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PHARMACOGRAPHIA AMERICANA MONARDA PUNCTATA L.

BY

EDWARD JOSEPH IRELAND

A THESIS SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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Pharmacographia Americana.

When, in 1883, J. U. and C. G. Lloyd issued the first number of "Drugs and Medicines of North America," the publication was welcomed by every lover of American vegetable materia medica. If it had been possible to succeed, the authors would have made a success of the undertaking. To cover systematically so large a field was too herculean a task for a life time. After years of hard work covering representatives of the Ranunculaceae the enterprise was discontinued.

It would be futile for any individual to attempt the task that had to be discontinued by the Lloyd brothers. If, nevertheless, a beginning toward a Pharmacographia Americana is made herewith, it is with a clear conception of the difficulties involved.

No systematic enterprise will be attempted. Monographs are to be published from time to time as material is available.

Having worked for almost a lifetime on the chemistry of several species of Monarda, a beginning is to be made with one of these. Professor W. O. Richtmann, Pharmacognosist of the Wisconsin Pharmaceutical Experiment Station and Superintendent of its Pharmaceutical Garden has taken special interest in the pharmacognostical aspect of the subject.

The Monardas are fit subjects for the first numbers of a Pharmacographia Americana, not only because the genus is a typical American one, but because it was named after the Spanish physician Nicholas Monardes, author of the first treatise on American materia medica.

This study of a typically American genus began in the summer of 1894 with the distillation of Monarda fistulosa, growing wild abuandantly on the caly soils in the vicinity of Madison.[1] The chemical investigation of the volatile constituents having revealed the presence of carvacrol, the isomer of position of thymol previously reported as a product of M. punctata, the study was extended to cover the latter species found extensively over the sandy areas of the Wisconsin river valley. The results obtained with material collected near Pine Bluff in 1895 were reported the next year.[2] Both investigations represent the first study of authentic materials. As was to be expected, the thymol isolated was found to be inactive. The fact, however, that M. punctata, growing on sandy soil, produced thymol whereas M. fistulosa, growing on clay soil, produced about the same amount of carvacrol, was of biochemical interest. Other observations made, notably that of the separation of red crystals,[3] which were obtained while purifying carvacrol, and which were identified later as

1.) Proc. A. Ph. A. 43 (1895), p. 256; also Pharm. Rundsch. 13(1895), p. 207.
2.) Proc. A. Ph. A. 44(1896), p. 238; also Pharm. Rev. 14 (1896), p. 198.
3.) Proc. A. Ph. A. 43, p. 256; Pharm. Rundsch. 13, p. 208; also Midland Dr. and Ph. Rev. 44(1910), p. 342.

dihydroxythymoquinone,[4] will be recorded in their proper places.

At present it may be well to point out that the discovery of thymoquinone in 1901[5] not only led almost immediately thereafter to the isolation of hydrothymoquinone and to the quinhydrone hypothesis of plant pigmentation,[6] but also emphasized the practical importance of a working hypothesis as contrasted with haphazard groping in the dark for analytical results in plant investigation. This hypothesis naturally suggested the study of enzymes, both oxydizing and hydrolizing, a study which revealed that the plant produced an oxidase which has the capacity to oxidize hydrothymoquinone through the intermediate quinhydrone to thymoquinone. In this connection a beautiful oxidase test was devised which is so satisfactory because both color and form changes can be observed on the crystals suspended, not dissolved, in water.[7] The presence of a hydrolase and a possible analogy with the formation of hydroquinone, the first member of a series of paraquinones, of which thymoquinone is a homologue, from arbutin

4.) Ph. Rev. 26, pp. 329, 364.
5.) Ph. Rev. 19, p. 200.
6.) Ibid., p. 202.
7.) Ph. Rev. 22, p. 190.

suggested further the search for hydrothymoquinone glucoside and, after its presence seemed indicated, its possible synthesis. Finally, the various color effects produced by the action of inorganic elements and groups on the quinhydrones, made necessary a study of the inorganic constituents, a study previously suggested by the fact that whereas M. punctata, growing on sandy soil, produces thymol, M. fistulosa, growing on clay soil, produces its isomer carvacrol.

The scope of these investigations was increased in 1903 when M. didyma L. with its showy flowers was included.[8] This species yielded but little volatile oil and, what is more, the plant apparently produces neither thymol nor carvacrol, a fact significant when it is recalled that the early settlers used its leaves as a substitute for tea. The common name for this species is Oswego tea. So fas as the particular group of compounds of interest to the phytochemical student of the Monardas is concerned, this species apparently devotes its energies to the production of pigments, some of which at least seem genetically related to both perfume and pigment of the other species.

A further contribution to the biochemistry of the genus was made when the study of M. citriodora L. of the southwest

8.)Ph. Rev. 21, p. 109.

revealed the presence of an aldehyde, related to if not identical with citral.[9] The discovery of this aliphatic aldehyde supplied, as it were, the missing link between the simpler products of plant synthesis and the group of compounds of special interest in connection with the study of this genus.

Further extensions of this study were made with the inclusion of two western species, viz. M. pectinata and M. menthaefolia.

For a better understanding of the biochemistry of these plants, separate studies of the various parts thereof have been undertaken from time to time. Striking differences were thus revealed in the inorganic constituents of the several organs. Directly practical results so far as organic constituents are concerned were obtained when the volatile oil distilled from the florets of M. fistulosa yielded crystals of thymoquinhydrone, the hypothetical presence of which had previously been assumed.

The existence of a group of related products with ten carbon atoms differing in the degree of oxidation - from cymene to thymol and carvacrol, monhydroxides of the hydrocarbon, through the several stages of oxidation to dihydroxythymoquinone, referrable to a hexahydroxide, gave

9.) Ph. Rev. 22, p. 153.

rise to a series of interesting studies in organic chemistry irrespective of their biochemical application. In order to understand the chameleon-like changes that occur at almost every turn in connection with some of these compounds, it is necessary to visualize the fact that whereas cymene, also its monatomic and diatomic phenols are benzene derivatives, thymoquinone and its hydroxides are derivatives of dihydrobenzene. In other words these two groups of compounds belong to two formulas of saturation, viz. C_nH_{2n-4} and C_nH_{2n-4}.

In spite of the unusually large amounts of plant material subjected to investigation, the quantities of some of those substances obtainable from the plant itself are so small that their artificial preparation became necessary in order that a better insight into their chemical properties might be obtained. The instantaneous oxidation of some of these already alluded to in the previous paragraph gave rise to interesting observations the importance of which in biochemical processes cannot well be overestimated.

Pre Linnean Names

Introduction

Inasmuch as the plant under consideration was known and frequently described by botanists previously to the introduction of the binomial system of botanical nomenclature by Linne in 1753, it seemed desirable first of all to trace as accurately as possible the connection between the name now commonly accepted and the earlier descriptive names.

Careful study of the earlier descriptions by W. C. Richtmann has revealed six descriptive references that may be regarded as original with their authors involving this plant, viz.

I. Origanum floribus ampliis etc. of John Ray of 1688.*

II. Clinopodium Virginianum etc. of P. Hermann of 1687.

III. Clinopodium Virginianum etc. of L. Plunkenet of 1691.

*Reference I Origanum floribus amplis etc of John Ray 1688 was given priority over reference II. Cf. notation to second reference.

IV. Clinopodium angustifolium etc. of R. Morison of 1699.

V. Monarda floribus verticillatis etc. of C. Linne of 1737.

VI. Monarda floribus verticillatis etc. of C. Linne of 1748.

The fate of these descriptive names, if they may so be designated, is traced in subsequent literature based on the six authorities in which they occur. The details of this study, made possible in the course of years by visiting botanical libraries in Washington, St. Louis, Chicago and elsewhere as well as by making use of the Wisconsin libraries, are herewith recorded.

Pre-Linnean Names [illegible].

Monarda punctata Linne, is a species of the genus Monarda, indigenous to North America. Hence there is no possibility of finding any mention of the genus or any of its species previous to the discovery of the Western Hemisphere by Columbus in 1492. Up to the present time, no mention has been found of the genus or the several species, except on the mainland of North America, so the earliest possible date of the mention of this plant is still further restricted.

Because of its marked structural characteristics, Monarda punctata, does not present the complications that a large number of plants do in connection with early history. In no case is there any doubt as to reference to the plant under consideration. Since the prevalent scientific names of plants date from the publication of the first edition of Linne's Species plantarum in 1753, reference to this, or any other plant, known for several centuries may be divided into two groups, viz. Pre-Linnean and Post-Linnean. In this publication Linne first made use of binomial names, consisting of a genus name and a species name, instead of the lengthy, involved, not overly characteristic, and generally descriptive designation employed previous to that time.

Systematic botanists do not, as a rule, accept these

Pre-Linnean references to plants in determining the synonymy, description, history, or other factors, unless there is a preserved specimen bearing the Pre-Linnean description, so that it may be compared with other determined specimens. This is undoubtedly necessary when there is no direct connection between the Pre-Linnean reference and the now universally used binomial name of the plant. When Linne, however, accepts a Pre-Linnean description as meaning the plant to which he assigns a definite binomial name, there should be no hesitancy in accepting these earlier descriptions as referring to that particular plant. In some cases, Linne does not use all of the descriptive attributes of a particular author, but only one of that author. However, in establishing the identity, the other references mentioned by that particular author should also be included in pointing out the connection.

Following this line of reasoning, the earliest determined references to Monarda punctata Linne occurs in a catalogue of plants of Virginia collected in 1680, by John Banister, and published in John Ray's Historia plantarum etc., v. 2, p. 1927 in 1688. This catalogue is entitled "Catalogo huc transmisso Anno 1680 quem composuit eruditissimus Vir & consummatissimus Botanicus D. Johannes Banister Plantarum a seipo in Virginia observatarum."

In this list occur the following description of the

plant under consideration:

I. "Origanum floribus amplis luteis purpureo maculatis, cujus caulis sub quovis verticillo decem vel duodecem foliis est circumcinctus."

This reference is noted by: -

1. Plukenet, L., Phytographia etc., tab. XXIV. fig. 1, (1691) as;

"Origanum floribus amplis luteis purpuro-maculatis, cujus caulis sub quovis verticillo decem vel duodecem foliolis rubentibus est circumcinctus. D. Banist. Cat. Stirp. Virgin.

Note the omission of the "e" in "purpureo" and the insertion of a hyphen between the words "purpuro" and "maculatis"; also note the spelling of "foliis," and the insertion of the word "rubentibus" before "est," the next to the last word in the sentence.

2. Plukenet, L., Almagestum botanicum, etc., p. 111 (1696)

"Clinopodium Virginianum, angustifolium, floribus amplis luteis, purpuro-maculatis, cujus caulis, sub quovis verticillo decem vel duodecem foliolis rubentibus est circumcinctus.D. Banister, Phytogr. Tab. 24. fig. 1."

Note the change of the initial "Origanum" of

Banister's description to "Clinopodium Virginianum, angustifolium" and the repetition of the word "rubentibus" as in Phytographia reference above. Also compare the initial 3 words of this reference with the initial 3 words in the Hermann reference as given later.

3. Ray, J., Historia plantarum, supplementum. p. 300 (1704)

"22. Clinop. Virginianum angustifolium floribus amplis luteis purpura maculata, cujus caulis sub quovis verticillo 10 vel 12 foliolis rubentibus est circumcinctus. D.Banist. Ejusd. ibid."

Note the abbreviation of the word "Clinopodium" and the use of figures "10" and "12" for the Latin words decem and duodecem."

