda.

Stamens 10 or less.
- Fruit on long drooping peduncles.
  - Fruit obovate, narrowed to the long slender base, crimson; leaves deeply lobed. 2. C. lenta.
  - Fruit oval or slightly obovate, orange-red; leaves slightly lobed. 3. C. pura.
- Fruit on erect or spreading peduncles.
  - Fruit oval or slightly obovate; leaves oblong-ovate. 4. C. cæsa.
  - Fruit short-oblong; leaves oval, concave. 5. C. Pringlei.

1. **Crataegus miranda**, n. sp.

Leaves ovate, long-pointed and acuminate at the apex, abruptly concave-cuneate or rounded at the base, sharply doubly serrate, and slightly divided into 4 or 5 pairs of small acuminate spreading lobes; about one-third grown when the flowers open at the end of May and then rough-

ened above by short white hairs and glabrous below, and at maturity thin, light yellow-green and scabrate on the upper surface, pale yellow-green on the lower surface, 6-7 cm. long and 4.5-6 cm. wide, with slender orange-colored midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glabrous, glandular, with minute persistent glands, 3-4 cm. in length; leaves on vigorous shoots long-pointed, gradually narrowed and cuneate at the base, often 8 cm. long and 6 cm. wide, with stout broadly-winged conspicuously glandular petioles. Flowers 1.8-2 cm. in diameter, on long stout slightly hairy pedicels, in narrow mostly 10-12-flowered corymbs; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, often glandular-serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 15-20, rarely 20; anthers pink; styles 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in September, on slender glabrous pedicels, in few fruited clusters, obovate, scarlet, lustrous, marked by small pale dots, 1.2-1.4 cm. long, about 1 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and reflexed closely appressed lobes; flesh thick, sweet and succulent; nutlets 5, thin, acute at the ends, slightly grooved on the back, 6 mm. long and 4.5-5 mm. wide.

An arborescent shrub 7-8 m. high, with numerous small stems, large ascending branches forming an open head, and stout slightly zigzag glabrous branchlets dark orange-green when they first appear, becoming dull reddish-brown and marked by small pale lenticels in their first season and pale gray-brown in their second year, and armed with slender nearly straight chestnut-brown shining ultimately gray spines, 4-5 cm. long, very numerous, persistent and compound on old stems.

Port Huron, *C. K. Dodge* (No. 26 A), May 20 and October 20, 1903, May 22, 1905, (No. 61), May 20 and September 13, 1903, May 22, 1905; also on the shores of the St. Clair River below Sarnia, Ontaria, *C. K. Dodge* (No. 99 type).

2. **Crataegus lenta,** Ashe, *Jour. Elisha Mitchell Sci. Soc.,* xviii, 18 (1902).

Leaves oval to ovate, long-pointed and acuminate at the apex, gradually or abruptly narrowed and concave-cuneate at the entire base, sharply doubly serrate above, with slender straight or incurved glandular teeth, and deeply divided into 6-8 pairs of narrow acuminate spreading or recurved lobes; nearly half-grown when the flowers open about the 20th of May and then membranaceous, yellow-green and roughened above by short white hairs and paler and slightly hairy below along the midribs and primary veins, and at maturity thin but firm in texture, bluish green and glabrous on the upper surface and nearly glabrous on the lower surface, 7-9 cm. long and 5-6 mm. wide, with slender yellow midribs, and primary veins extending obliquely to the points of the lobes; petioles very slender, slightly wing-margined at the apex, villose while young on the upper side, soon glabrous, 2.5-3.5 cm. in length; leaves on vigorous shoots ovate, acuminate, abruptly cuneate or rounded at the broad base, coarsely serrate, deeply lobed, often 9-10 cm. long and 8-9 cm. wide, with stout conspicuously glandular petioles. Flowers 1.6-1.8 cm. in diameter, on slender slightly hairy pedicels, in wide lax mostly 10-15 flowered corymbs, with conspicuous oblong-obovate glandular bracts and bractlets fading brown and generally persistent until after

the flowers open; stamens 5-10, usually 5-7; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the middle of September, on stout glabrous pedicels, on long drooping peduncles, obovate, slightly narrowed at the rounded apex, gradually narrowed from above the middle to the long slender base, crimson, lustrous, marked by large pale dots, 1.4-1.6 cm. long and 9-10 mm. in diameter; calyx little enlarged, with a narrow deep cavity and erect and incurved lobes generally persistent on the ripe fruit; flesh thick, pale yellow, sweet and juicy; nutlets 3 or 4, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a broad low ridge, 7-8 mm. long and about 5 mm. wide.

An arborescent shrub, 7-8 m. high, with stout stems covered with pale scaly bark, stout, erect and spreading branches forming a broad open irregular head, and slender zigzag glabrous branchlets, light orange color and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray brown the following year, and armed with slender straight or slightly curved purplish spines 2-3 cm. long, persistent and branched on old stems.

Near Port Huron, *C. K. Dodge,* (No. 24 type-tree), May 25 and October 9, 1902, May 18 and October 13, 1903, September 12, 1905, (No. 24 A), May 26 and October 9, 1902, May 26 and October 13, 1903, (No. 24 B), May 27 and September 27, 1905, (No. 118), September 22, 1904, May 22, 1905.

3. **Crataegus pura,** n. sp.

Leaves oblong-ovate, acute or acuminate at the apex, abruptly cuneate or rounded at the broad entire base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate spreading lateral lobes; about half-grown when the flowers open the midle of May and then thin, yellow-green, roughened above by short white hairs and glabrous below with the exception of a few short persistent hairs at the base of the primary veins, and at maturity thin but firm in texture, dark yellow-green, lustrous and scabrate on the upper surface, pale on the lower surface, 6-8 cm. long and 4.5-6.5 cm. wide, with stout orange-colored midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly villose, often glandular toward the apex, 2.5-3 cm. in length. Flowers 1.6-1.8 cm. in diameter, on slender villose pedicels, in very compact hairy mostly 6- or 7-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes wide, acuminate, glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 7 or 8; anthers dark rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the 10th of September and usually persistent until the end of the month, on slender villose drooping pedicels, in few-fruited clusters, oval to slightly obovate, bright orange-red, marked by small dark dots, 1.3-1.5 cm. long, 8-10 mm. in diameter; calyx prominent, with a wide shallow cavity, and erect and incurved persistent lobes; flesh thin, yellow, rather soft; nutlets 3 or 4, acute at the ends, slightly ridged on the back, with a low narrow ridge, 8.5-9 mm. long and 4-4.5 mm. wide.

A broad shrub 4 or 5 m. high, with stems covered with dark gray scaly bark, and stout slightly zigzag branchlets dark green, pubescent and marked by pale lenticels when they first appear, becoming light chestnut-

brown and lustrous in their first season and dark gray-brown the following year, and armed with occasional stout nearly straight chestnut-brown ultimately dark gray spines 3.5-4 cm. long.

Moist soil near Grand Rapids, *E. J. Cole* (No. 28 type), May 15 and September 9, 1902, May 15 and September 9, 1904, (No. 149-1) May 17, 1903, May 17 and September 5, 1904, (No. 155) September 21, 1904, May 17, 1905.

4. **Crataegus caesa**, Ashe, *Jour. Elisha Mitchell Sci. Soc.* xviii. 24 (1902).

Leaves ovate, acute or acuminate at the apex, rounded or abruptly cuneate at the broad base, sharply doubly serrate, and slightly divided into 5 or 6 pairs of small acuminate lateral lobes; more than half-grown when the flowers open about the 20th of May and then thin, yellow-green, roughened above by short white hairs and nearly glabrous below, and at maturity thin but firm in texture, dull dark green and smooth on the upper surface, paler and slightly villose on the lower surface along the thin prominent midribs and primary veins deeply impressed on the upper side of the leaf, 6-7 cm. long and 4-5 cm. wide; petioles slender, slightly wing-margined at the apex, villose while young, becoming nearly glabrous, 1.5-2 cm. in length; leaves on vigorous shoots broadly ovate, rounded or cordate at the base, often 7-8 cm. long and 5-6 cm. wide. Flowers 1.8-2 cm. in diameter, on slender slightly villose pedicels, in compact mostly 10-12-flowered hairy corymbs, with lanceolate often falcate glandular bracts and bractlets often persistent until after the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, acuminate, glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens usually 10; anthers dark rose color; styles 2-4, surrounded at the base by a narrow ring of pale hairs. Fruit ripening about the 10th of October, on stout erect slightly hairy pedicels, in 4 or 5-fruited clusters, short-oblong to slightly obovate, full and rounded at the apex, concave at the insertion of the pedicel, scarlet, lustrous, marked by numerous pale dots, about 1 cm. long and 9-9.5 mm. in diameter; calyx prominent, with a deep narrow cavity, and elongated erect and slightly incurved persistent lobes; flesh thick, yellow, sweet and juicy; nutlets 3 or 4, narrowed and rounded at the ends or acute at the apex, ridged on the back, with a high narrow ridge, 7-8 mm. long and 5-5.5 mm. wide.

A tree 7-8 m. high, with a trunk from 2-2.5 dm. in diameter covered with dark scaly bark, stout spreading or ascending branches forming a broad open irregular head, and slender nearly straight branchlets, light orange-green when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and dark gray the following year, and armed with few stout nearly straight gray-brown spines 2.5-3 cm. long, becoming branched and persistent on old stems.

Border of woods in sandy soil near the shores of the St. Clair River at Port Huron, *C. K. Dodge* (No. 49; type tree), May 25 and October 9, 1902, May 18 and October 13, 1903, (No. 22 A) May 25 and October 9, 1902, May 18 and October 13, 1903, (No. 34) May 25 and October 9, 1903, (No. 36) May 25 and October 9, 1902, (No. 41) May 20 and September 18, 1903, (No. 65 with 6-9 stamens) May 15 and September 6, 1903 (No.

77) May 29 and September 28, 1904; near Grand Rapids, *E. J. Cole* (No. 40), May 15 and September 7, 1905.

5. **Crataegus Pringlei**, Sargent, *Rhodora*, iii, 21 (1901); *Silva N. Am.* xii, 111, t. 672; *Proc. Rochester Acad. Sci.*, iv, 112; *Man.*, 446 f. 363.

Leaves oval, acute, rounded or often abruptly narrowed and cuneate at the base, coarsely and often doubly serrate, with glandular teeth, and occasionally irregularly divided above the middle into short broad acute lobes; as they unfold covered with soft white hairs and more or less tinged with red, when the flowers open, usually in the last week of May, roughened above by short closely appressed pale hairs and glabrous below with the exception of a few hairs on the slender midribs and remote primary veins, and at maturity thin, glabrous, bright yellow-green on the upper surface, pale on the lower surface, 5-6 cm. long, 4.5-5 cm. wide, usually conspicuously concave by the gradual turning down of the blades from the midribs to the margins, and drooping on long thin slender glandular petioles, at first villose, becoming glabrous, and 2.5-4 cm. in length; leaves on vigorous shoots sometimes truncate or slightly cordate at the base and frequently 7.5 to 8 cm. long and broad. Flowers about 2 cm. in diameter, on stout hairy pedicels, in many-flowered compound villose corymbs; calyx-tube narrowly obconic, villose particularly toward the base, the lobes narrow, acuminate, coarsely glandular-serrate, villose, or sometimes glabrous on the outer surface, reflexed after anthesis; stamens 10, occasionally 5-10; anthers small, dark rose color; styles 3-5, surrounded at the base by conspicuous tufts of pale tomentum. Fruit ripening and falling late in September or early in October, on stout hairy pedicels, in erect mostly few-fruited clusters, short-oblong, dark dull red and marked by occasional dark dots, hairy at the ends, with long scattered pale hairs, about 2 cm. long and 1.5-1.6 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and acuminate glandular-serrate, usually persistent lobes gradually narrowed from broad bases and spreading or often erect; flesh thick, yellow, dry and acid; nutlets 3-5, gradually narrow or acute at the ends or rounded at the apex, rounded and slightly ridged on the back, 7-7.5 mm. long and 4.5-5 mm. wide.