4. Linne, C., Hortus cliffortanus, etc., p. 495 (1737)

"Clinopodium virginianum angustifolium floribus amplis luteis purpuro-maculatis, cujus caulis sub-quovis verticillo decem vel duodecem foliolis rubentibus est cinctus. Pluk. alm. 111 t. 24 f. 1."

In this reference, the latter part, after the figures "111" refers to the illustration and not to the name given

in Plukenet's "Phytographia," and should be so interpreted. Linne's reference is that of Plukenet's Almagestum taken from Banister, and not that from Plukenet's "Phytographia."

5. Gronovius, J. F., Flora virginica. etc., 1 ed. p. 6 (1739)

"Criganum floribus amplis luteis purpureo maculatis, cujus caulis sub quovis verticillo decem vel duodecem foliis est circumcinctus. Banist. Cat. Stirp. Virg."

6. Van Royen, A., Florae leydensis, etc., p. 313 (1740)

"Clinopodium virginianum angistifolium, floribus amplis luteis purpuro-maculatis, cujus caulis sub quovis verticillo decem vel duodecem foliolis rubentibus est cinctus. Pluk. alm. 111. t. 24. 1."

Here again, the latter part of the reference applies to Plukenet's Phytographia, and it should be interepreted as above.

7. Linne, C., Hortus upsalensis, etc., p. 12 (1748)

"Clinopodium virginianum angustifolium, floribus amplis luteis purpuro maculatis, cujus caulis sub quovis verticillo decem vel duodecem foliolis rubentibus est cinctus. Pluk. alm. 111. t. 24. f. 1"

The latter part of the reference applies to Plukenet's Phytographia as in the previous two cases, ref. 4 and 6. This reference agrees with that of Linne's Hortus cliffortanus, as given above, with the exception of the omission of the hyphen in "purpuro-maculatis."

8. Linné, C., Species plantarum, etc., 1 ed., v. 1, p. 22 (1753)

Linné, C., Species plantarum, etc., 2 ed., v. 1, p. 33 (1762)

Linné, C., Species plantarum, etc., 3 ed., v. 1, p. 33 (1764)

"Clinopodium virginianum angustifolium, quovis verticillo duodecem foliolis rubentibus cincto. Pluk. alm. 111. t. 24. f. 1."

Note the omission of the words, "Floribus amplis luteis cujus caulis sub," "decem vel" and "est," and the change in the final word "circumcinctus" to "cincto." Here again the last part of the Plukenet's reference is to his Phytographia, while the Almagestum reference is modified from the Banister reference.

9. Miller, P., Gardener's Dictionary, 7 ed. (alphabetical) (1759)

"Clinopodium Virginianum, angustifolium, floribus amplis luteis purpura macula notatis, cujus caulis sub quovis verticillo decem vel

duodecem foliolis rubentibus est circumcinctus. Banit. Raii Sup. 300."

Note the change in "purpureo-maculatis" of the Banister reference to Miller's "purpura macula" with the insertion of "notatis."

10. Gronovius, J. F., Flora virginica, etc., 2 ed., (1762)

"Clinopodium virginianum angustifolium, floribus amplis luteis purpuro maculatis, cujus caules, sub quovis verticillo decem vel duodecem foliolis rubentibus est circumcinctus. D. Banister. Pluk. al. 3 t. 24, f. 1 Raj. suppl. 300 Clayt. n. 140."

Note again the change of the initial word of the Banister reference "Origanum" to "clinopodium virginianum angustifolium" as in Plukenet's Almagestum botanicum, and the omission of "e" in "purpureo" of the Banister reference: the change in the spelling of the word "caulis" from 1 ed. Gronovius, J. F., Flora virginica, p. 6 to "caules" in 2 ed. Gronovius, J. F., Flora virginica p. 6; the insertion of the word "rubentibus" before the word "est;" the change of the word "foliis" of his Flora virginica to "foliolis" as in the Plukenet's Almagestum. The Clayton reference is to the Herbarium specimen number.

11. De La Marck, J. B. M., Encyclopedie methodique, Botanique, v. 4, p. 257 (1797)

"Clinopodium Virginianum angustifolium, floribus amplis luteis, purpuro-maculatis, cujus caulis sub quovis verticillo, decem vel duodecem foliolis rubentibus est circumcinctus. Pluken. Almag. p. 111, t. 24, fig. 1, rai. suppl. 300."

Again, the last part of the reference applies to Plukenet's Phytographia while the major part of the sentence is from Plukenet's Almagestum, which is modified from that of Banister; Vahl omits the following: "floribus amplis luteis, cujus caulis, sub," "decem vel" and "est circum."

II. The second reference is by P. Hermann in his Hortus academicus Lugduno, Batavus catalogus, etc, p. 161 (1687) and is as follows:

"Clinopodium Virginianum angustifolium, flore luteo."

To which the following additional information is appended:-

"Caulibus exit humilioribus & gratilioribus. Folius angustioribus, pallidioribus, & adoratioribus. Floribus in caulis fastigio

pauciioribus, tenuioribus, flavescentibus. Caeteris partibus. Canadense simillimis. Possidemus ex munere Reverendi Dni de Marees sacorum dogmatum Praeconis fidilissimi & florum rariorum cultoris praestantissimi tincta."

The above reference dates one year earlier than the publication of the second volume of John Ray's Historia plantarum, containing Banister's Catalogue, which was prepared in 1680. The additional information on the title page of Hermann's Catalogue states that the plants were under observation from 1681 to 1686.

The reference of Hermann is noted by:-

1. Plukenet, L., Phytographia, etc., tab. XXIV, f. 1. (1691)

"Clinopod. Virgin. angustif. flore luteo. Cat. Hort. Ac. Lugd."

Note the abbrevation of the initial 3 words as used by Hermann.

2. Plukenet, L., Almagestum botanicum, etc., p. 111 (1696)

"Clinopodium Virginianum angustifolium, flore luteo, Hort. Leyd. 161."

3. Ray, J. Historia plantarum supplementum, p. 300

(1704)

"Clinopodium angustifolium Virginianum, flo. luteo. Hort. Lugd. Hanc speciem e Marilandia etiam habemus."

Note the inversion of "flore" of the original to "flo" by Ray; also note the inversion of the second word of the sentence, "angustifolium" with "Virginianum."

4. Gronovius, J. F., Flora virginica, etc., 2 ed., p. 6 (1762)

"Clinopodium virginianum angustifolium, flore luteo, Herm. Lugdb. 161."

III. The third reference is by L. Plukenet in Phytographia, etc., Tab. XXIV, f. 1, (1691) and is as follows:-

"Clinopodium virginianum angustifoliu fl. amplis luteis punctis purpureis."

There is no reference to this of Plukenet, noted by any later author as far as observed.

IV. The fourth reference is by R. Morison in his Plantarum historiae universalis, etc., v. 3, p. 375 (1699) and is as follows:

"Clinopodium angustifolium Virginianum Lamii flore luteo maculato."

The following additional information is given:-

"Planta haec rara Majororanae vultu, caulículis lignosis, ramosis, pedalibus donatur. Folia angusta biuncialis longitudinis, femunciam lata mucronata, quorum inferiora denticulationibus crenata, & superiora plana sunt petiolis uncialibus appendentia, binatum sub ramulorum exortu proveniunt. Verticilla summis geniculis ampla, foliola habent oblonga, colore eleganti Utriculi e componuntur verticilla, flores luteos Lamii amplitudine & forma floribus persimiles galea ampla prominente, & labio purpureis guttis eleganter notato emittunt. V. icon. tab. aen. 2."

This reference is noted by:-

1. Willdenow, C. L., Linné's Species plantarum 4 ed., v. 1. pt. 1, p. 126 (1797) Moris.

"Clinopodium virginianum angustifolium, lamii flore luteo maculato. Moris. hist., 3, 375. s. II. t. 8 f. 8 mala."

Note the inversion of the second and third words of the original.

2. De La Marck, J. B. M., Encyclopedie methodique,

botanique, v. 4, p. 257.

"Clinopodium angustifolium virginianum, lamii flore, luteo maculat. Moris, Hist. 3. p. 375. sec. II. t.8 f.8."

3. Vahl, M., Enumeratio plantarum, vel ab aliis, vel ab ipso, etc. v. 1. p. 220 (1804)

"Clinopodium virginianum angustifolium, lamii flore, luteo maculato. Moris. hist. 3. p. 375. s II., t. 8. f. 1."

Note again the inversion of the second and third words in the Willdenow reference.

V. The fifth reference is by C. Linné in his Hortus cliffortanus. p. 495 (1737) and is as follows:

"Monarda floribus verticillatis."

The following additional information is given:

"Crescit in Virginia."

"Cum haec Monardae sit species dicatur praecedens (spec. 1.) Monarda capitulis terminatricibus, caule obtuse angulato; cum alia datur species inter virginianas. D. Gronovii caule acute angulato, capitulisque terminatricibus."

This reference of Linné is noted by the following with no changes in the first part.

Linne, C., Species plantarum, etc., 1 ed., v. 1, p. 22 (1753)

Linne, C., Species plantarum, etc., 2 ed., v. 1, p. 33 (1762)

Linne, C., Species plantarum, etc., 3 ed., v. 1, p. 33 (1764)

Willdenow, C. L. Linne's Species plantarum, etc., 4 ed. v. 1, pt. 1, p. 174 (1794)

Gronovius, J. F., Flora virginica, etc., 1 ed., v. 1, pt. 1, p. 9 (1739)

Gronovius, J. F., Flora virginica, etc., 2 ed., v. 1, p. 6 (1762)

Van Royen, A., Flora leydensis, etc., p. 12 (1740)

Linne, C., Hortus upsaliensis, etc., p. 12 (1748)

Miller, P., Gardener's Dictionary 6 ed. (alphabetical) (1752)

VI. The sixth reference is also by C. Linne viz. in his Hortus upsalensis, etc., p. 12, (1748), and is as follows:-

"Monarda floribus verticillatis, corollis punctatis."

The following additional information is also given:-

"Habitat in Virginia."

"Hospitatur sub dio, inque frigidario, tepidario & caldario sed prima hyeme plerumque perit."

"Obs. Flores punctis obscuris glandulosis adspersi; Folia fragantissima sunt.

This reference is noted by the following with no change in the first part:

Linne, C., Species plantarum, etc., 1 ed., v. 1, p. 22 (1753)

Linne, C., Species plantarum, etc., 2 ed., v. 1, p. 32 (1762)

Linne, C., Species plantarum, etc., 3 ed., v. 1, p. 32 (1764)

Willdenow, C. L., Linne's Species plantarum etc., 4 ed., v. 1, pt. 1, p. 174 (1797)

Miller, P., Gardener's Dictionary, 7 ed. alphabetical (1759)

Linne, C., Systema vegetabilia 13 ed., p. 64 (1774)

Linne, C., Systema vegetabilia 14 ed., p. 68 (1784)

Linne, C., Systema vegetabilia 15 ed., p. 69 (1787)

"M. flor. verticillatis corallis punctatis, bracteis coloratis."

Gronovius, J. F. Flora virginica, etc., 2 ed., v.1. p. 6. (1762)

The above eight references comprise all the Pre-Linnean information that has been found referring to Monarda punctata Linne. The various cross references with variations of each, as indicated, have been included in connection with each original reference.

The binomial name of Monarda punctata, was first assigned to the plant by Linne, in his Species plantarum, etc., 1 ed. v. 1, p. 22 in 1753. The various cross references to this name, are all in accord with the original, and are too numerous to list.

The Post-Linnean synonyms for Monarda punctata Linne are much fewer in number than the pre-Linnean names, as the plant is so characteristic, that only one other botanist has assigned a different name to it. This fact is substantiated by an examination of the synonymy of the plant in the Index Kewensis. (the main volumes and the various supplements.)

This single Post-Linnean name was given by A. Michaux, in his Flora boreali-americana, etc., v. 1, p. 16. (1803) viz. "Monarda lutea" and is referred to as Monarda lutea Michaux."

The following additional information is given:-

"M(onarda) foliis lanceolatis, leviter serratis, partim ciliatis; floribus verticillatis; calycibus summitate barbatis; corrollis luteis."

"M. punctata Linn."

"Obs. Omnium specierum corolla punctata."

"Hab. a Virginia ad Floridam."

The reason for the change in the specific name of Monarda punctata Linné from punctata to lutea by Michaux, is evident from the above note by Michaux, that all species of Monarda have punctate corollas. This is also noted by A. Rees in the Cyclopedia, v. 23, (pages not numbered in 1819). This change appears necessary since the spots on the corolla of this species are much more prominent and characteristic than on the corolla of any of the other species of the genus. With the present practice of considering the binomial name given by Linne in the first edition of his Species plantarum published in 1753 as the standard, the name assigned to the plant by A. Michaux in 1803, has only historical interest. The name assigned by A. Michaux to this plant is seldom found in the literature. An instance of its use is as follows:-

Pursh, F., Flora americae septentrionlis, etc. 2 ed., v. 1, p. 18 (1816)

Reference is sometimes made to Monarda punctata Linne as Monarda punctata W., Willd., or Willdenow. It is to be noted in this connection, however, that the above combination is invariably followed by volume and page references, and hence is properly considered a reference, and not a change in the authority for the name. This was the common policy of the United States Pharmacopoeia in several of the early revisions, as that of:

1820, (1 ed.,) p. 27. (1820)
(2 ed.,) p. 27. (1828)

1820, (2 ed.,) p. 27. (1828)

1830 (Phil.) p. 3. (1831)

1840, ( ) p. 9. (1842)

1850, (1 ed.) p. 9. (1851)

1860, (1 ed.) p. 10. (1863)

1860, (1 ed.) p. 10. (1864)

1860, (2 nd.) p. 10. (1868)

1870, p. 10. (1873)

In the United States Pharmacopeia of 1880, published in 1882, the rules of the International Botanical Congress, held in Paris in 1867, were adopted as the basis of the botanical nomenclature of plants yielding drugs contained

in that revision of the Pharmacopoeia. From that time on the name of Linne is used in connection with the name of Monarda punctata.

An instance of the use of Willdenow's name instead of Linne's in connection with Monarda punctata is found in N. Chapman's Elements of Therapeutics and Materia Medica, v. 2, p. 296 (1824). This is a reference as previously stated, and not that Willdenow is to be credited with having named the plant.

J. C. Loudon in his Encyclopedia of Plants, p. 22, (1855) refers to Monarda punctata Pursh. This is evidently an error, as it is to be found nowhere else. Moreover, F. Pursh in his Flora americae septentrionalis, 2 ed., v. 1, p. 18, (1816) uses the name as Monarda punctata as Monarda punctata Willd. Sp/pl.I. p. 126. This again is a reference only.

It is only recently that attention has been called to 2 subspecies of Monarda punctata Linné. The division was made by F. W. Pennell in 1919. The information is contained in the Bulletin of the Torrey Botanical Club, v. 46, p. 186. The names assigned to these 2 subspecies are: Monarda punctata immaculata Pennell subsp. nov. and Monarda punctata villicaulis Pennell subsp. nov.

Descriptions of the 2 new subspecies and the typical

form of the normal species are given a key to the various localities where each of the subspecies are to be found.

Two varieties of Monarda punctata Linne are also recorded.

1. Monarda punctata var. lasiddnta Gray, in Asa Gray, Synoptical Flora of North America. The Gamopetalae, etc. (1886) p. 375.

A description of the variety and its habitat is given.

This variety is changed to a species Monarda lasidonta (A. Gray) Small, by J. K. Small in his Plants of the southern United States, 1 ed. pp. 1038 and 1337 (1903) in which Small gives a description and habitat of the plant.

2. Monarda punctata var. leucantha, Nash is described by G. V. Nash in the Bulletin of the Torrey Botanical Club. v. 23, p. 104 (1896) as a variety with white flowers. It is found in various localities south of Tampa, Florida.

Scientific and Popular Names

Genus name

It has already been shown (see Chapter on pre-Linnean names, 5th reference) that it was Linné[1] in 1737, who first gave the name Monarda, to the plants which comprise the genus, in honor of Nicolas Monardes[2], the Spanish physician of Seville who is generally credited with having made the first plant collection of American plants, and the authorship of the first treatise[3] on American drugs. Presuming that Monarda punctata and Monarda fistulosa occurred as widely distributed during the early period of Spanish exploration of America, as it has during the last century, as indicated by the authors of botanical texts, it would seem probable that some of the plants of this genus came under his supervision. However, we do not have positive proof that he knew the plants, which were later named in his honor.

Hewitt,[4] points out that Stunzer[5] in 1895, in his

1.)C. Linné, Hortus cliffortanus (1737), p. 495.
2.)A. Rees, The Cyclopaedia (1819), vol. XXIII alphabetical.
3.)N. Monardes, Cosas delas Indias (1565).
4.)Hewitt, Unpublished Thesis, U. of W., 1926.
5.)K. Stunzer, Die Schrift des Monardes uber die Arzneimittel Americas (1895), p. 32.

translation (German) of Clusius' Latin edition of Monardes test, states that the plants described by Monardes under the designation "la yerua de Juan infante"[6] and obtained from New Spain, may have been Monarda punctata L.

On the following pages, an attempt has been made to show the variations in the pronunciation of the genus name, Monarda. While the number of references given, does not in any way exhaust the possible number of references which might be added if more references were available, yet those which are recorded are sufficient to show that a variation in pronunciation is prevalent in the literature. The most common method of accentuation is Monarda, while the accent has also been found irregularly, as in Monarda and Monarda. The grave (\) instead of the acute (/) is given by Britton and Brown in two instances (see Monarda) in two different editions, so that if it was a typographical error, as suggested by Hewitt,[7] it was carried through the several editions without change.

6.) N. Monardes, Cosas delas Indias (1565), p. 40.
7.) Hewitt, Unpublished Thesis, U. of W., 1926.

Genus Monarda

Latin Synonyms

Monárda

J. C. Loudon, Encyclopaedia of Plants (1829), p. 1153.

R. Dunglison, Dictionary of Medical Science (1874), p. 663.

Monárda

J. Donn, Hortus Cantabrigiensis (1826), p. 20.

J. C. Loudon, Hortus Britannicus (1830), p. 10.

A. Eaton, Manual of Botany (1830), p. 228.

G. Don, A general History of the Dichlanydeous Plants (1838), 4, p. 758.

A. Gray, Manual of Botany of Northern U. S. (1848), p. 319.

A. Gray, How Plants Grow (1859), p. 179.

A. Gray, Lessons in Botany (1873), p. 250.

A. Gray, Field Forest and Garden Botany (1895), p. 352.

A. Gray, School and Field Book of Botany (1887), p. 245.

A. Gray, New Manual of Botany (1908), p. 702.

Monárda

Britton and Brown, Illustrated Flora of the Northern

States, Canada and British possessions, (1898) 3, p. 102.

N. Britton, Manual of the Flora of the Northern States and Canada (1901), p. 795.

Britton and Brown, Illustrated Flora of the Northern States, Canada and British possessions (1913), 3, p. 131.

Monarda L.

A. Wood, Class Book of Botany (1861), p. 550.

mŏn-ar´-da

Cassell & Co., The Encyclopaedic Dictionary (1885), 5, p. 85.

Monarda

W. P. C. Barton, Compendium Florae Philadelphicae (1818), I, p. 13. / A. Eaton, Manual of Botany/ (1823) 2, p. 27.

J. Bigelow, Treatise on Materia Medica (1822) p. 261.

A. Eaton, Manual of Botany (1822), p. 57.

A. W. Chapman, Elements of Therapeutics and Materia Medica (1824), p. 246.

J. R. Coxe, American Dispensatory (1827), p. 404.

A. Eaton, Manual of Botany (1829), p. 14.

L. C. Beck, Botany of the Northern and Middle States (1833), p. 275.

Monarda (cont'd)

J. Torrey, A Flora of the State of New York (1843), p. 2, vol. 2, p. 58.

J. Clarke, Catalogue of Flowering Plants and Ferns observed in vicinity of Cincinnati, Ohio (1852), p. 16.

I. A. Lapham, Fauna and Flora of Wisconsin (1852), p. 400.

I. A. Lapham, A Trans. Ill. Agr. Soc. (1856-7) v. 2, p. 527.

J. S. Newberry, Catalogue of Flowering Plants and Ferns of Ohio(1860), p. 26.

H. V. Sweringen, Dictionary of Pharmaceutical Science (1873), p. 269.

R. Dunglison, Dictionary of Medical Science (1874), p. 663.

I. A. Lapham, A Catalogue of Plants of Minnesota (1875), p. 20.

S. R. Barnes, Catalogue of the Phoenogamous and vascular cryptogamous plants of Indiana (1881), p. 23.

J. Macoun, Catalogue of Canadian Plants (1883), pt. I, p. 385.

A. Grey, School, and Field Book of Botany (1887), p. 245.

Torrey Bot. Club V (List of the Pteridophytes and

Monarda (cont'd)

Spermatophytes growing without cultivation in Northeastern N. A. (1893-1894), p. 282.

S. E. Jellife, The Flora of Long Island (1899), p. 133.

J. J. Fitzpatrick, Manual of Flowering Plants of Iowa (1899), p. 135.

Barnes, Reppert, and Miller, Flora of Scott and Muscatine Counties, Iowa (1900), p. 247.

A. Gattinger, The Flora of Tennessee (1901), p. 146.

C. Mohr, Plant Life of Alabama (1901), p. 702.

W. Greene, Plants of Iowa (1907), p. 210.

A. Gray, New Manual of Botany (1908), p. 702.

C. T. Stevens, An illustrated Guide to Flowering Plants (1910), p.

Nellie F. Flynn, Flora of Burlington and Vicinity (1911), p. 76.

L. H. Bailey, Manual of Cultivated Plants (1924), p. 640.

Species Monarda Punctata L.

It may be observed that in this compilation of the species name, Monarda punctata L., little attention has been shown any minor changes in the punctuation or abbreviation of the species name. Likewise, little emphasis has been placed on abbrevation of the author's name who is credited with naming the plant. However, important accentuation changes of the species name have been indicated, wherever they have been noted, while changes in author's name have been carefully recorded.

Monárda punctata L.

A. Gray, Manmual of Botany of the Northern U. S. (1848), p. 319.

Monárda punctata

J. Donn, Hortus Cantabrigiensis (1826), p. 11.

Monarda punctata L.

J. C. London, Hortus Britannicus (1830), p. 10.

Ibid.(1855), p. 20.

R. Dunglison, Dictionary of Medical Science (1874), p. 663.

Monarda punctata L.

C. Linne, Species Plantarum (1753), I, p. 22.

J. R. Forster, Flora America Septentrionalis (1771), p. 2.

Ibid. (1775), p. 2.