A tree occasionally 8 m. high, with a tall trunk 2.5-3 dm. in diameter, with thin bark readily separating into large flakes covered by small loose dark red-brown scales, stout branches forming a wide symmetrical head, and slightly zigzag branchlets at first dark green and villose, soon becoming glabrous, chestnut-brown and lustrous, and bright orange-brown in their second year, and armed with thick straight or somewhat curved chestnut-brown spines often 3-4 cm. long.

Agricultural College, *C. F. Wheeler* (No. 8), September 28, 1898; near Port Huron, *C. K. Dodge*, (No. 51), May 27, 1904; also southern New Hampshire through southern Vermont to western Massachusetts, western New York, and northeastern Illinois.

VII. INTRICATAE.

Stamens at least 10.
  Anthers pale yellow.
    Fruit obovate, orange color. 1. C. Wheeleri.
    Fruit short-oblong, crimson. 2. C. pusilla.
  Anthers rose color; fruit short-oblong, dark orange-red. 3. C. Bealii.
Stamens 5-8; anthers pale yellow; fruit subglobose to short-oblong, dull yellow. 4. C. flavida.

1. **Crataegus Wheeleri**, n. sp.

Glabrous with the exception of a few soft caducous hairs on the upper surface of the young leaves. Leaves ovate to oval, acuminate, gradually or abruptly narrowed and concave-cuneate at the entire or glandular base, finely doubly serrate above, with straight glandular teeth, and divided into 3 or 4 pairs of short acute lateral lobes; nearly fully grown when the flowers open about the 1st of June and then thin, yellow-green, slightly hairy above, with soft caducous hairs most abundant on the midribs and veins, and at maturity thin, yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 3.5-4.5 cm. long and 2.5-3.5 cm. wide, with slender orange-colored midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly hairy on the upper side while young, soon glabrous, glandular, with minute persistent glands, often rose-colored in the autumn, 1-1.4 cm. in length. Flowers 1.5-1.8 cm. in diameter, on slender pedicels, in compact mostly 4- or 5-flowered corymbs, with obovate to linear glandular bracts and bractlets fading brown and usually persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, glandular-serrate above the middle, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3 or 4. Fruit ripening the end of September, on long slender erect stems, in usually 3- or 4-fruited clusters, obovate, full and rounded at the apex, gradually or abruptly narrowed at the base, bright orange color, lustrous, marked by occasional large dark dots, 1-1.2 cm. long and 8-9 mm. in diameter; calyx little enlarged, with a wide deep cavity, and elongated closely appressed often deciduous lobes; flesh thin, dark yellow-green, dry and mealy; nutlets 3 or 4, full and rounded at the ends, ridged on the back, with a broad low grooved ridge, 7-7.5 mm. long and 4.5-5 mm. wide.

A shrub 5-10 dm. high, with slender slightly zigzag branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray-brown the following year, and armed with very slender straight purplish shining spines 2-4 cm. long.

Dry sandy soil, near Grand Rapids, *E. J. Cole* (No. 102-1 type), September 25, 1904, June 3, 1905, (No. 102), May 25, 1901, September 10, 1902.

This species is named for Charles F. Wheeler, a critical student of the plants of Michigan, long an associate of Professor Beal at the Michi-

gan Agricultural College and with him the author of a *Flora of Michigan.*

2. **Crataegus pusilla**, n. sp.

Glabrous with the exception of a few hairs on the upper surface of the young leaves and on the inner surface of the calyx-lobes. Leaves oblong-ovate, acuminate, gradually or abruptly narrowed and concave-cuneate at the entire glandular base, finely doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small acute lobes; nearly fully grown when the flowers open during the first week of June and then yellow-green, smooth, lustrous and villose along the midribs and veins above and pale below, and at maturity thin, yellow-green, 4.5-5 cm. long and 3-3.5 cm. wide, with thin yellow midribs and primary veins; petioles slender, narrowly wing-margined sometimes nearly to the middle, glandular, with bright red glands, 1-2 cm. in length; leaves on vigorous shoots broadly ovate and often deeply lobed. Flowers 1.8-2 cm. in diameter, on long slender pedicels, in mostly 5-7 flowered corymbs, with linear-obovate to linear glandular-hispid rose-colored bracts and bractlets often persistent until after the flowers open; calyx-tube narrowly obconic, the lobes slender, acute, glandular-serrate, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3 or 4, surrounded at the base by a ring of short white hairs. Fruit ripening early in October, on stout erect stems, in 2- or 3-fruited clusters, short-oblong, full and rounded at the ends, crimson, more or less blotched with green, lustrous, marked by large dark dots, 1.2-1.4 cm. in diameter; calyx prominent, with a deep narrow cavity, and spreading often persistent lobes; flesh thin, yellow, hard and dry; nutlets 3 or 4, gradually narrowed to the rounded ends, rounded and only slightly ridged on the back, about 6 mm. long, and 3.5-4 mm. wide.

A shrub 5-10 m. high, with slender nearly straight branchlets dark orange-green tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by dark lenticels during their first season and dull reddish-brown the following year, and armed with stout straight red-brown spines 2.5-3 cm. long.

Dry soil near Grand Rapids, *E. J. Cole* (Nos. 66-2 type, 66-1, 66-3), September 25, 1904, June 3, 1905.

3. **Crataegus Bealii**, n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate to oval, acute or acuminate at the apex, rounded or abruptly cuneate at the broad entire or glandular base, doubly serrate above, with broad glandular teeth, and slightly divided into 3 or 4 pairs of short broad lateral lobes, about half-grown when the flowers open at the end of May and then thin, yellow-green and glabrous with the exception of a few soft caducous hairs along the upper side of the midribs and veins, and at maturity thick and firm to subcoriaceous, very dark yellow-green, smooth and lustrous on the upper surface, pale yellow-green on the lower surface, 5-8 cm. long and 4-7 cm. wide, with stout orange-colored midribs, and very thin primary veins extending to the points of the lobes; petioles stout, slightly wing-margined at the apex, villose along the upper side while young, soon becoming glabrous, glandular, with numerous persistent glands, often rose color in the autumn, 2-3 cm. in length; leaves on vigorous shoots coriaceous, coarsely serrate, more deeply lobed, often 8-9 cm. long and 7-8 cm. wide, with thick rose-

colored midribs, stout petioles winged nearly to the base, with broad glandular-serrate wings, and foliaceous lunate coarsely glandular-serrate persistent stipules. Flowers 1.4-1.5 cm. in diameter, on long slender pedicels, in mostly 5-8-flowered narrow corymbs, with large oblong-obovate glandular-hispid rose-colored bracts and bractlets persistent until the flowers open, the long lower peduncles from the axils of upper leaves; stamens usually 10, rarely 10-16; anthers pink; styles 3-5, surrounded at the base by a broad ring of pale tomentum. Fruit ripening the end of September, on long stout erect pedicels, in few-fruited clusters, short-oblong to subglobose, dark orange-red, lustrous, marked by many large dark dots, 1-1.2 cm. long and about 1 cm. in diameter; calyx very prominent, with a wide deep cavity, enlarged spreading and often slightly incurved persistent lobes dark red on the upper side below the middle; flesh thin, yellow-green, hard and dry; nutlets 3-5, gradually narrowed and rounded at the ends, or when 5, acute at the ends, ridged on the back with a high narrow ridge, 7-8 mm. long and 4-5 mm. wide.

A shrub 1-2 m. high, with stout erect stems, and stout apparently unarmed branchlets light orange-green and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season, or when very vigorous light reddish brown.

Roadsides in dry sandy soil near Grand Rapids, *E. J. Cole* (No. 116 type), May 30 and June 2, 1901, May 30 and September 9, 1902, *E. J. Cole* and *C. S. Sargent*, September 25, 1901, *E. J. Cole* (No. 116-1), May 27 and September 9, 1902 (No. 46), June 2, 1901, (No. 46-1), September 13, 1902, (No. 103), May 25, 1901, and September 8, 1902.

This distinct and handsome species is named for William J. Beal, the distinguished professor of botany at the Agricultural College of Michigan, an authority on Grasses, and the author of many important works on the flora of the state.

4. **Crataegus flavida**, n. sp.

Glabrous with the exception of the short rigid white caducous hairs on the upper surface of the unfolding leaves. Leaves oblong-obovate, acute, gradually narrowed and concave-cuneate at the entire base, finely serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acute lobes; nearly fully grown when the flowers open about the first of June and then thin, glabrous and yellow-green, and at maturity thin but firm in texture, yellow-green, paler on the lower than on the upper surface, 3.5-4 cm. long and 1.5-3 cm. wide, with thin yellow midribs and primary veins; petioles slender, narrowly wing-margined at the apex, occasionally glandular, often rose color in the autumn, 1.5-2 cm. in length; leaves on vigorous shoots subcoriaceous, broadly ovate to semiorbicular, short-pointed at the apex, rounded or cuneate at the base, coarsely serrate, more deeply lobed, with broad acuminate lobes, often 5-6 cm. long and wide, with stout broadly winged petioles. Flowers about 1.5 cm. in diameter, on long slender pedicels, in mostly 7-12-flowered lax corymbs, the lower peduncle from the axil of an upper leaf; stamens 5-8; anthers pale yellow; styles 3-5. Fruit ripening at the end of September, on long spreading or erect pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, dull yellow or orange-yellow, occasionally slightly tinged with red, 1-1.2 cm. in diameter, sometimes rather broader than high; calyx little enlarged, with a wide shallow cavity, and spreading

appressed usually persistent lobes; flesh thin, yellow-green, dry and mealy; nutlets 3-5, full and rounded or when 5 narrowed at the ends, ridged on the back, with a high broad ridge, 6-7 mm. long and about 5 mm. wide.

A shrub 2-3 m. high, with numerous intricately branched stems covered with ashy gray bark and forming a wide dense head, and stout slightly zigzag branchlets light orange-green tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by small pale lenticels in their first season and dull reddish brown the following year, and armed with numerous slender nearly straight purplish shining spines 4.5-5.5 cm. long.

Near St. Clair, *C. K. Dodge* (Nos. 9 A, 102, 108, 113, 127, 134 and 20), 1903-1906; also near London, Ontario.

VIII. COCCINEAE.

Stamens 10 or less; anthers pale yellow. 1. C. Dodgei.

1. **Crataegus Dodgei,** Ashe, *Jour. Elisha Mitchell, Sci. Soc.,* xix. 26 (March, 1903). Sargent, *Proc. Phil. Acad. Sci.,* 1905, 632; *Rhodora,* vii. 213.

Crataegus Gravesii, Sargent, *Rhodora,* v. 159 (June, 1903).
Crataegus fallens, Gruber, *Proc. Berks County Nat. Sci. Club,* i. 19 (October, 1903).