A. Michaux, Flora Boreali-Americana (1803), I, p. 16.

E. A. Atlee, American Medical Recorder (1819), 2, p. 496.

P. L. Geiger, Handbuch der Pharmacie (1829), II, bd. I, Abth. p. 372.

J. Torrey, A Flora of Northern and Middle Sections of U. S. (1824), I, p. 24.

A. W. Chapman, Elements of Therapeutics and Materia Medica (1824), 2, p. 296.

J. L. Riddell, Synopsis of the Flora of the Western States (1835), p. 80.

Wm. E. A. Aiken, Cat. of Phaenogamous Plants and Ferns, native or naturalized in the vicinity of Baltimore, Md. (1837), p. 76.

E. Winkler, Real Lexikon (1842), 2, p. 75.

C. A. Lee, Cat. of the Medicinal Plants Indigenous and Exotic growing in the State of N. Y. (1848), p. 43.

I. A. Lapham, Fauna and Flora of Wisconsin (1852), p. 400.

I. A. Lapham, Trans. Ill. State Agr. Soc. (1857), p. 527.

F. Stearns, Proc. A. Ph. A. (1858), 77, p. 271.

A. W. Wood, Classbook of Botany (1860), p. 550.

J. S. Newberry, Catalogue of the Flowering Plants and Ferns of Ohio (1860), p. 26.

H. Hollembaek, American Eclectic Materia Medica (1865), p. 257.

J. Pereira, Materia Medica and Therapeutics (1866), p. 492.

Dorvault, L'Officine on Repertoire General De Pharmacie Pratique (1867), p. 613.

G. B. Wood, A Treatise on Therapeutics & Pharmacology (1868), 3rd ed., v. I, p. 343.

H. V. Sweringen, Dictionary of Pharmaceutical Science (1873), p. 269.

J. King, American Dispensatory, (1875), p. 529.

J. B. Biddle, Materia Medica (1876), p. 210.

C. Pickering, Chronological History of Plants (1879) pp. 948 & 999.

A. Gray, A Synoptical Flora of N. A. (1878), 2, pt. I, p. 374.

Bentley and Trimen, Medicinal Plants (1880), 3, p. 208.

C. Luerssen, Handbuch der Systematische Bot. (1882), 2, p. 1031.

J. Macoun, Catalogue of Canadian Plants (1883), pt. 1, p. 386.

L. Johnson, A Manual of Medical Botany of N. A. (1884), p. 239.

A. Gray, A Synoptical Flora of N. A. (1886), 2, pt. I, p. 373.

Real Encyclopadie der Gesammten Pharmacie VII, (1889), p. 702.

J. M. Coulter, Botany of Western Texas (1891), 2, p. 339.

H. W. Patterson, Numbered Check List of North American Plants (1892), p. 99.

B. B. Smyth, Check List of the Plants of Kansas (1892), p. 18.

C. F. Millspaugh, American Medicinal Plants (1892), 2, p. 116.

R. Dunglison, Dictionary of Medical Sciences (1893), p. 709.

Stille, Maisch and Casperi, National Dispensatory (1894); p. 1046.

L. H. Bailey, Asa Gray's Field, Forest, and Garden Botany (1895), p. 352.

L. E. Sayre, Organic Materia Medica and Pharmacognosy (1895), p. 343.

S. W. Waggman, A Compendium of Botanic Materia Medica, (1895), p. 208.

A. Brestowski, Handwater buch der Pharmacie (1896), 2, p. 154.

J. J. Fitzpatrick, Manual of Flowering Plants of Iowa (1899), p. 206.

A. Gattinger, The Medicinal Plants of Tennessee (1899), p. 68.

Britton and Brown, Illustrated Flora of the Northern States & Canada (1898), v. 3, p. 104.

C. W. Hyams, N. C. Agri. Exp. Sta. Bull. No. 150 (1898), p. 377.

Felter and Lloyd, Kings American Dispensatory 18th ed. (1900), p. 1274.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p251.

W. D. Barnes, F. Reppert & A. A. Miller, The Flora of Scott and Muscatine Counties, Iowa (1900), p. 247.

T. Kearney, U. S. Nat. Herb. Bull. (1901), vol. V #6, p. 458.

C. Mohr, Plant Life of Alabama (1901), p. 702.

A. Gattinger, The Fora of Tennesse (1901), p. 147.

J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.

J. W. Blankinship, Miss. Bot. Garden (1907) 18th Rept., p. 187.

H. Hus, Miss. Bot. Garden (1908), 19th Rept., p. 165.

Witmer Stone, Ann. Rept. of N. J. State Museum (1910), p. 668.

J. W. Harshberger, Die Vegetation der Erde, (1911), p. 413.

M. Grieve, Mints, Their Cultivation and Uses (1911), p. 2.

H. L. Gerth van Wijk, A Dictionary of Plant Names, (1911), p. 853.

Rusby and Stedman, A Reference Handbook of Medical Science (1916) vol. VI, p. 532.

Bruntz and Jaloux, Plantes Officinalis (1918), p. 185.

F. W. Pennell, Bull. Torrey Club (1919), v. 46, p. 186.

R. C. Ruark, Am. Jr. Pharm. (1919), 91, p. 91.

L. Reutter, Traite de Matiere Medicale et De Chimie vegetale (1923), p. 243.

R. C. Wren, Potter's Cyclopoedia of Botanical Drugs & Preparations (1923), p. 166.

H. S. Pepoon, An Annotated Flora of the Chicago Area (1927), p. 449.

P. A. Rydberg, Flora of the Prairies and Plains of Central North America (1923), p. 692.

J. K. Small, Manual of Southeastern Flora (1933), p. 1164.

In presenting this detailed synonomy with numerous references, it seemed worth while to point out in a single plant species, not only what may be termed conflicting synonyms, but also minor isidiosyncrasies in spelling. While these are minor matters, the tabulation of parallel synonyms in the languages of the botanical literatures consulted may seem more worth while. It may be pointed out in this connection that while folklore undoubtedly played a role in coining such terms as horsemint and bee balm, the foreign language equivalents, so far as applied to this plant, have nothing to do with folklore but are literal translations by systematists.

Latin	Monarda punctata	"
English	Spotted Monarda	Horsemint
German	Getuepfelte Monarda	Pferdeminze
	Geflockte Monarde	
French	Monarde ponctuete	Menthe de Cheval
Italian	"	Menta cavallo Americana
Swedish	"	Hastmynta
Norwegian Danish	"	Hestemynte
Spanish	la yerua de Juan infante	"

Latin	•	Herba Monarda	•
English	mountain balm	[illegible]	Gravel Wort)
German	•	•	•
French	Montain balm	Herbe de Monarde	•
Italian	•	•	•
Swedish	•	•	•
Norwegian Danish	•	•	•
Spanish	•	•	•

English Synonymy:

While the English synonyms of Monarda punctata L. may appear to be well standardized and differentiated from those belonging to the other species of Monarda, yet in an attempt to tabulate the synonyms of this species, the greatest confusion has been found. A few illustrations may suffice to show that such confusion exists. The term, horsemint, found to be the common name for the genus, Monarda, is also represented as a very common synonym for anyone of three species of Monarda, e. g. Monarda didyma L., Monarda fistulosa L., and Monarda punctata L. That it is also employed to designate two species of entirely different genera, e. g., Mentha sylvestris L. (see Chapter on German Synonyms) and Cunila Mariana Gray[1] will help to emphasize the state of this confusion.

A further illustration may be shown in the synonym, bee-balm. While it is commonly known as the synonym for Monarda didyma L., yet it is mentioned, frequently, in the literature as the synonym for both Monarda fistulosa L. and Monarda punctata L.

In regard to the etymology of the synonym, horsemint, very little has been learned. However, regarding the

1.) N. Blanchan, Nature's Garden, p. 50.

prefix, horse, which is combined to the word, mint, to give us the synonym, horsemint, Lindsay[2] states that "horse" seems to have the same sense as in horse-radish or horse-leech, where it is a form of hoarse or coarse in contra-distinction to a species not as coarse.[3] Lindsay also intimates that "horse" may be a corrupted form of hoarse. As for bee-balm, the synonym may have been derived from the entomological importance of the plant, the value of which is recognized in apiculture.

Hewitt[4] includes the word, Monarda, as one of the synonyms, pointing to its use in American Dispensatories during the period when the plant was official in the U. S. Pharmacopoeia (1820-1870 incl.), and by later writers, who have presumably taken it from that source. However, the use of this word (Monarda) does not seem to have any justification in designating Monarda punctata L. as "the" Monarda any more than the term, mint, is sometimes used to indicate Peppermint, as "the" Mint.

The synonym American horsemint might seem to indicate that the species grown on English soil would be designated English horsemint. However, as it has already been shown

2.) W. S. Lindsay, Plant Names (1923), p. 55.
3.) Ibid.
4.) Hewitt, Unpublished Thesis, U. of W. 1926.

(Chapter on German synonym) that the English horsemint has no species relationship, but is found to belong to another genus.

Inasmuch as dark brown spots occur on the corollas of Monarda punctata L., the synonyms, spotted monarda, dotted monarda, and dotted-flowered monarda seem to be appropriate.

The synonym, Origanum, appears to be adopted in English from the first Latin word occurring in the pre-Linnean name as recorded by Banister[5] in 1688 and later noted by Plukenet[6] and Gronovius[7].

Regarding the synonyms, mountain balm, and gravel-wort, little information was available in the literature.

5.) J. Ray, Historia plantarum, etc., (1688), vol. 2, p. 1927.
6.) L. Plukenet, Phytographia, etc. (1691), tab. XXIV, fig. 1.
7.) J. F. Gronovius, Flora virginica etc. (1739), 1 ed. p. 6.

1) Balm
2) Beebalm
3) Beebalm Wort
4) Mountain Balm
5) Spotted Beebalm
6) Bergamot
7) Sand Bergamot
6) Wild Bergamot
8) Horsemint
8) Horsemint
9) Horse-Mint
10) Horse-Mint
11) Horse-mint
12) horsemint
13) American Horsemint
14) American horsemint
15) American horse mint
16) Common horsemint
18) Dotted Horse Mint
17) Dotted Horsemint
19) Sand Horsemint
20) Monarda
20) Monarda
21) Dotted Monarda
22) Dotted-flowered Monarda

23)
Spotted Monarda

24)
Spot-flowered Monarda

25)
Origanum

25)
Origanum

26)
American Origanum

27)
Rignum

28)
Wort

29)
Gravel-Wort

1.) The name Balm is applied to the genus Melissa, the "Common Balm" being M. officinalis. In addition to the Balm of Gilead, (Populus balsamifera var. candicans), there are "balms" with modifying attributes, such as Horse-Balm (Collinsonia), etc. also Balsam Poplar (Populus balsamifera) etc. The designation Balm was applied to a Monarda because of its close relationship to Melissa in its botanical classification.

2.) Inasmuch as it has been pointed out that M. punctata L. is sometimes used as a bee food, (See Chapter on Cultivation) this name calls for no explanation. The reason why the related species M. fistulosa cannot serve as bee food though it may produce the same nectar has also been pointed out, hence this name should not be applied to the latter species, although it is sometimes found as one. Although apiculture has been highly developed in Germany and France, no German or French equivalents are recorded for the simple reason that the plant has not been cultivated in Europe, hence has not served as bee food in those countries.

G. Blaque, Travaux de Laboratorie de Matiere Medicale de La Faculte de Pharmacie de Paris. (1923-24), vol. 15, Chap. III, p. 46.

3.) It would be of interest to learn where Zoernig found this synonym. The word "wort" as applied to plants

is typically English rather than American. Comp. Gravel-Wort, footnote 26.