Glabrous with the exception of a few hairs on the inner surface of the calyx-lobes. Leaves broadly obovate, acute, gradually narrowed and concave-cuneate at the entire base, finely serrate above, with straight or incurved glandular teeth, and divided above the middle into 4 or 5 pairs of short broad acute lobes; slightly tinged with red when they unfold, nearly fully grown when the flowers open at the end of May and then thin and yellow-green, and at maturity thin but firm in texture, dark yellow-green and lustrous on the upper surface, paler on the lower surface, 3-4 cm. long and 2-3 cm. wide, with slender midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, occasionally glandular while young, with minute caducous red glands, 1.5-2 cm. in length; leaves on vigorous shoots thicker, ovate, coarsely serrate, more deeply lobed and often 4-5 cm. long and broad. Flowers 1.2-1.4 cm. in diameter, on slender pedicels, in compact mostly 10-12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, minutely glandular-serrate, reflexed after anthesis; stamens 7-10, usually 10; anthers pale yellow; styles 2 or 3, surrounded at the base by a broad ring of pale tomentum. Fruit ripening in October, on short stout red spreading pedicels, in few-fruited clusters, subglobose to short-oblong, crimson, lustrous, marked by small pale dots, 1-1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading incurved lobes dark red on the upper side toward the base and generally persistent on the ripe fruit; flesh thick, yellow, dry and mealy; nutlets 2 or 3, full and rounded at the ends, ridged on the back, with a broad grooved ridge, 5-6 mm. long and 3.5-4 mm. wide.

A broad round-topped shrub 2-3 m. high, with stout intricately

branched stems covered with dark scaly bark, and slender nearly straight branchlets light orange-green and marked by small pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull reddish brown the following year, and armed with numerous stout straight or slightly curved purplish shining spines 2.5-5.5 cm. long.

Sandy soil near Port Huron and St. Clair, St. Clair County, Michigan, common, *C. K. Dodge* (No. 6), May 21 and October 24, 1903, (No. 9), May 19 and September 24, 1903, (No. 109), October 2, 1904, May 28, 1905, (No. 124), June 4, 1905, (No. 126), May 26, 1905, (No. 134), September 21, 1905, May 29, 1906. Agricultural College, *W. J. Beal*, (Nos. 6 and 26), 1900 and 1901; Grand Rapids, *E. J. Cole*, (Nos. 126 and 126-1), 1901 and 1902; also through Ontario and western New York to eastern Massachusetts, southern Connecticut and eastern Pennsylvania.

With this species, which is now known to be one of the most widely distributed Thorns of the northern states, Mr. Ashe has associated the name of C. K. Dodge of Port Huron who for several years has carefully and systematically studied Crataegus in St. Clair County.

Crataegus Dodgei, var. lumaria, n. var.

Crataegus lumaria, Ashe, *Jour. Elisha Mitchell Sci. Soc.,* xix. 25 (1903).

Port Huron, *C. K. Dodge* (No. 35 type plant), May 25 and October 9, 1902, May 25 and October 3, 1903, May 31, 1905.

Crataegus lumaria was established on a single small shrub growing in sandy soil within the limits of the city of Port Huron, and although it differs from *C. Dodgei,* which is common in this region, in its slightly villose pedicels, rather less lustrous leaves and somewhat smaller fruit, it may perhaps best be considered a variety of that species, at least until other individuals are found.

IX. ANOMALAE.

Stamens usually 20; anthers pale pink.

Leaves broadly ovate to rhombic or obovate; fruit short-oblong. 1. C. urbana.

Leaves ovate to oval; fruit subglobose, sometimes broader than high. 2. C. Coleæ.

Stamens 5-10; anthers light rose color.

Leaves ovate, usually rounded or truncate at the broad base; pedicels densely villose; fruit subglobose, not more than 8 mm. in diameter. 3. C. honesta.

Leaves oblong-ovate to oval, usually cuneate at the base; pedicels slightly villose; fruit short-oblong, 1-1.2 cm. long. 4. C. pinguis.

1. **Crataegus urbana,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves broadly ovate to rhombic or obovate, acute or acuminate at the apex, abruptly cuneate or more rarely rounded at the

entire base, sharply doubly serrate above, with glandular teeth, and divided usually only above the middle into 3 or 4 pairs of short acute lobes; more than half-grown when the flowers open from the 15th to the 20th of May and then thin, yellow-green, lustrous and roughened above by short glistening white hairs, and pale bluish green below, and at maturity thin but firm in texture, dark yellow-green, smooth and lustrous on the upper surface, pale on the lower surface, 4.5-7 cm. long and 3.5-5.5 cm. wide, with thin yellow midribs and primary veins; petioles slender, wing-margined at the apex, glandular, with occasional minute glands, 2-2.5 cm. in length, leaves on vigorous shoots ovate to oval, long-pointed and acuminate at the apex, usually gradually narrowed and rounded at the base, more deeply lobed, often 7-8 cm. long and 5-6 cm. wide. Flowers 1.8-2 cm. in diameter, on long slender pedicels, in broad mostly 15-20-flowered crowded corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, finely glandular-serrate, reflexed after anthesis; stamens 13-20, usually 20; anthers pale pink; styles 2 or 3, surrounded at the base by a broad ring of lustrous white hairs. Fruit ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, crimson, lustrous, marked by large pale dots, 1.1-1.3 cm. long and 9-10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and spreading something slightly incurved persistent lobes; flesh thin, yellow, rather juicy; nutlets 2 or 3, usually 3, full and rounded at the ends, ridged on the back with a low slightly grooved ridge, marked on the inner faces by large shallow depressions, 6-7 mm. long and 3.5-4 mm. wide.

A shrub 3-4 m. high, with numerous stems spreading into broad thickets, and stout nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in their first season and dull reddish-brown the following year, and armed with many stout straight or slightly curved chestnut-brown shining spines 3-5 cm. long.

Moist ground near Grand Rapids, *E. J. Cole* (No. 3 type), May 20, 1901, September 20, 1903, (Nos. 3-1 and 3-2), May 16, 1901, September 20, 1901, (No. 6), May 20, 1901 and September 5, 1904.

2. **Crataegus Coleae**, Sargent, *Trees and Shrubs*, i. 7, t. 4 (1902).

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. Leaves ovate to oval, acute, abruptly cuneate at the broad entire base, finely often doubly serrate above, with incurved glandular teeth, and divided into numerous short acute lateral lobes; more than half-grown when the flowers open about the 20th of May and then bright yellow and lustrous above and pale below, and at maturity thin, dark green and lustrous on the upper surface, pale and somewhat glaucous on the lower surface, 4.5-5 cm. long and 3-3.5 cm. wide; petioles slender, slightly wing-margined at the apex, 1.2-1.5 cm. in length; stipules linear, coarsely glandular-serrate, caducous; leaves on vigorous shoots often rounded at the broad base, more coarsely serrate and more deeply lobed. Flowers 1.8-2 cm. in diameter, on long slender pedicels, in broad mostly 8-12 flowered corymbs, with linear-obovate to linear conspicuously glandular-serrate caducous bracts and bractlets, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, acuminate, gland-

ular-serrate, with small bright red stipitate glands, villose on the inner surface particularly toward the base, reflexed after anthesis; stamens 18-20; anthers large, tinged with pink; styles 2-5, usually 2-4, surrounded at the base by a broad ring of pale tomentum. Fruit ripening the end of September, on slender drooping stems, in many-fruited clusters, subglobose but often somewhat broader than high, bright orange-red marked by small pale dots, 8-10 mm. in diameter; calyx enlarged and prominent, with a broad deep tube and elongated reflexed lobes sometimes deciduous before the fruit falls; nutlets 2-5, broad, full and rounded at the ends, prominently ridged on the back, with a high broad ridge, slightly penetrated by shallow depressions, 7-8 mm. long.

A broad treelike shrub 4-5 m. high, with numerous stout spreading stems covered with close dark bark, and slender nearly straight or slightly zigzag branchlets marked by oblong pale lenticels, light yellow-green when they first appear, bright red-brown and very lustrous during their first season and dark gray-brown the following year, and armed with numerous stout nearly straight lustrous spines 2.5-4.5 cm. long and often pointed toward the base of the branch.

Hillsides in rich moist soil near Grand Rapids, *E. J. Cole* (No. 8-1 type), May and September, 1901.

This handsome shrub is named for Miss E. J. Cole of Grand Rapids, the author of *The Grand Rapids Flora* and a careful and industrious student of the plants of southern Michigan, where she has made a number of other important discoveries.

3. **Crataegus honesta**, n. sp.

Leaves ovate, acuminate, cuneate, rounded or truncate at the broad base, finely often doubly serrate above, with straight glandular teeth, and divided into 5 or 6 pairs of narrow acuminate spreading lateral lobes, not more than one-third grown when the flowers open about the middle of May and then membranaceous, yellow-green and roughened above by short white hairs and glabrous below, and at maturity thin, yellow-green and scabrate on the upper surface, pale yellow-green on the lower surface, 4.5-5 cm. long and 3.5-4 cm. wide, with thin yellow midribs and primary veins; petioles slender, slightly wing-margined at the apex, glabrous, occasionally glandular, 1.5-2.5 cm. in length; leaves on vigorous shoots broadly ovate, gradually narrowed and rounded at the base, more coarsely serrate and more deeply lobed, often 5-6 cm. long and 4.5-5 cm. wide, with stout broad-winged petioles. Flowers 1-1.2 cm. in diameter, on slender densely villose pedicels, in compact hairy mostly 10-15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, hairy at the base, glabrous above, the lobes slender, elongated, acuminate, irregularly glandular-dentate usually only above the middle or entire, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5-10; anthers light rose color; styles 2-4. Fruit ripening early in September, on stout still slightly hairy pedicels, in broad drooping clusters, subglobose or a little longer than broad, cherry red, lustrous, marked by pale dots, 7-8 mm. in diameter; calyx prominent with a broad shallow cavity, a long spreading often incurved generally persistent lobes; flesh thin, yellow, dry and hard; nutlets 2-4, full and rounded at the ends, or when more than 2, narrowed at the apex, ridged on the back,

with a broad high deeply grooved ridge, marked on the inner faces by broad depressions, 6.5-7 mm. long and 3.5-4 mm. wide.

A shrub 2-3 m. high, with stout slightly zigzag branchlets, dark orange-green and sparingly villose when they first appear, soon glabrous, becoming light chestnut-brown and marked by small pale lenticels in their first season and dull reddish brown the following year, and armed with numerous stout nearly straight chestnut-brown shining spines 2.5-3 cm. long.

Low moist soil near Grand Rapids, *E. J. Cole* (No. 4 type) May 16, 1901, September 5, 1904 (No. 5), May 16, 1901, May 24 and September 5, 1904.

4. **Crataegus pinguis**, n. sp.

Leaves oblong-ovate to oval, acuminate, abruptly cuneate or rounded at the entire base, sharply doubly serrate above, with straight glandular teeth, and very slightly divided into 5 or 6 pairs of small acute lateral lobes; not more than one-third grown when the flowers open from the 10th to the 15th of May, and then membranaceous, yellow-green and roughened above by short rigid white hairs and glabrous below, and at maturity very thin, yellow-green, lustrous and scabrate on the upper surface and paler on the lower surface, 5-5.7 cm. long and 5-6 cm. wide, with slender yellow midribs, and 5 or 6 pairs of thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly villose while young, soon becoming glabrous, often rose color in the autumn, 2.5-3 cm. in length. Flowers 8-10 mm. in diameter, on very slender slightly villose pedicels, in wide hairy mostly 10-15-flowered corymbs, with small linear-obovate to linear-glandular bracts and bractlets fading brown and often persistent until the flowers open, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, covered with long scattered pale hairs, the lobes small, acuminate and rose-colored at the apex, finely glandular-serrate, glabrous on the outer, slightly hairy on the inner surface, reflexed after anthesis; stamens 5 or 6; anthers dark rose color; styles 2 or 3. Fruit ripening the end of September, on long slender reddish spreading or erect stems, in few-fruited clusters, short-oblong, full and rounded at the ends, crimson, slightly pruinose, becoming lustrous, marked by large pale dots, 1-1.2 cm. long and 8-10 mm. in diameter; calyx little enlarged, with a narrow shallow cavity and small spreading and slightly incurved generally persistent lobes dark red on the upper side below the middle; flesh thick, yellow, soft and very succulent; nutlets 2 or 3, usually 2, full and rounded at the ends, ridged on the back, with a broad low deeply grooved ridge, marked on the inner faces by large irregular depressions, 6-7 mm. long and 4-4.5 mm. wide.

A tree sometimes 6 or 7 m. high, with a trunk often 1.5 dm. in diameter, covered with close dark gray bark, large spreading and ascending branches forming an open irregular head, and slender nearly straight glandular branchlets, light orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in their first season and light red-brown the following year, and armed with many stout slightly curved dark chestnut-brown shining spines 4-5.5 cm. long; or sometimes shrubby in habit and only 2 or 3 m. high.

Moist bottom-lands, near Lowell, about twenty-five miles southwest of Grand Rapids, *E. J. Cole* (No. 161 type), August 22, 1902, September 24, 1904, May 13, 1905 (Nos. 162 and 164), September 25, 1904.

X. TOMENTOSAE.

Leaves thin with midribs and veins only slightly impressed on their upper surface.
- Leaves pale-pubescent below at maturity; stamens 20.
  - Anthers rose color or pink.
    - Fruit obovate; corymbs villose; anthers dark rose color. 1. C. tomentosa.
    - Fruit subglobose; corymbs hoary-tomentose; anthers pink. 2. C. pubifolia.
  - Anthers pale yellow 3. C. structilis.
- Leaves glabrous at maturity; stamens 10; anthers rose color. 4. C. flammea.

Leaves subcoriaceous to coriaceous, with midribs and veins deeply impressed on their upper surface; stamens 20.
- Anthers rose color. 5. C. gemmosa.
- Anthers pale yellow. 6. C. Michiganensis.

1. **Crataegus tomentosa**, Linnaeus, *Spec.* 476 (1753); Sargent, *Silva N. Am.*, iv, 101, t. 183; *Proc. Phil. Acad. Sci.*, 1905, 656; *Man.*, 492, f. 406.

Leaves ovate to ovate-oblong, acute, abruptly acuminate or rarely rounded at the apex, gradually narrowed to the cuneate entire base, sharply and usually doubly serrate above, with broad spreading, often glandular teeth, and frequently divided above the middle into several short lateral lobes; nearly fully grown when the flowers open from the first to the middle of June, and at maturity thin but firm in texture, gray-green, puberulous or ultimately glabrous above, coated below with pale persistent pubescence, conspicuously reticulate, vinulose, 5-12 cm. long and 2.5-8 cm. wide, with broad midribs and primary veins; turning brilliant orange and scarlet in the autumn before falling; petioles stout, glandular, wing-margined, 1.3-2 cm. in length. Flowers 1.2-1.4 cm. in diameter, on slender villose pedicels, in broad compound many-flowered hairy corymbs; calyx-tube narrowly obconic, densely villose, the lobes lanceolate, acuminate, coarsely or pinnately serrate, usually glandular, reflexed after anthesis; stamens 20; anthers pale rose color; styles 2-5. Fruit ripening early in October, on slender erect pubescent pedicels, in broad many-fruited clusters, pear-shaped, dull orange-red, translucent when fully ripe, 1.2-1.4 cm. in diameter, mostly persistent on the branches until the following spring; calyx prominent, with a wide shallow cavity, and appressed usually persistent lobes; flesh thick, orange-yellow, sweet and succulent; nutlets 2-4, full and rounded at the ends, or when 3 or 4 gradually narrowed and acute at the ends or rounded at the apex; rounded and prominently ridged on the back, penetrated on the ventral faces by broad deep cavities, 6-7 mm. long and 3.4 mm wide.

A tree 3.5-7 m. high, with a trunk 1.2-1.5 dm. in diameter, covered

with smooth pale gray or dark brown furrowed bark, slender spreading often horizontal smooth gray branches forming a wide flat head, and slender branchlets hoary-tomentose when they first appear, becoming dark orange color and puberulous in their first winter and ashy gray in their second year, and unarmed or armed with occasional slender straight dull ashy gray spines 2.5-3 cm. long.

Port Huron, *C. K. Dodge* (No. 31), June 14 and September 17, 1902 (No. 62), June 6 and October 1, 1903; near St. Clair (No. 8), June 5 and September 11, 1902; Belle Isle, Detroit, *O. A. Farwell* (No. 1078A), June 2, 1899, May and September, 1903; Lansing, *E. F. Smith*, 1879 and 1882; Agricultural College, *W. J. Beal* (No. 11), June 5, 1900; near Grand Rapids, *E. J. Cole* (Nos. 11 and 42), June and September, 1900; also near Troy, New York, to eastern Pennsylvania, and through central New York to southern Minnesota, Iowa, Missouri and eastern Kansas, and southward along the Appalachian Mountains to northern Georgia and central Tennessee.

2. **Crataegus pubifolia,** Ashe, *Bull N. Car. College of Argiculture and Mechanic Arts*, clxxv. 114 (1900).

Leaves ovate to obovate, acute or acuminate at the apex, cuneate at the entire base, sharply often doubly serrate above, with straight or incurved glandular teeth, and slightly divided usually only above the middle into 3-5 pairs of narrow acuminate lobes; thin, yellow-green, roughened above by short appressed hairs and soft-pubescent along the midribs and veins below, more than half-grown when the flowers open during the first week of June, and at maturity 6-7 cm. long and 5-6 cm. wide, with slender midribs and primary veins; petioles stout, wing-margined often to below the middle, villose-pubescent, glandular, with minute usually deciduous glands, 1-1.5 cm. in length; leaves on vigorous shoots thicker, ovate, rounded or abruptly cuneate at the broad base, more coarsely serrate and more deeply lobed, often 7-8 cm. long and 6-7 cm. wide. Flowers 1.2-1.4 cm. in diameter, on short stout densely hoary-tomentose pedicels, in wide many-flowered tomentose corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly coated with matted white hairs, the lobes slender, acute, laciniately glandular-serrate, villose below and glabrous above the middle on the outer surface, tomentose on the inner surface, reflexed after anthesis; stamens 20; anthers pink; styles 2 or 3. Fruit ripening the end of September, on short pubescent pedicels, on long slender peduncles, in 15-20-fruited clusters, short-oblong to subglobose, orange red, lustrous, becoming translucent, 8-10 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and spreading and recurved often deciduous lobes; flesh thick, orange color, soft and succulent; nutlets 2 or 3, full and rounded at the ends, or when 3 narrowed at the apex, ridged on the back, with a broad low slightly grooved ridge, penetrated on the inner faces by large deep cavities, 6-7 mm. long and 2.5-3 mm. wide.

A tree sometimes 5 or 6 m. high, with a trunk often 1.5 dm. in diameter, covered with dark gray bark, small spreading and ascending branches forming an open irregular head, and stout nearly straight branchlets hoary-tomentose when they first appear, becoming bright chestnut-brown marked by small pale lenticels and pubescent or puberulous during their first season, and darker-colored and still puberulous

the following year, and armed with numerous stout nearly straight light chestnut-brown shining spines 4.5-5 cm. long.

Near Algonac, St. Clair county, *C. K. Dodge* (No. 64), June 6 and September 6, 1903, June 14 and September 19, 1904; also on Walpole Island, Lambton County, Ontario.

This species differs from *Crataegus tomentosa*, L., in the hoary-tomentose, not villose, corymbs, with stouter and shorter pedicels, in the lighter-colored anthers, and in the subglobose not narrow-obovate fruits. It is referred to *Crataegus pubifolia*, Ashe, which was described from a plant found in central Iowa, and which I have not seen, on the strength of the statement made by Mr. Dodge that Ashe declared that this was his *C. pubifolia*. Gruber's No. 127 from Kutztown, Pennsylvania, is probably the same species.

3. **Crataegus structilis**, Ashe, *Jour. Elisha Mitchell Sci. Soc.*, xix, 12 (1903); Sargent, *Proc. Phil. Acad. Sci.*, 1905, 656.

Leaves oblong-ovate to oval or obovate, acuminate, gradually narrowed to the slender concave-cuneate entire base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into numerous short acuminate lobes; nearly fully grown when the flowers open during the first week of June and then membranaceous, yellow-green and covered above by short soft white hairs most abundant on the midribs and veins, and pale and hoary-pubescent on the lower surface, and at maturity thin but firm in texture, dark green and glabrous or nearly glabrous on the upper surface and pale and puberulous on the slender midribs and primary veins below, 7-8 cm. long and 4.5-5 cm. wide; petioles stout, broadly wing-margined to below the middle, hoary-tomentose while young, becoming puberulous later in the season, 1-1.5 cm. in length. Flowers 1.4-1.8 cm. in diameter, on stout hoary-tomentose pedicels, in wide compact many-flowered tomentose corymbs, with linear acuminate glandular bracts and bractlets fading brown; calyx-tube broadly obconic, hoary-tomentose, the lobes narrow, acuminate, slightly serrate usually only near the middle, puberulous, reflexed after anthesis; stamens 20; anthers pale yellow; styles 2, surrounded at the base by a narrow ring of white tomentum. Fruit ripening about the 1st of October, and mostly persistent until after the leaves have fallen, on stout erect puberulous pedicels, in wide many-fruited erect or spreading clusters, oblong to obovate, narrowed at the ends, orange-scarlet, lustrous, 8-10 mm. long, 6-7 mm. in diameter; calyx prominent, with a deep narrow cavity, and spreading appressed pubescent lobes mostly deciduous from the ripe fruit; flesh thick, orange color, sweet and succulent; nutlets 2, rounded and obtuse at the ends, obscurely ridged on the broad rounded back, penetrated on the inner face by wide grooves, 5-6 mm. long and about 4 mm. wide.

A tree 5-6 m. high, with a tall slender stem covered with dark gray scaly bark, spreading or ascending branches forming a broad round-topped head, and slender nearly straight branchlets marked by many large pale lenticels, dark orange color and hoary-tomentose when they first appear, bright chestnut-brown and puberulous during their first winter and dark gray-brown the following year, and sparingly armed with slender dark gray spines 2-5 cm. long, becoming elongated and much-branched on old stems and branches.

Algonac, St. Clair County, *C. K. Dodge* (No. 105), June 14 and Sep-

tember 30, 1904; Belle Isle, Detroit, *O. A. Farwell* (Nos. 15 and 22), June 19 and September 23, 1902, June 6, 1903; also through Ontario and western New York to eastern Pennsylvania.

4. **Crataegus flammea**, n. sp.

Leaves obovate to rhombic, acuminate, gradually narrowed and concave-cuneate at the entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small spreading lobes; nearly fully grown when the flowers open the first week of June and then thin, light yellow-green, lustrous and slightly roughened above by short white hairs most abundant along the midribs, and paler and sparingly villose along the midribs and veins below, and at maturity thin, dark yellow-green, lustrous and scabrate on the upper surface, pale and nearly glabrous on the lower surface, 5-7 cm. long and 4-5 cm. wide, with slender rose-colored midribs, and thin primary veins extending very obliquely toward the apex of the leaf; petioles stout, wing-margined nearly to the base, villose on the upper side, 1-1.5 cm. in length; leaves on vigorous shoots subcoriaceous, broadly obovate, usually long-pointed, concave-cuneate at the base, coarsely serrate, more deeply lobed, often 7-8 cm. long and 6-7 cm. wide, with broadly winged petioles. Flowers 1.5 cm. in diameter, on long slender slightly hairy pedicels, in compact mostly 12-15-flowered hairy corymbs, with linear-obovate to linear glandular caducous bracts and bractlets fading brown; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from a broad base, acuminate, minutely glandular dentate, glabrous on the outer, densely villose on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles usually 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening about the 10th of October, on slender slightly hairy pedicels, in wide erect many-fruited clusters, short-oblong to subglobose, orange-red, marked by pale dots, 1-1.1 cm. in diameter; calyx prominent, with a short tube, a wide shallow cavity, and reflexed closely appressed usually persistent lobes; flesh thin, orange-red, sweet and edible; nutlets usually 3, thick, full and rounded at the ends, ridged on the back, with a low grooved ridge, penetrated on the inner faces by broad shallow cavities, 6-7 mm. long and 3.5-4 mm. wide.