H. Zoernig, Arzneidrogen (1911) vol. II, p. 329.

4.) Why this plant that favors sandy low lands, such as river bottoms, should be called Mountain Balm does not become apparent. Yet the references cited below reveal that it was thus designated at an early date.

T. Nuttall, Genera of N. AmericanPlants (1818), Vol. I, p. 17.

J. Bigelow, Treatise on Materia Medica (1822), p. 261.

J. R. Coxe, American Dispensatory (1825), p. 462.

V. J. L. Jourdan, Pharmacopoea Universalis (1832), Vol. II, p. 104.

R. Hooper, Lexicon Medicum or Medical Dictionary (1838), p. 81.

5.) This popular name calls for no further comment.

C. V. Riley, 4th Rept. U. S. Entomological Com. (1885), p. 164.

J. M. McFarland, Standard Plant Names, 1924, p. 287.

6.) This was apparently taken over from the common designation of the related M. fistulosa.

A. B. Lyons, Plant Names, Scientific and Popular, (1900), p. 251.

E. A. Ruddiman, Manual of Materia Medica (1907), p. 190.

Merck's Index (1907), p. 290.

H. Kraemer, A Textbook of Botany and Pharmacognosy (1907), p. 57.

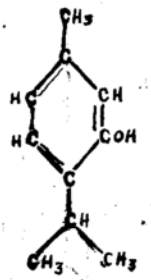
T. Stedman, Medical Dictionary (1924), p. 635.

Merck's Index (1930), p. 341.

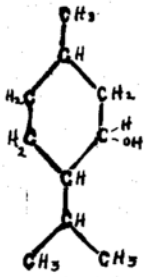
7.) The modifying term was no doubt added to differentiate it from M. fistulosa (Wild Bergamot) which grows on clay soil, whereas M. punctata prefers sandy soil.

H. S. Pepoon, An Annotated Flora of the Chicago Area (1927), p. 449.

8.) The name horse mint signifies coarse mint. Its usage here is comparable to that in horse radish (the Ger. Pferde knemmel, an Oenanthe (Brockhaus), also Pferdebohne (do.), Pferdeschwanz, an Equisetum (do.), Eng. horsetail, Pferdezahnmais (do.) (See Thiernamen der Pflanzen) horse play, etc. Chemically the difference finds expression in the presence of thymol in horsemint as to that of menthol in (pepper)mint. The former is a phenol with the disagreeable properties of this class, whereas the latter, hexahydrothymol, is a secondary alcohol. The structural difference finds expression in the formulas of the two compounds.



Thymol



Menthol

A. E. Atlee, American Medical Recorder (1819), Vol. 2, p. 496.

J. Bigelow, Treatise on Materia Medica, (1822), p. 261.

W. P. C. Barton, Lectures on Materia Medica and Botany (1827) vol. 2, p. 213.

A. W. Chapman, Elements of Therapeutics and Materia Medica (1824), vol. 2, p. 296.

J. R. Coxe, American Dispensatory (1831) p. 462.

Wood and Bache, Dispensatory of U. S. (1834), p. 434.

A. Wood, Classbook of Botany (1847), p. 417.

W. Beach, American Practice and Family Medicine, (1847), p. 685.

A. Gray, Botany of the Northern U. S. (1848), p. 320.

A. Clapp, Synopsis (1852), p. 148.

J. Darby, Botany of the Southern States (1855), p. 469.

A. Gray, Manual of the Botany of the Northern U. S. (1857), p. 309.

F. Stearns, Proc. A. Ph. A., vol. 7, (1858), p. 271.

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A. Gray, School and Field Book of Botany (1869), p. 250.

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L. Colange, Zell's Popular Encyclopediae (1874) p. 374. / A.Stille,Therapeutics & Materia Medica (1874), 4p. 802./

J. King, American Dispensatory (1875), p. 529.

A. Gray, Synoptical Flora (1878), vol. 2, pt. I, p. 374.

J. M. Flint, Classification of Materia Medica Collection of U. S. Nat. Mus. (1883), p. 463.

J. B. Biddle, Materia Medica (1876), p. 210.

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A. Gray, Lessons and Manual of Botany (1887), p. 413.

J. M. Maisch, Org. Materia Medica (1887), p. 388.

J. Coulter, U. S. Herb (1890), Vol. 1, no. 2, p. 47.

Parke Davis & Co., Organic materia medica (1890), p. 97.

S. Waggaman, Compendium of Botanic Materia Medica (1895), p. 208.

L. H. Bailey, Asa Gray's Field, Forest and Garden Botany (1895), p. 352.

Britton and Brown, Illustrated Flora of Northern States and Canada (1898), vol. 3, p. 104.

Lloyd and Felter, Kings American Dispensatory (1900) 18th ed. 3rd rev., vol. 2, p. 1234.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.

C. Mohr, Plant Life of Alabama (1901), p. 702.

W. Greene, Plants of Iowa (1907), p. 210.

O. A. Wall, Handbook of Pharmacognosy (1917), p. 105.

E. W. Felter, The Eclectic Medical Journal (1919),

vol. 79, p. 389.

G. Blaque, Travaux du Laboratoire de Matiere Medicale de La Faculte de Pharmacie de Paris (1923-24) vol. 15, Chap. III, p. 46.

M. Dorland, American Illustrated Medical Dictionary (1925) (alphabetical).

9.) -

A. W. Chapman, Elements of Therapeutics and Materia Medica (1824), vol. 2, p. 296.

A. Gray, Synoptical Flora (1878), vol. 2, pt. 1, p. 374.

L. Johnson, A Manual of the Medical Botany of N. A. (1884), p. 212.

A. Gray, School and Field Book of Botany (1887), p. 245.

A. Gattinger, The Medicinal Plants of Tennessee (1884) p. 68.

J. J. Fitzpatrick, Manual of Flowering Plants of Iowa (1899), p. 135.

10.) -

C. A. Lee, A Catalogue of Modern Plants Indigenous and Exotic, growing in the State of N. Y. (1848), p. 43.

J. S. Newberry, Catalogue of the Flowering Plants and Ferns of Ohio (1860), p. 26.

Miller and Young, Catalogue of the Phaenogamous and Acrogenous Plants of Suffold Co. L. I. (1874), p. 11.

Grieve & Leyel, A Modern Herbal (1931), vol. 2, p. 546.

11.) - P. L. Riddell, A Synopsis of the Flora of the Western States (1835), p. 80.

J. Torrey, A Flora of the State of N. Y. (1843), pt. 2, vol. 2, p. 58.

I. A. Lapham, Trans. Ill. State Agr. Soc. (1856-7), vol. 2, p.527.

L. Colange, Zell's Popular Encyclopedia (1874), vol. 2, p. 390.

A. Stille, Therapeutics and Materia Medica (1874), vol. 1, p.

Wheeler & Smith, Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Michigan, etc., (1881), p. 57.

J. Macoun, Catalogue of Canadian Plants (1883), pt. 5, p. 356.

A. Gray, Elements of Botany (1887), 414.

J. M. Coulter, Botany of Western Texas (1891), vol. 2, p. 339.

A. Gray, Synoptical Flora of N. A. (1896), p. 375.

Wooton & Coulter, Asa Gray's Manual of Botany (1898), 6th ed., p. 414.

Britton and Brown, Illustrated Flora of the Northern States and Candad (1898), vol. 3, p. 102.

C. W. Hyams, N. C. Agricultural Exp. Sta. No. 150, (1898), p. 377.

J. J. Fitzpatrick, Manual of Flowering Plants of Iowa (1899), p. 135.

W. Greene, Plants of Iowa, (1907).

N. F. Flynn, Flora of Burlington and Vicinity, Vt. (1911), p. 76.

12.) -

N. Chapman, Elements of Therapeutics and Materia Medica (1823).

A. W. Chapman, Flora of the Southern U. S. (1865), p. 320.

H. L. Gerth van Vijk, A Dictionary of Plant Names (1911), I, p. 853.

N. Dorland, American Illustrated Medical Dictionary (1925), p. 709½

13.) The modifying term was, no doubt, used to differentiate it from the European.

Encyclopedia Perthensis (1819), vol. 16, p. 165.

Bentley and Trimen, Medicinal Plants, (1880), vol. 3, p. 208.

J. M. Nickell, Botanical Ready Reference (1881), p. 90.

Stille and Maisch, National Dispensatory (1884), 3rdd ed., p. 987.

Merck's Index (1907), p. 290.

J. Rudolphy, Pharmaceutical Directory and Handbook (1910).

M. Grieve, Mints, Their Cultivation and Use (1911), p. 2. / T. Stedman, Medical Dictionary (1924), p. 635./

Merck's Index (1930), p. 341.

14.) -

Stille and Maisch, National Dispensatory (1879), p. 927.

Century Dictionary (1890), vol. 4, p. 3830.

A. Graa, Manual of International Pharmacy (1911), p. 190.

15.) -

H. L. Gerth van Wijk, A Dictionary of Plant Names, (1911), I, p. 853.

16.) Rusby and Stedman, A Reference Handbook of Medical Science, vol. VI (1916), p. 532.

17.) Inasmuch as the designation horsemint applies to the entire genus, the attribute "dotted" specifically marks the M. punctata.

A. Gray, How Plants Grow (1859), p. 179.

18.) C. Mohr, Plant Life of Alabama (1901), p. 702.

19.) That species of the genus "Horsemint" which grows on sandy soil.

H. S. Pepoon, An Annotated Flora of the Chicago Area (1927), p. 449.

20.) That genus was named after the Spanish physician Monardes by Linné has been pointed out. (See Chapter on Genus name.)

F. Pursh, Florae Americae Septentrionalis (1816), I, p. 16.

A. Eaton, Manual of Botany (1818), vol. 2, p. 27.

J. Bigelow, Treatise on Materia Medica (1822), p. 261.

J. R. Coxe, The American Dispensatory (1825), p.391.

J. R. Coxe, The American Dispensatory (1831), p. 462.

Wood & Bache, U. S. Disp. (1834), p. 434.

J. Pereira, Materia Medica (1866), p. 492.

H. V. Sweringen, Dictionary of Pharmaceutical Science (1873), p. 269.

J. B. Biddle, Materia Medica (1876), p. 210.

L. Johnson, A Manual of Medical Botany of N. A. (1884), p. 212.

E. A. Sayre, Organic Materia Medica and Pharmacognosy (1895), p. 343.

Century Dictionary (1890), p. 3830.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.

H. Euler, Pflanzenchemie, (1908), p. 77.

21. -

S. Elliott, A Sketch of the Botany of South Carolina and Georgia (1821), p. 28.

F. D. Porcher, Trans. A. M. A. (1849), vol. 2, p. 806.

22 .) - It is the flowers that are dotted or spotted.

G. Don, A General History of the Dichlamydeous Plants (1838), vol. 4, p. 758.

23.) -

Grieve and Leyel, A Modern Herbal, Vol. II, p. 546.

A. Rees, The Cyclopaedia (1819), vol. XXIII, alphabetical.

24.) -

J. Donn, Hortus Canatabrigiensis (1826), p. 11.

25) - That the plant was regarded as an Originanum has been shown in the Historical Introduction.

S. Elliott, A Sketch of the Botany of S. Carolina and Georgia (1821), p. 28.

J. M. Nickell, Botanical Ready Reference (1882), p. 90.

C. F. Millspaugh, American Medicinal Plants (1892), vol. 2, p. 116.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.

26) - To differentiate it from the European Origanum.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.