An arborescent shrub sometimes 4-5 m. high, with stout ascending stems covered with rough dark bark, small spreading branches forming a round-topped head, and slender slightly zigzag glabrous branchlets light orange-yellow when they first appear, becoming light chestnut-brown, very lustrous, and marked by occasional pale lenticels in their first season and dull red-brown the following year, and armed with few stout nearly straight purplish ultimately dark gray spines 3-4 cm. long.

Near St. Clair, St. Clair County, *C. K. Dodge* (No. 110), September 21, 1904, May 27, 1906; also on the banks of the St. Clair River below Sarnia, Ontario, (*C. K. Dodge* No. 98 A type).

5. **Crataegus gemmosa**, Sargent, *Bot. Gazette*, xxxiii. 119 (1902); *Silva N. Am.* xiii. 141, t. 686; *Proc. Rochester Acad. Sci.* iv. 133; *Man.* 498, f. 412.

Leaves broadly oval or rarely broadly obovate, acute or acuminate, gradually narrowed and cuneate or occasionally rounded at the entire base, sharply and usually doubly serrate above the middle, with straight glandular teeth, and often slightly divided toward the apex into short

acute lobes; dark red and covered with pale hairs as they unfold, nearly fully grown when the flowers open from the middle to the end of May and then thin, light yellow-green, nearly glabrous above and pale and villose below, and at maturity thick and firm to subcoriaceous, very dark dull green on the upper surface, pale and pubescent on the lower surface along the stout yellow midribs deeply impressed and occasionally puberulous above, and along the 4 or 5 pairs of slender primary veins extending obliquely to the end of the leaf, 4-6 cm. long and 2.5-5 wide; petioles stout, slightly wing-margined at the apex, villose or pubescent, glandular while young, with bright red caducous glands, usually rose color in the autumn, 7-14 mm. in length; leaves on vigorous shoots more coarsely serrate, frequently divided into short acute lateral lobes often 10 cm. long and 5 cm. wide, with rose-colored midribs and stout spreading primary veins, and foliaceous lunate acuminate coarsely glandular-serrate stipules. Flowers 1.2-1.5 cm. in diameter, on slender villose pedicels, in broad open compound hairy many-flowered corymbs, with lanceolate or oblanceolate acuminate glandular-serrate conspicuous bracts and bractlets; calyx-tube narrowly obconic, more or less covered with matted pale hairs or nearly glabrous, the lobes lanceolate, acuminate, glabrous or villose on the outer surface, villose on the inner surface, coarsely glandular-serrate, reflexed after anthesis; stamens 20; anthers small, rose color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in October and becoming very succulent just before falling, on long slender pedicels, in drooping many-fruited glabrous or puberulous clusters, subglobose to short-oblong, scarlet, lustrous, 1.2-1.4 cm. in diameter; calyx prominent, with an elongated tube, a deep narrow cavity and reflexed villose lobes bright red toward the base on the upper side; flesh thick, bright yellow, sweet and usually succulent; nutlets usually 3, or 2, full and rounded at the ends, or somewhat narrowed at the base, ridged on the back, with a broad low rounded slightly grooved ridge, penetrated on the inner faces by deep broad cavities, 6-6.5 mm. long and 3.5-4 mm. wide.

A tree occasionally 10 m. high, with a tall trunk often 3 dm. in diameter, covered with dark brown scaly bark, stout spreading or ascending branches forming a broad rather open symmetrical head, and stout zigzag glabrous red-brown or gray-brown lustrous branchlets, armed with straight or slightly curved thick chestnut-brown spines, usually about 5 cm. long, and winter-buds sometimes 6 mm. in diameter.

Grand Rapids, common, *E. J. Cole,* 1876-1901, *C. W. Fallass,* May 15, 1895; Agricultural College, *W. J. Beal,* May 25, 1899; south of Sarnia, Lambton County, Ontario on the bank of St. Clair River, *C. K. Dodge* (No. 98), October 4, 1903, June 4, 1905; also through Ontario and Northern Ohio to western New York.

6. **Crataegus Michiganensis,** Ashe, *Bull. N. Car. College of Agriculture and Mechanic Arts,* clxxv, 111 (1900).

Leaves obovate and rounded at the apex to rhombic and acute at the apex, cuneate at the entire base, sharply doubly serrate above, with straight glandular teeth, and sometimes slightly divided above the middle into 4 or 5 pairs of small acuminate lobes; more than half-grown when the flowers open about the 1st of June and then thin, light yellow-green and slightly hairy above especially along the midribs, and pale and sparingly villose below through the season along the stout midribs,

and prominent primary veins, and at maturity subcoriaceous, very dark green, smooth, glabrous and lustrous on the upper surface, pale or glaucous on the lower surface, 5-6 cm. long and 4-5 cm. wide; petioles stout, wing-margined to below the middle, slightly hairy along the upper side while young, becoming glabrous, 1.5-2 cm. in length; leaves on vigorous shoots coriaceous, oval to obovate, rounded or acute at the apex, more coarsely serrate, often 7-8 cm. long and 5.5-6.5 cm. wide. Flowers 1.6-1.8 cm. in diameter, on long stout slightly hairy pedicels, in mostly 18-20-flowered corymbs becoming lax after the flowers open; calyx-tube narrowly obconic, sparingly villose below, glabrous above, the lobes foliaceous, wide, acuminate, laciniately glandular-serrate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 2-4. Fruit ripening the middle of October, on long slender slightly hairy reddish pedicels, in wide erect many-fruited clusters, subglobose to short-oblong, crimson, lustrous, villose at the ends, with long scattered white hairs 1-1.2 cm. in diameter; calyx prominent, with a narrow deep cavity, and large spreading and reflexed coarsely serrate persistent lobes; flesh thin, yellow, sweet and succulent; nutlets 2-4, almost orbicular, full and rounded at the ends, ridged on the back with a broad doubly grooved low ridge, penetrated on the inner faces by large deep cavities, about 5 mm. long and 3-4 mm. wide.

A shrub 3-4 m. high, with numerous small erect stems covered with smooth pale gray bark, and spreading into broad thickets, small erect branches forming a wide irregular head and slender nearly straight glabrous branchlets, orange-green and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull reddish-brown the following year, and armed with numerous stout, straight or slightly curved light chestnut-brown shining spines 3-4 cm. long, and persistent and branched on old stems.

Low sandy shores of the St. Clair River at Port Huron, *C. K. Dodge* (No. 121 type plant), May 29 and September 15, 1902 and 1903.

Ashe describes the flowers as scarcely more than 1 cm. in diameter, which is certainly a mistake, and the corymbs as glabrous or nearly so.

Crataegus oxyacantha L., the European hawthorn, has become sparingly naturalized in southern Michigan, and has been reported from Detroit by O. A. Farwell, and from the vicinity of Ann Arbor by C. A. Davis.

Arnold Arboretum,
February, 1907.

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EIGHTH ANNUAL REPORT

OF THE

STATE GEOLOGIST,

ALFRED C. LANE

TO THE

BOARD OF GEOLOGICAL SURVEY

FOR THE YEAR 1906.

ACCOMPANYING THE PRECEDING PAPERS.

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ANNUAL REPORT FOR 1906.

OFFICE OF THE STATE GEOLOGIST,
LANSING, MICHIGAN, NOV. 14, 1906.

To the Honorable the Board of Geological Survey of the State of Michigan:

HON. F. M. WARNER, *President.*
HON. W. J. MCKONE.
HON. P. H. KELLEY, *Secretary.*

Gentlemen—I beg to submit my report for the fiscal year July 1, 1905, to June 30, 1906, inclusive, and for the field season of 1906.

The following is the usual statement of expenditures from the annual appropriation:

FINANCES.

	Salaries.	Field.	Office.	Total.
July	$595 50	$154 09	$48 62	$798 21
August	667 50	351 27	93 68	1,112 45
September	463 32	80 73	29 61	573 66
October	388 59	122 09	53 90	564 49
November	373 67	22 09	44 23	439 99
December	438 50	17 01	18 80	474 31
January	392 20	97 81	52 80	542 81
February	603 84	42 04	37 81	683 69
March	392 20	66 15	239 58	697 93
April	384 80	27 74	269 35	681 89
May	370 40	35 02	64 36	469 78
June	612 06	318 19	130 54	960 79
	$5,682 49	$1,234 23	$1,083 28	$8,000 00

In addition to this we had: For the year 1905-6, to be used in the topographical survey through the United States Geological Survey $2,000 00
Of this there was expended in the survey of the Marquette quadrangle 1,683 79

Concerning the value of this see letter below.

The balance, together with $3,000 for 1906-7, is being expended in Oakland and Livingston counties—Rochester, Pontiac, Milford and Howell quadrangles.

The appropriation for biological survey, Act 250, Session 1905, was expended as follows:

To C. A. Davis, for botanical work in connection with a study of peat producing plants of the bogs, including all his expenses in accompanying Prof. Russell in the Upper Peninsula	$1,000 00
To T. L. Hankinson and his assistants, under the direction of Prof. J. G. Reighard, in a survey of the fauna and flora of Walnut Lake, Oakland County, with especial regard to the food habits of the Whitefish	1,000 00
Of publication funds there remains for reprinting reports—not enough to do anything	93 27

Our annual reports now come out of the general fund and there is no special provision for continuing the series of green volumes.

PUBLICATIONS.

On the new system, practically the sole publication of the Board is its annual report. The report for 1905 which should be out in November, 1906, will therefore be almost double the size of its predecessors—a book of some 600 pages. Besides my personal report it contains a report of the University expedition to Isle Royale and the Porcupines, W. F. Cooper's report on Bay County with valuable maps showing thickness of the drift, and the report of Bryant Walker on the land snails of the State.

We have also issued a good many copies of the small geological map of the State for which there is a steady demand. We have given this away one at a time. But as it is used in teaching, when enough to supply a whole class is asked, it seems fairer to ask cost price. The money thus received, however, goes into the general fund.

Of the Joint Topographic Survey a small provisional edition of the Marquette sheet in black and white for the use of engineers has been issued. The Dexter, South Lyon, Saline, Ypsilanti, Wayne, Detroit, Wyandotte, Romulus and Grosse Point sheets have also been issued.

I also prepared for the Lake Superior Mining Institute a brief description of the geology of Keweenaw Point with a general map,[1] reprints of which I have found of value in distributing to enquirers.

The reports by Robert E. Horton to the Michigan Engineering Society of the State, on water power, and various publications of the United States Geological Survey referred to later, will also afford valuable information to the seeker and are to be obtained from the United States Geological Survey at Washington, D. C.

WORK PRACTICALLY READY FOR PUBLICATION.

Your annual report for 1906 will also be a considerable volume, and it may contain at least the following reports:

1. The report of Prof. I. C. Russell on the surface geology of the Iron

[1] Printed in Vol. XII of their transactions.

Mountain district, a posthumous report and perhaps the last which will appear from that able and interesting writer.

2. The report of C. A. Davis on peat and the peat producing flora. This report not only gives a concise summary of the state of the peat industry and its prospects in the State, but describes a new variety of peat of great interest in connection with the origin of coal. It also emphasizes several new or little regarded facts, that peat will absorb up to 15 per cent. of moisture, even when under cover, and therefore need not be dried below that point, that the sphagnum moss is not the principal ingredient of peat, but that the moss creeps over the already nearly filled up bog, etc.

3. The report of W. C. Gordon on the Black River section of the Keweenawan rocks north of Bessemer, with some additions by myself in the way of general correlation, calling attention to a region of copper bearing rocks hardly at all explored.

4. Prof. Hankinson's report on the biological survey of Walnut Lake, Sherzer's report on Wayne County, Davis' report on Tuscola County, Grabau's on the Traverse limestone, Gregory's on Arenac County, and Prof. Ries' on moulding sands; also Kaufmann's report on the fleshy fungi (mushrooms), are in a more or less advanced state of preparation, and represent the work of the year in greater or less part.

CO-OPERATION.

As far as possible I have tried to work hand in hand with the agencies and individuals who are studying the resources of the State scientifically.

A list of these may serve as a useful guide to those places in the literature where information regarding Michigan may be found.

The United States Department of Agriculture under Milton Whitney has been making a soil survey of Cass County, and have issued a soil map of the Oxford area.

The Typographic Survey, under A. M. Walker has practically finished the Rochester and Pontiac sheets, and made a start on the Milford and Howell sheets.

With the Hydrographic Division in various branches there has been exchange of information, especially with Mr. Frank Leverett, in getting out a series of water supply papers to replace Nos. 30 and 31 by A. C. Lane, now entirely out of print. No. 160 on the water supply of the region north of Lake Michigan is out. Nos. 182 and 183 on the Lower Peninsula will soon appear.

We have also taken up the collection of well records which the United States Geological Survey for lack of funds has been compelled to drop.

I have done all I could to help Prof. C. A. Palache, who prepared an erudite study of calcites for Volume VI of your reports, in his further studies[1] for the United States Geological Survey.

We have tried to keep informed of our work the Detroit Engineering Society, the Michigan Engineering Society, the Lake Superior Mining Institute, the Michigan Academy of Sciences, the Pioneer and Historical Society, etc.[2]

[1] A note on quartz from Hancock recently appeared in the Neues Jahrbuch. BB 13, p. 155.
[2] In many cases we have reprints of their papers for general distribution.

The State of Illinois has recently revised its Geological Survey, appropriating therefor $25,000 per annum, and at the invitation of the newly appointed State Geologist, J. Foster Bain, a meeting of the State Geologists of the Mississippi Valley was called to consider topics of common interest, such as common names, relations to the Federal Survey, etc.

Informal co-operation with the University, Agricultural College and College of Mines is always in progress. The biological survey has been largely conducted by and under the University teachers of botany and zoology.

The main co-operation with the College of Mines has been in connection with Pres. McNair's interesting tests of the weight of the earth. A pendulum swung at the bottom of one of the deep shafts has a notably different rate owing to the less force of gravity, nearly 5,000 feet of the earth's crust being above it. If we know the exact weight and shape of the crust immediately above the pendulum, we can from its lessened rate of vibration infer what the density and weight of the whole may be. I have helped in the needful examination of the rocks, and Mr. A. H. Meuche is preparing a contour map of the surface of the adjacent country. Both pieces of work have geological value independent of Mr. McNair's researches.

Analyses have been made for us at the various State institutions under the same arrangements that have heretofore prevailed. They mainly find their fit place in special reports—those of W. F. Cooper and others.

A number of tests of mine waters and other brines are to be incorporated in a bulletin I am preparing on that subject. Some preliminary notes were read before the Geological Society of America and appeared in the Journal of Geology.[1]

We may, in some cases, be able to date our rocks by the character of the water contained.[2]

WORK OF THE SURVEY.

During the past year Mr. W. F. Cooper has been mainly employed getting out his Bay County report, and quite largely in editorial work, indexing, etc., on the annual report for 1905. But there has also been time to compile deep well records, etc.

Mr. W. C. Gordon nearly finished his report on the Black River section, and then resigned to take a position with the Oliver Iron Mining Co., leaving me to add a little on the intrusives and iron bearing rock.

Mr. A. H. Meuche was appointed in his place, and continued contour work around Calumet, with the assistance of Mr. Leon Meuche, and work on copper country sections.

Prof. C. A. Davis has continued the study of the surface deposits of the Upper Peninsula to the broken but intensely interesting region of the Huron Mountains, upon which the ice sheet which crept down from the Labrador Highlands over the Lake Superior basin seems barely to have lapped. I may note that he finds that, owing to less evaporation

[1] XIV, 3, April, 1906, p. 221.
[2] Further notes on this subject appeared in the Portage Lake Mining Gazette, March 3, 1905. Trans. Lake Superior Mining Institute, Vol. XII.

probably, light sandy soils seem to do unusually well in the Upper Peninsula, and support hardwood timber.

While there is, as we have seen, a large demand for the map of the surface geology of the State, there is even a larger demand from teachers of physical geography from the Agricultural Department and from numerous private sources, for the map of the surface geology of the State upon which Prof. Davis is at work. In fact we should not wait for the completion of the whole State, but get out sheets as far and as fast as possible. The work of preparation of these have been in the hands of Mr. J. F. Nellist, who informs me that he will soon be ready to send to press, but has been delayed by a variety of circumstances.

GOLD.

But Prof. Davis' studies also have bearing in my mind on the development of our gold resources. When we know just how and in what direction the ice moved over the State we can tell in what direction we are most likely to find in the gravel the gold of the gold quartz veins known to exist, and vice versa may be able from the results of panning to trace gold to its source. Mr. W. M. Courtis, A. I. M. E., of Detroit, has prepared the following summary for us. His plan of campaign commends itself to follow Prof. Davis' studies.

I have inserted one or two places in his list.

GOLD IN MICHIGAN.

BY W. M. COURTIS.

Dear Sir:—

At your request I am sending you a list of the newspaper clippings I have in regard to gold discoveries in Michigan, both quartz and placers or gold in gravel.

The little map shows places where reports say gold has been found in the gravel. Some of these I have authenticated myself, washing out the particles of gold. In two cases, Ionia and Hillsdale, found not substantiated, I found in the former place what appeared a large nugget taken from 20 feet down in a well. By my test it proved to be brass, and history shows a building burnt down here many years before, probably melting some brass, which gradually sunk through the fine sand there.

At Hillsdale, in digging a ditch bright flakes were found that looked like gold dust. Tests on these showed that they were brass filings that had been washed down from some workshop and in high water had been spread along the small creek bars. Many of the gold quartz finds when looked up proved to be pieces of float quartz and when not wilful swindle were float ore from up the lake country as native copper was also found in these deep gravel beds.

At Lowell and along the Grand River there is gold in a certain channel that crosses the river near this place. This gravel is com-

posed of a different kind of pebbles from the gravel found in the high banks along the river which rise in some places two or three hundred feet above. The gold in the Grand River begins at Maple River and was found down to Ada Creek and probably down to the lake, no gold being found in the most favorable bars above the former place.

These high bluffs are stratified in some places, at others irregular deposits. None of these strata would pan gold even taking the ferruginous seams, the most promising, except in the lower seams a few colors were found.

The gravel in the old river channel seems sufficiently rich to work with dredges in some parts where the land is not too valuable and as this old channel apparently comes from the northwest, it is worth looking into by the Geological Survey, as its course may be found and prove rich on bed rock. There seemed to be a steady increase in the colors of gold as depth is gained—pans running from four to thirty colors. The total average of all our tests was about three cents per cubic yard, though very little digging was done, only taking up the mussels and panning the gravel. The estimate of three cents included all the barren dirt that was tested, barren gravel that overlays the old bed and is not any criterion of what the river channel would run, which should be tested with six holes. The gold was much coarser than I would suspect, some of it being like mustard seed.

I thought it had been "salted" but I walked out a rod or two from the shore, dug up the mussels and alone washed the dirt. Here I got but one to four colors to the pan. This gravel contains a large amount of black, magnetic sand, iron, garnets, zircons and is analogous to those deposits worked in Russia which in their richest parts yield from two to four dollars per cubic yard.

The following is a list of the places where gold is said to have been found in the gravel:

Washed by myself.

Maple River, Ionia County.
Lowell, Kent County.
Ada Creek, Kent County.
Grand River, below Lyons, Ionia County.
Flat River, Ontonagon County.
Iron River.
Ishpeming, Marquette County.

Reported discoveries.

Ionia and Hillsdale (brass mistaken for gold)
Birmingham, Oakland County.
Union City Branch, to the S. E. and S. W. (?).
Marcellus, St. Joseph County.
Burr Oak, St. Joseph County (pyrites likely).
Grand Haven, Ottawa County.
Allegan, Allegan County.
Greenville, Montcalm County.
Howard City, Montcalm County.
County Line, Newaygo County.
Muskegon River, Newaygo County.

Whitehall, Oceana County.
White River, Oceana County.
Elbridge, Hart, June 7, 1906.
Little Sable River, Manistee County.
West Summit, Wexford County.
Manistee River, Manistee and Wexford Counties.
Walton, Kalkaska County.
Rapid River, Kalkaska, Kalkaska County.
Leelanau County, near Lake.
Antrim County, same river (nuggets, reliable).
Boyne River, Charlevoix County.
Little Traverse, Emmet County.
Victoria Copper Mine (large nugget).
Ishpeming district, near gold mines, perhaps good placers.

The following places were reported but believed to be only pyrites:

Cheboygan, Cheboygan County.[1]
Alpena, Presque Isle County.[1]
Caseville, Genesee County.[1]
Flushing, Genesee County.[1]
Caro, Tuscola County.[1]
Near Fargo, St. Clair County.
T. 8 N., R. 14 E., ($6.00 a ton?)
N. E. ½ S. E. ¼ Sec. 33, T. 49 N., R. 42 W., Tr. Au. 15c Ag.

It can easily be seen how many places report the discovery of gold in the gravel, and if it should be proved it came from an old channel, also why some of the tests have failed in the same district.

It is certainly worth the expense to test the gravels at different points on the west side of Michigan. If the testing were successful, and it seems certain it will be, as some of the finds were by men who understood placer washing, and in one place in Antrim County, quite large nuggets were gotten from the gravel by an experienced man who intended to have gone back the following summer but died during the winter. He had told one of the wealthy pine lands men, who asked me if it were possible but did not know the exact stream where the find had been made.

A systematic examination of the river would soon plot out the source and course of the river. A party of six men with a camp outfit and light star drill rig on wheels with two mining students who would work for their expenses and experience, and keep records, would do a great deal of work in one summer and perhaps all that would be necessary to start up a new industry which would repay the State many times the outlay.

Having laid out such work in San Domingo, where I surveyed the gold field of Mont Pueble, Columbus' gold field (though he got most of his gold robbing the graves), I learned how quickly it could be done.

It was finished much quicker than estimated for each river being platted as barren or gold bearing, the district was soon surrounded and measured out.

[1] Iron pyrites, examined.

A rocker, small sluice box with balances and blowpipe outfit, measuring box for fraction of a cubic yard made our kit.

A jointed hand drill of gas pipe with auger end fifty feet long in five foot lengths with movable handle costing about $15.00 is very convenient for determining the depth of clay, sand or marl.

The information would be useful in other ways as determining beds of clay, marl or bog ore that might be met with and the character of the surface gravel with their depth. The survey could begin at Lowell in early spring, working north with warm weather and south again from Lowell in the fall.

Very truly yours,

(Signed.) W. M. COURTIS.

P. S. Also on lands south of the Gogebic iron fields.

Have assayed many ores from N. M. (North Michigan), which carry gold up to $250, not at Ishpeming.

Ishpeming ore sample ran into thousands—$2.99. Average 50 tons.