Rusby and Stedman, A Reference Handbook of Medical Sciences (1916), vol. VI, p. 532.

27.) = Corruption of Origanum.

S. Elliott, A Sketch of the Botany of S. Carolina and Georgia (1821), p. 28.

M. A. Curtis, Geolog. & Nat. Hist. Sur. of S. C. (1867), pt. III, p. 40.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.
Comp. Beebalm Wort footnote 5.

28 28.) = Possibly so-called because it was regarded as a remedy against gravel. Falter and Lloyd in King's American Dispensatory have recorded in a similar manner, the common synonym "Gravel weed" to Diervilla trifida Moench, Epigaea repens Linne, and Eupatorium purpureum Linne, because all three of these plants were used for gravel or calculous deposits in the urine.

J. Brereton, Florae Columbianae (1830), p. 14.

29 29.) =

F. Pursh, Florae Americae Septentrionalis (1816), p. 16.

H. L. Gerth van Wijk, A Dictionary of Plant Names (1911), I, p. 853.

SPECIES MONARDA PUNCTATA

Latin synonyma

I. Monarda lutea Michaux

L. Plukenet, Amaltheum Botanicum (1705), p. 61

A. Michaux, Flora Boreali-Americana (1803), p. 16

F. Pursh, Flora Americae Septentrionalis (1816) p. 16

S. Elliott, A Sketch of the Botany of S. C. & Georgia (1821) p. 28

J. Torrey, Flora of the Northern and Middle Section of U. S. (1824) p. 26

A. Eaton, Manual of Botany, (1824), p. 365

G. Bentham, Labiatarum 1832-1836

L. C. Beck, Botany of the Northern & Middle States (1833)

A. Wood, Classbook of Botany (1846) pt. 2, p. 417

A. De Candalle, Prodromus (1848), 12, p. 363

A. Clapp, Synopsis (1852), p. 148

Bentley & Trimen, Medicinal plants (1880), 3, p. 208

J. Macoun, Catalogue of Canadian plants (1883) pt. I, p. 385

A. Gray, Synoptical Flora of N. A. (1896), p. 375

C. Mohr, Plant Life of Alabama (1901), p. 702

G. Blaque, Travaux du Laboratoire de Matiere

Medicale de La Faculte de Pharmacie de Paris, v. 15, Chap. III, (1923-24), p. 46

II. Monarda floribus verticillatis

C. Linné, Hortus Cliffortianus (1737), p. II & p. 495

J. F. Gronovius, Flora virginica, etc., 1 ed., v. 1, (1739), p. 9

A. Van Royen, Flora leydensis, etc., (1740), p. 12

C. Linné, Hortus upsalensis, etc., (1748), p. 12

C. Linné, Species plantarum, etc., 1 ed., v. 1, (1753), p. 22

C. Linne, Species plantarum, etc., 2 ed., v. 1, (1762), p. 33

J. F. Gronovius, Flora virginica, etc., 2 ed. v. 1, (1762), p. 6

C. Linné, Species plantarum, etc., 3 ed. v. 1, (1764), p. 33

C. Linné, Species plantarum, 4 ed., v. 1, p. 174 (edited by Willdenow)

P. Miller, Gardener's Dictionary 6 ed. alphabetical

III. Monarda floribus verticillatis, corollis punctatis.

C. Linné, Hortus upsaliensis, etc., (1748) p. 12

C. Linné, Species plantarum, etc., 1 ed., v. 1, (1753), p. 22

P. Miller, Gardener's Dictionary 7 ed., (1759), alphabetical

C. Linné, Species plantarum, etc., 2 ed., v. 1, (1762), p. 32

J. F. Gronovius, Flora virginica, etc., 2 ed., v. 1, (1762), p. 6

C. Linné, Species plantarum, etc., 3 ed., v. 1, (1764), p. 32

C. Linné, Systema vegetabilis, 13 ed., (1774), p. 64

C. Linné, Systema vegetabilis, 14 ed., (1784), p. 68

C. Linné, Systema vegetabilis, 15 ed., (1787), p. 69

C. Linné, Species plantarum, etc., 4 ed., v. 1, pt. 1, (1797), p. 174
(edited by Willdenow)

IV. Clinopodium Virginianum, angustifolium; floribus amplis luteis purpuro-maculatis, cujus caulis, sub quovis verticillo decem vel duodecim foliolis rubentibus est circumcinctus.

L. Plukenet, Almagestum botanicum, etc., (1696), p. 111

J. Ray, Historia plantarum, suppl. (1704), p. 300

C. Linné, Hortus cliffortanus, etc., (1737), p. 495

J. F. Gronovius, Flora virginica, etc., 1. ed., (1739), p. 6

A. Van Royen, Florae leydensis, etc., (1740), p. 313

C. Linné, Hortus upsalensis, etc., (1748), p. 12

C. Linné, Species Plantarum, etc., 1 ed., v. 1, (1753), p. 22

P. Miller, Gardener's Dictionary, 7th ed. (1759), alphabetical

C. Linné, Species plantarum, etc., 2 ed., v. 1, (1762), p. 33

J. F. Gronovius, Flora virginica, etc., 2 ed., v. 1, (1762), p. 6

C. Linné, Species plantarum, etc., 3 ed., v. 1, (1764), p. 33

J. B. M. De La Marck, Encyclopedie methodique, Botanique, v. 4, (1797), p. 257

M. Vahl, Enumeratis plantarum vel ab aliis, vel ab ipso observatarum, etc., v. 1, (1804), p. 220

V. Clinopodium Virginianum angustifolium, flore luteo

P. Hermann, Hortus academicus. Lugduno. Batavus catalogus etc., (1687), p. 161

L. Plukenet, Phytographia, etc., tab. XXIV, f. 1 (1691)

L. Plukenet, Almagestum botanicum, etc., (1696) p. 111

J. Ray, Historia plantarum, suppl. (1704), p. 800

J. F. Gronovius, Flora virginica, etc., 2 ed., (1762), p. 6

VI. Clinopodium virginianum angustifoliu fl. amplis luteis punctatis purpureis

L. Plukenet, Phytographia, etc., Tab. XXIV f. 1 (1691)

VII. Clinopodium angustifolium Virginianum Lamii flore luteo maculato

R. Morison, Plantarum historiae universalis, etc.,

C. Linné, Species plantarum, 4 ed., v. 1, pt. 1, (1797), p. 126

J. B. M. De La Marck, Encyclopedie methodique, botanique, v. 4, (1797), p. 257

M. Vahl, Enumeratio plantarum vel ab aliis, vel ab ipso, etc., v. 1, (1804), p. 220

VIII. Origanum floribus amplis luteis purpureo maculatis cujus caulis sub quovis verticillo decem vel duodecim foliolis rubentibus est circumcinctus

J. Ray, Historia plantarum, etc., v. 2., (1688), p. 1927

L. Plukenet, Phytographia, etc., tab. XXIV, fig. 1, (1691)

Subspecies:-

I. Monarda punctata subsp. immaculata Pennell

F. W. Pennell, Torrey Botanical Club, v. 46, (1919), p. 186

II. Monarda punctata Pennell, subsp. villicaulis nov.

F. W. Pennell, Torrey Botanical Club, v. 46, (1919), p. 186.

Varieties:

I. Monarda punctata var. lasidonta Gray

A. Gray, Synoptical Flora of N. A. (1896), p. 375

J. Coulter, U. S. Herbarium (1890), I, No. 2, p. 47

J. Parkinson, Theatrum botanicum (Appendix) (1640), p. 1675.

L. H. Pammel, Notes on the Flora of Texas (1894), p. 10

Wooton & Standley, Flora of New Mexico (1915) p. 560

II. Monarda punctata var. leucantha Nash

G. V. Nash, Bulletin of Torrey Botanical Club. (1896) 23, p. 104.

J. K. Small, Manual of Southeastern Flora (1933), p. 1164

III. Monarda punctata humilis Torr.

Wooton & Standley, Flora of New Mexico (1915) p. 560

P. C. Standley, U. S. Nat. Herb. 13, (1910), p. 174

German Synonymy.

Inasmuch as Monarda punctata is indigenous to only North America, it might be assumed that German authors in writing about the plant, would avail themselves of an opportunity to accept the established English synonyms, and translate them literally into German. That they did this becomes apparent from a review of the German synonyms which have been found in German and English literature, e. g. from the English synonym, horsemint, we discover the following words in German: Pferdemuenze, Pferdeminze, and (Amerika). The designation, Amerika, which is enclosed in parenthesis and added to the last synonym was used to differentiate this variety of horsemint from the English variety which is a synonym for Mentha sylvestris.

The German synonyms, Monarda gefleckte and Monarda getuepfelte are also other examples of the adoption of the German translation of the English synonyms, spotted, and dotted Monarda of Lat. Monarda punctata L.

Hewitt[1)] mentions two other synonyms in his list of German synonyms, but a study of them, reveals that either cannot be classified as synonyms in this instance. The first, Monardenkraut, meaning in English, Monarda plant,

1.)

might be used to designate any of the other species as well, while the words, Herba Monarda, are Latin words, and consequently do not belong under the title of German synonymy. The following are the German synonyms as recorded in the literature with their references.

Gefleckte Monarde

J. King, American Dispensatory (1875), p. 629.

Getupfelte Monarde

P. L. Geiger, Handbuch der Pharmacie (1827), II, bd. I, Abth., p. 372.

Pferdenminze

Stills and Maisch, National Dispensatory (1879), p. 927.

Real-Encyclopadie d. ges. Thom.

A. B. Lyons, Plant Names, Scientific and Popular (1907), p. 299.

J. Ruddphy, Pharmaceutical Dictionary and Handbook (1911)

H. L. Gerth van Wijk, A Dictionary of Plant Names, (1911) I, p. 853.

H. Zoernig, Arzneidrogen (1911) p. 329.

A. Graa, Manual of International Pharmacy (1911), p. 305.

Pferdemunze

H. T. Hedges, A Polygot Index (1884), p. 78.

Pferdemunze

H. T. Hedges, A Polygot Index (1884), p. 154.

French Synonymy

The French Synonymy, limited to a small number of synonyms, appears very similar to the German synonymy in that the synonyms adopted, are the equivalents of the English synonyms, but as would be expected, they are expressed in literal French, e. g., the word, horsemint, becomes Menthe de Cheval, while mountain balm, another English synonym becomes montain balm. The words, Monarda ponctuete, is the French equivalent for Monarda punctata.

In order to conform to the procedure, of noting the changes in spelling, which has been used in the compilation of the other Synonyms, the same attention will be devoted to changes in the spelling, whereever they are noted.

Menthe de Cheval

Dorvault, L'Officine on Repertoire Generale De Pharmacie Pratique (1867), p. 613.

Real Encyclopedie der Gesammten Pharmacie VII, p. 116.

Stille and Maisch, The National Dispensatory (1879), 2nd ed., p. 927.

H. T. Hedges, A Polygot Index (1884), p. 79.

A. B. Lyons, Plant Names, Scientific and Popular (1900), p. 251.

A. Graa, International Pharmacy (1911), p. 356.

Monarde

Charabat, Dupont and Pillet, Les Huiles Essentielles (1879), p. 565.