At Williamston, Ingham County, Mr. Taylor found a little nugget at bed rock. Mr. Jas. B. Seager reports having washed as many as 20 colors to a pan in the Huron Mountains, where most of the drift is very local, while tests I made of Lake Superior sands gave no visible result.

LAURENTIAN.

These were made in the course of a brief visit to the Keewatin-Laurentian areas north of Marquette, meeting Prof. Davis and E. R. Downing and looking over their results.

The results of my studies of the Keewatin-Laurentian agree so closely with those of another working geologist on the other hemisphere that I am tempted to quote, verbatim but condensing, as my own experience, the words of F. P. Mennell in the Geological Magazine for June, 1906 (p. 255):

"The great granite masses," like those north and south of the Marquette range, "as a rule indicate anticlinal or domelike structures" and "the relative distances of the different rocks from the granites may be taken as one of the chief aids in determining the succession." Any indication, however, of marked transgression on the part of the igneous rock . . . . . prevents such a criterion being relied on. Metamorphosed igneous intrusions figuring amongst the schists"—the greenstone schists and amphibolites for instance—"may behave as rocks of any date earlier than their real period of formation. Their intrusive character has to be inferred from (1) petrological character, (2) unexpected appearances among the old sediments, (3) traces of central action, (4) absence of pebbles from them in conglomerate beds." "Very few developments fail to show important conglomerate beds" "invaluable as datum lines." "Their pebbles afford important evidence of their age." "At their roots granite masses do not show those features which we have learned to regard as characteristic of intrusion where we have seen them invading normal sediments. Actual dikes do not extend far from the main mass of the rock. The char-

acteristic feature of this invasion of crystalline schists is in fact the production of lit-par-lit injection." "The off shoots from the deep seated portions must corrode their way into the surrounding rocks or insinuate their material between their laminas. The last process is the usual one and even the few large dikes that are seen are mere feeders by which the injection is carried on, and which soon became exhausted in their process."

They therefore scarcely ever extend beyond the zone of injection "lit-par-lit."

CALCIFEROUS.

I also visited near Marquette, the Upper Peninsula Experiment Station, intelligently presided over by Mr. L. Geismar.

The United States Department of Agriculture have recently made a soil map of this area with his aid. The station is situated on a number of terraces where the bed rock comes close to the surface.

This bed rock is on the Calciferous formation, which for Michigan may be conceived as taking its locality name from Calciferous station of the Marquette & Southeastern R. R., outcropping also extensively at Eben, the junction with the Chicago & Northwestern R. R. and extending from the Lake Superior sandstone below up to the St. Peter sandstone, or an unconformity where the St. Peter sandstone should be, above which comes the well marked "Trenton," Ordovician or lower Silurian fossils. It is represented by the beds about 404 to 642 feet in the Gladstone well, from about 320 to 550 at Marinette, and probably from 280 to 630 feet in the Rapid River well, being thus about 230 feet thick. According to Rominger the Calciferous is "Cambrian-Primordial."

In connection with this Calciferous lime-bearing formation it is interesting to note that Mr. L. Geismar informs me that over it the soil is much better than over the Lake Superior sandstones which lie outside it, and Mr. Harris, the intelligent and wide awake manager of the Marquette & Southeastern R. R. changed the preliminary location of a spur of that line several miles to the south at Mr. Geismar's suggestion upon examining a geological map of the State, in order to bring it into the region of a better land.

BAYPORT LIMESTONE.

Another term which has come up for definition has been the Upper Grand Rapids. The United States Geological Survey objected to my using the Ohio term, Maxville, on the ground that its equivalence with the Upper Grand Rapids has not been proved, though I know no respect in which they can be seen to differ, and suggested that I had already used the term Bayport limestone, which indeed I had, as a commercial and local term applied to the well-known and valuable quarries without really meaning thereby to introduce formally a new geologic term, a thing I am slow to do. But as they rather insisted, the term Bayport may be used for that upper part of the Grand Rapids characterized by the predominance of light colored high grade limestone (90% $CaCO_3$) and white sandstone, and freedom from gypsum and much shale.

It includes the upper 60 feet of the Huron County and South Bay City sections, and about the same thickness at Saginaw.[1]

EARTHQUAKES.

For some time there have been earth disturbances in the copper country, of which exaggerated sensational reports have been wired abroad. Few (see report Peter Dawe, Mine Inspector, Houghton County), have been hurt thereby, and in fact the shocks are often less noticeable in the mines than on the surface. Still they have for some time been felt at a distance of several miles from any mining, indeed, perhaps, outside the copper country. There was a notable shake, breaking window glass in Calumet, in August, 1905, upsetting bottles in Dr. W. S. Whislers' office on the north wall but not on the west, so that I got some idea of its direction. At that time, following a hint of Mr. McNaughton, I put a pencil in a dish of sand in the basement vault of the Geological Survey building (125 East street, Houghton), which was upset February 8, 1905, to S. 30° E. This shock was also felt at Calumet but was not so severe as the previous August. Other shocks occurred April 18-20, and on May 26 it was again upset away from the Atlantic mine lode in section 9, the South Pewabic lode, which at that time was closed and went out of commission. The tracks crossing the lode were buckled so as to indicate a shortening of some six feet and while there was some indication of tension further back from the mine I failed to find as much stretching as compression. It may, however, have been diffused. There are three theories in explanation.

First, that the shakes are purely local, due to the yielding of pillars and caving in of huge masses of rocks overhanging the mines, only a fraction of an inch, however, at a shock.

Secondly, that these waves are set off by shocks from some distant point.

Thirdly, that there is really a state of compression and unrest in the rocks of the copper country, while mining operations have provided lines of weakness along which it relieves itself. One side of the copper range is bounded by a famous old break or fault, and the country around the Great Lakes is known to be tilting.

On this matter there was a lively discussion at the Lake Superior Mining Institute meeting in August, 1906. I do not see how there can be any settling of the question definitely until we have installed near the copper country, at Marquette or Calumet or Houghton, a modern instrument for the careful record of earth waves (seismograph). The United States Weather Bureau is installing a number of such instruments in their stations, but only where the Federal Government owns the building, and I would earnestly recommend that all those interested join with me in doing what we can to secure the location of at least two such instruments in the Upper Peninsula.

We may note that in the iron country there are immense caves which alter the whole appearance of nature, to which anything in the copper country is not a circumstance. Nor is the Lower Peninsula exempt. Complaint is already made of settling over coal mines beneath Saginaw and Bay City, and the salt caverns at Manistee are already said to be

[1] At East Saginaw 399 — 451 = 52 feet; at Plate Glass Works 550—625 = 75 feet; at Mt. Pleasant 970 — 1,020 = 50 feet. See Volume VIII, Part II, Plate I, pp. 12, 13, 97, 98, 112, 213-215.

causing settling there and breakage of water mains. We may expect to see the same thing along Detroit and St. Clair rivers, and anywhere where salt is made, not by pumping an already existing brine, but by pumping down water on rock salt and dissolving it out. It do not know whether it would be worth while to have the water mains of South Detroit with elastic joints yet.

My personal work, besides the executive routine of answering letters, writing and editing reports, in which I have been helped by Mr. Cooper, and the papers on the work of the Survey for the various State societies, has been mainly in the study of the grain of rocks, the composition of mine waters, the origin and distribution of copper in connection therewith, and especially the examination of samples variously located.

MOULDING SAND.

In my annual report for 1902 there were some comments on moulding sands. In the course of a preliminary investigation it seemed to me curious and perhaps needless that so many foundries should go way out of the State to the Ohio River for their moulding sand, while others found a supply nearer by. It seemed fitting therefore, to employ a special expert, Prof. H. Ries, of Cornell University, to investigate the matter for a few weeks and report upon the distribution of such sands at a cost not to exceed $500.

CLAY.

Samples of surface clays from the Sault to the southern line have generally proved to be calcareous, though often very fine and gritless, approaching in character a slip clay. The ordinary Michigan surface clay is about one-fourth limestone flour. Such a clay from near Cheboygan, sent by A. M. Gerow, is said, however, to make a good material for art pottery, and shale clays near Grand Ledge, Omer, Turner and Cheboygan, are, I understand, to be further exploited for paving brick, etc.

WATER.

Our work on waters will be found largely in the water supply papers of the United States Geological Survey Nos. 160, 182 and 183. The subject of mine waters will make a special report. I published a preliminary article on it in the Portage Lake Mining Gazette, March 8, 1906, to be reprinted in the Lake Superior Mining Institute proceedings, and also an abstract of a paper at Ottawa, in the Journal of Geology, 1906, p. 221.

Besides advancing the rock salt developments around Alpena, we have made a number of visits to the rock salt shaft at Oakwood, where E. F. Bradt and Mr. Luke have been pluckily fighting their way against very great obstacles. The shaft is now down over 300 feet and the rock is less likely to be creviced as the work proceeds.

In the exploitation of mineral and other waters it is becoming more and more common to consult this office. Among the wells of exceptional interest are:

(1). One at Grand Lake near Alpena, by F. B. Preston, giving a section from the Bell shale the base of the Traverse down into the

Salina. Alpena with its wealth of salt and suitable limestone at hand to shipping facilities is, as I have said, an ideal place for the manufacture of soda.

(2). A group at the Saginaw Plate Glass Works, and one at the Saginaw High School, which give us a better set of samples than we have had before.

This last well is interesting since it is for salt baths, a great preventive of cold after exercise or manual training. There is not a town in Lower Michigan that could not have salt baths if they chose.

Pamphlets on the water supply of Ann Arbor, by Prof. I. C. Russell and W. H. Sherzer have appeared recently and Battle Creek still discusses the advisability of using artesian wells. The experience of Bay City and the Green Bay towns indicates the inadvisability of using surface waters, even of the Great Lakes, without adequate filtration. Regarding the use of artesian wells, referring to the water supply papers 182 and 183 for details, I would emphasize two points. First, they will practically always be hard and charged with carbonates so as to attack pipes. Second, they will always flow more at the beginning than later, their permanent flow being determined by the porosity of the rock, and the area of the drainage basin. The old well points will clog with lime, and with the growth of the cities, new wells will be required. This has been true this past year at Lansing and Owosso. It is from a geological point of view a decided advantage to scatter these wells so that they will not interfere with each other so much. This can be readily done by using electrically driven pumps such as the one used at Houghton.

COAL.

The usual development of coal fields within the coal basin has gone on, and—in spite of what geological reports show—also in the Devonian black shales. I wish especially to record and commend the courtesy of those who remembered to write me that I was right in my forecasts, even the unfavorable, and send records of their work. Every drilled well record is of geological interest, and is likely to throw light on valuable deposits of shale and limestone, and on the water possibilities if nothing else. Reports of 11 foot coal seams and of anthracite have never proved reliable. The only new work concerning which I am in doubt is near Cadillac. There, coal has been reported a few miles outside the coal basin as mapped, and as the whole region is covered with drift with no outcrops the map may be in error, though the reports are certainly premature.

OIL.

The development of the Port Huron field by new wells of modest yield goes on. The report of a development of a paying field of oil on Manitoulin Island has naturally led to the exploration of the country south of Sault Ste. Marie of similar geological structure.

The first well close to Pickford is at this writing down some 800 feet, having struck an artesian flow at 600 feet.

SAND LIME BRICK.

This has become an established industry and the use of the bricks is spreading. There are, counting some failures, 16 plants in the State. The difficulties have been in maintaining even quality and size, and securing also even pressure on each brick. But practice is making perfect. At the Manistee plant 94 per cent sand and 6 per cent quick lime is used. The brick are steamed at 125 pounds steam pressure. The sand is improved by being ground in a tube mill with French pebbles, thus giving a greater variety in size and permitting closer packing. About 25 per cent will pass 100 mesh sieve, 50 per cent a 75 mesh sieve, all a 20 mesh sieve. The pressure per brick is 150 tons, and the resulting brick has a crushing strength of 2,000-3,000 pounds per square inch and 8 per cent. absorption. They sell at $6.00 per thousand.