Monarde ponctuete

V. J. L. Jourdan, Pharmacopea Universalis (1832), ii, p. 104.

montain Balm

V. J. L. Jourdan, Pharmacopea Universalis (1832), ii, p. 104.

Herbe de menthe de cheval

H. Zoernig, Arzneidrogen (1911), 2, p. 329.

Herbe de monarde

V. J. L. Jourdan, Pharmacopea Universalis (1832), ii, p. 104.

Distribution

As pointed out in the historical introduction, it was Linnaeus[1] who gave the genus name Monarda to an American plant in honor to the Spanish physician, Nicolas Monardes, author of the first treatise on American materia medica.[2] Yet, in spite of the fact that the Monardas have been regarded, well nigh universally, as a typically American genus, Reutter,[3] as late as 1923, made the statement that the original habitat of M. punctata L. is southern Europe, and that it has been cultivated in North America. The fact is that Monardas, particularly in the showy M. didyma has been extensively cultivated in Europe, as many as five cultural varieties[4] being recognized.

So far as known, Monarda punctata L. is a North American species. It has been found in 27 states of the United States, in one province of Canada, and in Mexico. The extent of its distribution as recorded, is indicated on the accompanying maps. For a detailed account of its

1.) C. Linné, Hortus cliffortanus (1737), p. 495.
2.) Monardes, Cosas delas Indias, 1565.
3.) Traite de Matiere Medicale, p. 243.
4.) J. H. McFarland, Standardized Plant Names (1924), p. 237.

distribution, the political units of the United States are taken up in alphabetical order as a means of convenience. The other countries are considered in the order named above. In the far western states, where Monarda punctat L. is not prevalent, other species of Monarda occur which closely resemble this plant. (Monarda menthaefolia, Monarda pectinata. Nuttall.)

Alabama. Mohr[1] states that Monarda punctata L. may be found in dry, sandy soil at the borders of fields, pastures, and waysides throughout the state.

1.) C. Mohr, Plant Life of Alabama (1901), p. 702.

Arizona. The only reference to the plant in this state is given by Gray[1] who reports the occurrence of Monarda punctata lasiodonta, Gray. He also records that Wislizenus, Woodhouse, and Rothrock observed the plant, but they failed to indicate the locality in which they had seen it growing.

1.) Asa Gray, Synoptical Flora of North America (1886), p. 375.

Colorado. Mohr[1] includes this state in his general statement of the habitat of the plant, while Coulter[2] and Rydberg,[3] authors of two Rocky Mountain floras, fail to give any reference to the plant.

1.) C. Mohr, Plant Life of Alabama (1901), p. 702.
2.) J. M. Coulter, New Manual of Rocky Mt. Botany (1909).
3.) P. A. Rydberg, Flora of the Rocky Mountains and Adjacent Plains, (1917).

Florida. Michaux,[1] in 1803, was the first author to mention this state as habitat of the plant. In subsequent years, the following authors in outlining the general area of occurrence refert to its having been found in Florida: Beck,[2] Chapman,[3] Wood,[4] Gray,[5] Britton and Brown,[6] Watson and Coulter,[7] Small,[8] Gray,[9] Wall,[10] Rydberg,[11] Small,[12] Nash[13] mentions the occurrence of Monarda punctata Leucantha, Nash. He states "a few specimens were secured at Ballast Point near Tampa, but it occurs in greater abundance and luxuriance, forming large masses, at the foot of shell mound on Sneed's Island, near the mouth of the Manatee River."

1.) A. Michaux, Flora Boreali Americana L. (1803), p. 16.
2.) L. C. Beck, Botany of U. S. North of Virginia (1848), p. 273.
3.) A. W. Chapman, Flora of the Southern U. S. (1860), p. 320.
4.) A. Wood, Class Book of Botany, (1861), p. 550.
5.) A. Gray, Snoptical Flora of North America (1886), p. 375.
6.) Britton and Brown, Illust. Flora of the Northern States and Canada (1898), vol. 3, p. 104.
7.) Watson and Coulter, Asa Gray's Manual of Botany (1898), p. 414.
8.) J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.
9.) A. Gray, New Manual of Botany (1908), p. 704.
10.) O. A. Wall, Handbook of Pharmacognosy (1917), p. 105.
11.) P. A. Rydberg, Flora of the Prairies and Plains of Central N. A. (1932), p. 692.

Please see bottom of following page for footnotes 12 & 13.

The same author, also, observed Monarda punctata L. in great abundance in the northern tier of counties from Lake City westward, being particularly common around Tallahasse and River Junction. He records that the flowers of the latter were invariably of a dull golden yellow, while, from Tampa south, they were observed to be of the white flowered variety.

Footnotes continued from preceding page:
12.) J. K. Small, Manual of Southeastern Flora (1933).
13.) G. V. Nash, Bull. Torrey Bot. Club (1896), vol. 23, p. 104.

Georgia. As early as 1821, Elliott[1] listed Monarda punctata in his "Botany of S. Carolina and Georgia," yet in the text, he designated only the lower country of S. Carolina. Although the state lies within the general area of habitat as recorded by many authors of floras, yet Small[2] is the only author who specifically mentions its occurrence in the state.

1.) Stephen Elliott, A Sketch of the Botany of S. Carolina and Georgia (1821), p. 30.
2.) J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.

Illinois. Its occurrence in this state has been reported by several botanists. Thus Pepoon[1] reports it as growing in the sandy soil near Lake Michigan, also in the southeastern part of the state. Lapham[2] makes only a general statement as to its habitat in the state. Pennell[3] reports two varieties; Monarda punctata L., the typical species of the Coastal Plain and Monarda punctata villacaulis, Pennell, which he reports as growing on the sandy soil of northern Illinois. A specific reference is made to an herbarium specimen of this variety found on sandy soil in Hyde Park near the lake by Chase.

The only other reference found was of a general nature.[4]

1.) H. S. Pepoon, An Annotated Flora of the Chicago Area (1927), p. 449.
2.) I. A. Lapham, Trans. Ill. State Agr. Soc. (1856-7), vol. 2, p. 527.
3.) F. W. Pennell, Bull. Torrey Bot. Club (1919), vol. 46, p. 186.
4.) Stille and Maisch, Nat. Dispensatory (1884), 3rd ed., p. 987.

Indiana. Monarda punctata L. has been recorded by Barnes[1] as growing in the state from Marion, northward, but Pennell[2] regards the plant which occurs in this state as a subspecies, Monarda punctata villicaulis, Pennell, identical with that which was found by him in Illinois. He also states that he found it in the dry, sandy, open soil, in Clarke and Lake counties (Indiana) and in the dry sandy soil in northern Indiana, without particular reference to locality. The same author reports its occurrence in Winona, Kosciusko county, having been observed there by C. C. Dean, while the specimen at Whitings, Lake county, is credited to N. L. Britton.

1.) C. R. Barnes, Cat. of the Phaenogamous and Vascular Cryptogamous Plants of Indiana (1881), p. 23.
2.) F. W. Pennell, Bull. Torrey Bot. Club (1919), vol. 46, p. 188.

Iowa. In this state, Barnes, Reppert and Miller[1] record common growth in the sandy soil along the rivers of Scott and Muscatine counties. Fitzpatrick[2] states that it has been found in sandy soil, infrequently, in Dubuque, Muscatine, Louisa, Des Moines, Cedar Johnson, Linn, and Jefferson counties, while Greene[3] indicates in a general manner, that the plant is found in dry fields throughout the state.

1.) W. D. Barnes, F. Peppert and A. A. Miller, the Flora of Scott and Muscatine Counties (1900), p. 247.
2.) J. J. Fitzpatrick, Manual of the Flowering Plants of Iowa (1899), p. 135.
3.) Wesley Greene, Plants of Iowa (1907), p. 210.

Kansas. In this state, Monarda punctata L. occurs over a large area as indicated by B. B. Smyth[1] viz. in the following localities: Osage City, Burlingame, Quenemo, Emporia, Cottonwood Falls, Madison, Ellingwood, Great Bend, Hoisington, Reno County, Hutchinson, Arlington, Larned, Kinsley, Jetmore, Wichita, Mulvane and Douglass.

Small[2] also records the growth of the plant in the state.

1.) B. B. Smyth, Check List of the Plants of Kansas (1892).
2.) J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.

Louisiana. Sweringen[1] includes the state in a general statement, viz. from New Jersey to Louisiana, while Mohr[2] notes the occurrence of the plant in several localities.

1.) H. V. Sweringen, Dictionary of Pharmaceutical Science (1873), p. 269.
2.) C. Mohr, Plant Life of Alabama (1901), p. 702.

Maryland. Aiken[1] and Sollers[2] observed the plant in the neighborhood of Baltimore, while Redmond[3] states that it occurs in Worchester country.

1.) Wm. E. A. Aikin, Cat. of Phaenogamous Plants and Ferns, native or naturalized in the vicinity of Baltimore, Md. (1837), p. 76.
2.) Basil Sollers, Check list of Plants compiled for the Vicinity of Baltimore (1886), p. 39.
3.) Paul J. Redmond, A Flora of Worcester County, Md. (1932), p. 55.

Michigan. As early as 1839, Wright[1] indicated the occurrence of the plant in the southern peninsula, while Coleman[2] also records the same locality as habitat of the plant. In compiling a list of the medicinal plants, F. Stearns[3] records Monarda punctata L. as growing in light sandy soil in the lower portion of the state. Wheeler and Smith[4] give the habitat as southern Michigan, particularly around New Haven.

1.) John Wright, Geological Survey of Michigan (1839), p. 34.
2.) N. Coleman, Cat. of Flowering Plants of the Southern Peninsula of Michigan (1874), p. 28.
3.) F. Stearns, Proc. A. Ph. A. vol. 7, p. 271.
4.) Wheeler and Smith, Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Michigan, indigenous, naturalized and adventive (1881), p. 57.

Minnesota. Bailey[1] Watson and Coulter,[2] Gray,[3] Small,[4] Rydberg,[5] and Wall[6] mention the state as the western boundary of the northern tier of states.

1.) L. H. Bailey, Asa Gray's Field, Forest and Garden Botany (1895), p. 352.
2.) Watson and Coulter, Asa Gray's Manual of Botany (1898), 6th ed., p. 414.
3.) Asa Gray, New Manual of Botany (1908), p. 704.
4.) J. K. Small, Manual of Southeastern Flora (1933), p. 1164.
5.) P. A. Rydberg, Flora of the Prairies and Plains of the Central N. A. (1932), p. 692.
6.) O. A. Wall, Handbook of Pharmacognosy (1917), p. 105.

Missouri. As early as 1835 Riddell[1] reported this species in the pine barrens of what at that time was Missouri territory. Eggert[2] reports the plant in the vicinity of St. Louis and Small[3] records the growth of the plant on the plains, prairies and meadows of the state, while Hus[4] mentions its growth on the plateaus of the Missouri river.

1.) John L. Riddell, Synopsis of the Flora of the Western States. (1835), p. 80.
2.) Henry Eggert, Cat. of the Phaenogamous and Vascular Cryptogamous Plants in the vicinity of St. Louis (1881), p. 11.
3.) J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.
4.) Henri Hus, An ecological cross section of the Mississippi river in the region of St. Louis, Missouri. Rept. Missouri Bot. Garden, 19th rept. (1908), p. 165.

Mississippi. In his "Flora of the Southern U. S."
Chapman[1] in 1860 listed this species. Brendel[2] was somewhat more specific. He states that the plant grows in upper Mississippi, but he does not mention any particular locality.

1.) A. W. Chapman, Flora of the Southern U. S. (1860), p. 320.
2.) Frederich Brendel, Flora Peoriana (1887), p. 56.