In regard to crushing the sand, I have had sent in from Ypsilanti, from L. C. Holden at Sault Ste. Marie and other places, samples often taken for clay which proved to be merely fine sand, such as would do very well to mix with coarser sand to make a less porous brick.

WINCHELL NOTES.

I received this year from Prof. N. H. Winchell, a ledger containing a copy of the notes of work which he did for your Board in 1869. Owing presumably to the fact that his brother soon after ceased to direct the Survey none of that work was published, though quite a little of it is still of value, and should be issued. It includes observations on the Lake Michigan and Green Bay shores, around Alpena and down the Au Sable.

EXAMINATION OF SPECIMENS.

The examination of specimens from wells and otherwise is becoming more and more important. It is customary for all geological surveys to name gratis all specimens sent them—not going into complete and expensive examination, the cost of which should be paid by the one benefitted, but such an opinion as an experienced man may give in a few moments, as to whether a sample is likely to have value and if so what kind of examination should be given to it, thus saving useless expense to those perhaps ill able to afford it. Especially since the time of C. E. Wright has the Survey taken pains to collect samples from churn drills, and records of such borings for oil, gas, salt or salt water, coal, etc.

On the other hand where mining companies desire we examine extensive suites of the cylindrical rock cores extracted by the diamond drill. It is often more convenient for both parties, for them to pay my expenses to visit the cores as our Houghton office is crowded. In fact, I have examined the past year the cores from over 20,000 feet of drilling already and this has been the largest piece of work of the kind I have had. It is a pity that we have not better accommodations for them, for there are thousands of feet of drill cores costing tens, perhaps hundreds of thousands of dollars, stored in temporary wooden buildings scattered over the Upper Peninsula, of very great scientific as well as practical value,

exposed to great fire risks, often in damp places so that the boxes rot and can hardly be handled, and where the cores coat with mold so that they can scarcely be recognized, which would, as appears from letters submitted, be freely donated to the State and to science if we only had any place to take care of them. I would earnestly plead for a fireproof building of concrete and steel for their preservation, a stone library for a library of stone.

Not only the smaller companies but the larger companies such as the Quincy, the Keweenaw and others would be glad to send cores which have cost thousands of dollars to such a place for examination and preservation, as will appear from letters which I submit to you. To try to keep pace with the exploring done by the great iron companies is, however, so large a task that the money needed would be out of the question. And besides, these great companies employ able geologists for their exclusive service.

There is no work of the Survey that pays the State better, besides being of direct benefit to the individual, even though there is no printed work to show for it, than information leading to judicious exploration. Fruitless exploration is a waste of labor. More than that it may give a region an undeservedly bad name. When Mr. Jas. McNaughton, manager of the Calumet & Hecla Mining Co., writes: "Your advice," based on the study of the grain of some drill cores, "was valuable inasmuch as we at once found the lode and at practically the distance from the shaft which you indicated, for which we are exceedingly obliged," it justifies the time I have spent on the study of the grain of the traps of Keweenaw Point.

BIOLOGICAL SURVEY.

This seems to me to have started off remarkably well with the modest means at hand. The first paper, the only one published, that of C. C. Adams and others of the University expedition to Isle Royale and the Porcupines is already in good demand.

At this writing Walker's paper on the snails of the State is printed but not bound.

The extensive peat report already mentioned as ready for the printer, is needed, judging from the inquiries for information.

The work this summer under the direction of Prof. Reighard, by Prof. T. L. Hankinson and his assistants, Elmer McDonald and E. L. Michael, bids fair to tell us under what conditions whitefish will thrive in deep, cold ponds, like many of our marl lakes, where the water is kept aërated and in circulation by bottom springs and so capable of supporting the proper fish food as well as the fish themselves. Assistance has also been had from Prof. J. G. Needham, of Lake Forest University, who made a short stay, Prof. N. H. Harvey, of Ypsilanti, Prof. W. B. Barrows, of the Michigan Agricultural College, and numerous other members of the biological department of the University, and Dr. John F. Eastwood, of the medical chemical laboratory. A careful map of the lake was prepared by A. Adams, of the civil engineering department of the University.

JOINT TOPOGRAPHIC SURVEY.

The Joint Topographic Survey does not extend as far as its usefulness would. The Marquette sheet, though as yet only issued in a not very clear black and white edition has been of value: to the scientific departments of the Normal school, as witnessed by a letter from Prof. Downing; to the city of Marquette as witnessed by letters from J. E. Sherman, chairman of the Electric Light and Water Board; and to engineers generally, as witnessed by the following letter of J. E. Jopling, chief engineer of the Cleveland-Cliffs Co., which suggests some of its uses:

Ishpeming, Nov. 1, 1906.

Dr. Alfred C. Lane, State Geologist, Lansing, Michigan:

Dear Sir:—The work so far accomplished by the State Geologist and through the cooperation of the United States Government has resulted in a topographic sheet covering Marquette and its vicinity. The topographer in charge of the work, Mr. Whitman, has taken great pains in doing the work accurately and has made us a map which we as engineers have found extremely useful in many ways. During the past summer the opportunity has arisen to check a good deal of this work by means of surveys for different projects, and it is with pleasure that we can state that the work so far carried on has been of great use and our only wish is that it could be extended throughout the county.

The work above alluded to was in connection with projective improvements of the company's water power in the neighborhood of Marquette, and it has occurred to me that for this industry alone the State would largely benefit from an extended survey over a large part of this territory.

Another instance in which the map is very useful is the new location of wagon roads, as before the work of improving existing roads is undertaken it would always be well to ascertain if a better route is not obtainable, which can be determined very often by the use of the topographic map.

The development of the mining resources of northern Michigan could well be helped by a map, as we have always found that business men as well as engineers continually refer to these maps in talking over mining projects.

In case it should be determined to extend the survey in Marquette county, part of the information which large holdings have obtained in the way of correct levelling and location of township and section corners might be used. The men connected with these enterprises have expressed their view of the subject to me and I feel sure that their cooperation can be relied upon. Some of this information is so extensive that the State could be saved the expense over several square miles, leaving the appropriation to cover a still larger area.

Such topographic maps are almost useless in a rough and uncultivated country such as is to be found in a good deal of this district without the true location of the section corners. You will remember that on the Marquette sheet, Mr. Whitman connected his work with these corners, although it had not been customary to do so.

Very truly yours,

(Signed) J. E. JOPLING,
Mining Engineer.

Hon. Chas. Ward wrote of their value to him in planning for the water power development of the Huron River and if they were only ready they would be of great use in preparing electric road projects, automobile maps, drainage projects, and assessments.

Ann Arbor, May 12, 1905.

Prof. A. C. Lane, Lansing, Michigan:

Dear Sir:—I notice that you are asking the Legislature for an appropriation to continue the very commendable work in surveying and mapping the topography of this State.

I am interested in the development of water powers in this vicinity and your recently published map of the Ann Arbor quadrangle has been of practical daily assistance to me in my work.

The future prosperity of Michigan manufactures will depend very largely on the development of the water power that is now running to waste and to that end alone a continuation of your work is valuable. I trust that you will be successful in securing your appropriation.

Very truly,

(Signed) CHAS. A. WARD.

Students of physical geography like Prof. Jefferson, of Ypsilanti, are at the same time the most earnest advocates of these maps, and the most lynx eyed of critics, and we owe him gratitude in each capacity. There is not one of the Normal schools of the State from which does not come a demand for topographic maps.

RECOMMENDATIONS.

In making the following suggestions as to special appropriations that might be asked from the Legislature and could be expended wisely and with profit to the State, I add a brief statement of the reasons for each.

Cases, cement walk, electric wiring and brick veneer to present building, $1,000.00.

The Auditor General rules that such items require special appropriation. The risk of fire is greater than it was originally.

Addition to our present lot, $750.00.

The land adjacent to it has been under option to the College of Mines. But since the Legislature did not provide for its purchase it has been plotted into lots. Not merely for the sake of the drill core stack but for protection we should secure this lot directly in the rear.

Fire-proof stack for drill cores, of concrete and steel, $10,000.00.

This will be very plain, but of capacity to hold nearly 5,000 boxes each holding core from 25-50 feet of hole, and should have room for all that may come in twenty-five years, if we do not get too many iron country cores and at times only save selections.

The following sample letter presents the appeal for this. The arguments are briefly the cost of the cores—$3.00 to $5.00 a foot—the risk of loss by fire and disarrangement, the greater accessibility and ease and closeness of comparison if brought together.

Houghton, Mich., Oct. 22, 1906.

Alfred C. Lane, Houghton, Michigan:

Dear Sir:—It has occurred to me since talking with other mining men that there ought to be some central place for the storing of diamond drill cores taken out by the different mines which seldom have a suitable place for their safe keeping. If your office, for instance, had such a place, I have no doubt that you could get the cores from the different mines for storing, and this would be of value to your office as well as conferring a favor upon us.

Kindly let me know whether you now have a suitable place for the safe keeping of diamond drill cores. We drilled some ten thousand feet in the Arcadian Copper Co.'s lands and the cores are now stored in the basement of our office in wooden boxes. If the office should be destroyed by fire of course they never could be replaced.

We have no objection to allowing the States to examine these cores and so you can see it would be a mutual advantage.

Yours very truly,

(Signed) R. H. SHIELDS,
Superintendent.

For continuance of the biological survey—the survey of the plants and animals of the State—as authorized by Act 250 of the Session of 1905, per annum, in accordance with recommendation of Board of Scientific Advisors, $4,100.00.

With only $1,000 per annum you have gained information as to peat and as to where whitefish will thrive which will be worth many times its cost to the State.

Of course in scientific work one cannot be sure of so prompt valuable results. We seem to have been exceptionally fortunate.

Yet there are other problems which would sooner or later be answered by such a survey, for instance, the limits of venomous reptiles, and the malaria infested mosquitoes the practical value of which it needs no specialist to see.

For United States Geological Survey, to continue joint topographic survey, per annum, $10,000.00.

I do not need to repeat the arguments of these maps, which have been set forth in memorials of the Michigan Engineering Society, Michigan Academy of Science, etc., as well as other State societies and the National Survey.

Illinois is now spending $15,000 per annum; Ohio, $25,000. To say nothing of their value in schools, drainage assessments, map making, electric road promotion, city water supplies, the one item of the power developments they suggest may often repay in taxes all their cost, and secure a loss of power never to be regained rather than lead to a waste of resources never to be restored. The Marquette sheet as I am informed led to the project of a $500,000 dam. Three years' taxes on such a plant would repay the cost of the map, and of course the taxes collected are but a minute fraction of the benefit to the community of such a plant.

But scientific work has paid in the long run in every way, though the motive thereof is never primarily commercial but rather a better conception and knowledge of the world around us, in which we live and move and have our being.

To meet as far as might be without legislation certain desires of the Academy of Sciences discussed in my last annual report, the Board appointed the following Board of Scientific Advisors:

Dr. L. L. Hubbard, of Houghton, and Prof. I. C. Russell, of Ann Arbor, geologists.

Prof. W. J. Beal, of Agricultural College and Prof. F. C. Newcombe, of Ann Arbor, botanists.

Prof. W. B. Barrows, of Agricultural College and Prof. J. Reighard, of Ann Arbor, zoologists.

To these gentlemen[1] as well as to my co-employes and many friends of science and mining men outside the Survey, I wish to express my hearty thanks for advice and assistance.

Very respectfully,

ALFRED C. LANE.

[1] Though Prof. Russell has passed, at the prime of his life, usefulness and fame, being this year president of the Geological Society, beyond the reach of earthly thanks.

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