New Jersey. Early references to the occurrence of the plant in this state were made by Pursh,[1] Torrey,[2] and Beck.[3] Other authors who observed its growth and made general statements regarding its habitat are: Wood,[4] Gray,[5] Hollembaek,[6] Bailey,[7] and Wood.[8] Sceringen[9] lists New Jersey as one of the states in which the plant grows, while Stone[10] gives a detailed account of the plant and its habitat. He states that it occurs in dry, open, sandy ground of the middle, coast and Cape May districts, north to Middlesex and Mercer Counties, and appears as a weed in many places. He also mentions its occurrence in the pine barrens.

1.) Fred Pursh, Flora Americae Septentrionalis (1816), 2nd ed. vol. I, p. 19.
2.) John Torrey, Flora of the Northern and Middle Sections of the U. S. (1824), pt. V, I., p. 26.
3.) L. C. Beck, Botany of the Northern and Middle States (1833), p. 276.
4.) A. Wood, Class Book of Botany (1847), p. 417.
5.) Asa Gray, Botany of the Northern U. S. (1848), p. 320.
6.) H. Hollembaek, The American Eclectic Materia Medica (1865), p. 257.
7.) L. H. Bailey, Asa Gray's Field, Forest and Garden Botany (1895), p. 352.
8.) G. B. Wood, A Treatise on Therapeutic and Pharmacology, 3rd ed., vol. I (1868), p. 345.
9.) H. V. Sweringen, Dictionary of Pharmaceutical Science, p. 269.
10.) Witmer Stone, Ann. Rept. of N. J. State Museum (1910), p. 668.

His detailed statement of the distribution of this plant so characteristic of the middle district is herewith recorded:

Middle District - New Egypt, New Lisbon, Camden, Medford, (S.) Mickleton, Blackwood, Clementon, Swedesboro.

Pine Barrens - Speedwell, (S) Landisville, Hammonton, Mouth of Batsto.

Coast Strip - Absecon (S), Atlantic City (S), Ocean City, Wildwood.

Cape May - Cold Spring (OHB), Dias Creek, Cape May.

The meaning of the letters (S) and OHB) which appear after some of the localities is not explained.

New York. The earliest reference to the growth of the plant in this state was made by Torrey[1] in 1835. Other references by the following writers recorded its occurrence in a general way: Beck,[2] Stille and Maisch,[3] Gray,[4] Britton and Brown[5] Watson and Coulter,[6] Wall,[7] Blaque,[8] Rydberg[9] and Small.[10] Gray[11] was more specific in pointing out that he had observed the plant growing in the sandy fields, and along the dry banks of Long Island. He also reported that the plant was found in Oswego, N. Y. by Knieskern, and in Jefferson County by Vasey.

1.) John Torrey, Rept. on Bot. Dept. Survey of State of N. Y. (1835), p. 158.
2.) L. C. Beck, Botany of the U. S., North of Virginia (1848), p. 273.
3.) Stille and Maisch, National Dispensatory, 3rd ed. (1884), p. 987.
4.) Asa Gray, New Manual of Botany (1908), p. 704.
5.) Britton and Brown, Illust. Flora of Northern States and Canada (1898), v. 3, p. 104.
6.) Watson and Coulter, Asa Gray's Manual of Botany (1898), p. .
7.) O. A. Wall, Handbook of Pharmacognosy(1917), p. 105.
8.) Georges Blaque, Travaux du Laboratorie de Matiere Medicale de La Faculte de Pharmacie de Paris.
9.) P. A. Rydberg, Flora of the Prairies and Plains of Central North America.
10.) J. K. Small, Manual of Southeastern Flora (1932), p. 692; (1933), p. 1164.
11.) Asa Gray, Synoptical Flora of North America (1886), p. 375.

North Carolina. The earliest reference to the occurrence of the plant in this state, was made by Pursh[1] in 1816, and Wood recorded the plant as common to Carolina, without special reference to locality. Curtis[3] stated that the plant is common, while Hyams[4] indicated it as one of the medicinal plants of the state.

1.) Frederick Pursh, Flora Americae Septentrionalis (1816), 2nd ed. vol. I, p. 19.
2.) A. Wood, Classbook of Botany (1847), p. 417.
3.) M. A. Curtis, Geolog. and Nat. Hist. Survey of N. C. pt. III (1867), p. 40.
4.) C. W. Hyams, Medicinal Plants in North Carolina. N. C. Agr. Expt. Sta. Bull. No. 150 (1898), p. 377.

Ohio. Although Riddell[1] wrote a supplementary catalogue of Ohio plants, he did not refer to the occurrence of Monarda punctata L. However, Newberry[2] reported its growth and Schaffner[3] also listed it.

1.) J. L. Riddell, Supplementary Cat. of Ohio plants (1836).
2.) J. S. Newberry, Catalogue of the Flowering Plants and Ferns (1860), p. 26.
3.) J. H. Schaffner, Field Manual of the Flora of Ohio (1928), p. 465.

Oklahoma. Pennell[1] has recorded the occurrence of Monarda punctata in Sapulpa, Creek County, while Wooton and Standley[2] have reported that Monarda punctata lasidonta, A. Gray, occurs generally throughout the state.

1.) Francis W. Pennell, Bull. Torrey Club, vol. 46, p. 186.
2.) Wooton and Standley, Flora of New Mexico (1915), p. 560.

Pennsylvania. In 1818, Barton included the plant in his Compendium Florae Philadelphicae. A few years later, Torrey[2] reported the plant as very common in the state. Recently Benner[3] stated that the plant had been reported from Solebury township and Bristol in Bucks county, Penn., but that he could not find it. He added, however, that the plant may be found in the coastal region.

1.) W. P. C. Barton, Compendium Florae Philadelphicae (1818), p. 13.
2.) John Torrey, Compendium of the Flora of the Northern and Middle States (1826), p. 23.
3.) W. M. Benner, Flora of Bucks County, Pennsylvania (1932), p. 260.

South Carolina. As early as 1816 Pursh[1] made a general statement regarding the occurrence of Monarda punctata in Carolina while Elliott[2] indicated that Monarda punctata grew in the lower country of South Carolina.[3] Wood recorded that it was common to Carolina without recording any locality.

1.) Fred. Pursh, Flora Americae Septentrionalis (1816), 2nd ed. vol. I, p. 19.
2.) Stephen Elliott, A Sketch of the Botany of S. Carolina and Georgia (1821), p. 30.
3.) A. Wood, Class Book of Botany (1847), p. 417.

Tennessee. Gattinger[1] observed that horsemint preferred the sandy soil along the Mississippi river in this state, while in his "Flora of Tennessee,"[2] he reported its occurrence in Memphis on the authority of Dr. Egeling.

1.) A. Gattinger, The Medicinal Plants of Tennesse(1894), p. 68.
2.) A. Gattinger, The Flora of Tennesse (1901), p. 147.

Texas. Monarda punctata L. appears to have been widely observed in this state by Britton and Brown,[1] Watson and Coulter,[2] Gray,[3] Wall,[4] Rydberg,[5] and Small,[6] who refer to it, in a general manner. Blankinship[7] records that the plant was collected at New Braunfels by Lindheimer in 1850.

Several new sub-species have been found in this state. Pennell[8] states that Monarda punctata immaculata, Pennell, was collected in 1913 in the sandy soil of Aloe and Victoria Counties, while he credits Charles Wright with having seen the plant, but without any reference to its locality. The other sub-species, Monarda punctata lasiodonta. A Gray has been reported by Wooton and Standley[9] who add that the variety is probably Monarda punctata humilis, Torr. of Sitgreaves Report, from near Zuni,

1.) Britton and Brown, Illustrated Flora of the Northern States and Canada (1898), vol. 3.
2.) Watson and Coulter, Asa Gray's Manual of Botany (1898), p. 104; 6th ed., p. 414.
3.) Asa Gray, New Manual of Botany (1908), p. 704.
4.) O. A. Wall, Handbook of Pharmacognosy (1917), p. 704.
5.) P. A. Rydberg, Flora of the Prairies, and Plains of Central North America (1932), p. 692.
6.) J. K. Small, Manual of Southeastern Flora (1933), p. 1164.
7.) J. W. Blankinship, Rept. of Missouri Bot. Gard. (1907), 18th Rept. p. 187.

Please see bottom of following page for footnotes 8 & 9.

although Dr. Torrey does not mention the very characteristic pubescence of the calyx teeth, the distinguishing peculiarity. Gray[10] also reports the occurrence of the same species as reported by Drummond, and Pammel[11] mentions its occurrence in the sandy soil at Clay Station.

A survey of the Monardas is being made at present;

Footnotes continued from preceding page:

8.) Francis W. Pennell, Bull. Torrey Bot. Club, vol. 46, p. 186.

9.) Wooton and Standley, Flora of New Mexico (1915), p.560.

10.) Asa Gray, Synoptical Flora of North America (1886), p. 375.

11.) L. H. Pammel, Notes on the Flora of Texas (1894), p. 10.

Vermont. Brainerd, Jones and Eggleston[1] state that the plant was found in Colchester after having been introduced with western seed. Flynn[2] also reports the occurrence of the plant in Colchester and Burlington and ascribes the discovery of the plant in Essex to Jones and Howe. She also records that the plant is very rare.

1.) E. Brainerd, L. R. Jones, W. W. Eggleston, Flora of Vermont (1900), p. 74.
2.) Nellie F. Flynn, Flora of Burlington and Vicinity (1911) IX, p. 76.

Virginia. All of the references relating to the habitat of the plant in this state are of an early date. Forster,[1] in 1771, was the first to record its habitat in a general way, while Michaux many years later observed its growth.[2] In 1836, Bentham[3] describes the plant but gives the names of Michaux, Pursh and Wray as the persons who had observed it. Pursh[4] includes this state when he mentions its occurrence in the sandy fields from New Jersey to Carolina.

1.) J. R. Forster, Flora Americae Septentrionalis (1771), p. 2.
2.) A. Michaux, Flora Boreali Americana I, p. 16 (1803).
3.) George Bentham, Labiatarum (1836).
4.) Frederick Pursh, Flora Americae Septentrionalis (1816), 2nd ed. vol. I, p. 19.

Wisconsin. The distribution of Monarda punctata L. in this state has been recorded in a general way by Gray,[1] Britton and Brown,[2] Wall,[3] and Rydberg.[4]

Lapham, interested in the flora of Wisconsin, added marginal notes, in copies of several of his botanical reference books (Gray[5] and Mann[6]) on the occurrence of the plant, while in his own book, "Fauna and Flora of Wisconsin"[7] he recorded his observations of the plant.

Dr. Sherman, also made marginal notes in Wood's[8] book regarding the occurrence of the plant at Eagle River, and at Kilbourn, Wisconsin.

1.) A. Gray, Manual of Botany of the Northern U. S. (1850), p. 19.
2.) Britton and Brown, Illust. Flora of the Northern States and Canada (1898), v. 3, p. 104.
3.) O. A. Wall, Handbook of Pharmacognosy (1917), p. 105.
4.) P. A. Rydberg, Flora of the Prairies and Plains of Central N. A. (1932), p. 692.
5.) A. Gray, Synoptical Flora of N. A. (1886), p. 375 (U. W. Biology Library)
6.) Horace Mann, Cat. of the Phaenogamous Plants of the U. S. east of Mississippi and the Vascular Cryptogamous Plants of N. A., north of Mexico (1868), p. 32.
7.) I. A. Lapham, Fauna and Flora of Wisconsin (1852), p. 400.
8.) A. Wood, Class Book of Botany (1868), p. 550.

The University of Wisconsin herbarium contains over eighteen specimens of this species which were collected in the following counties: Marquette, Sauk, Richland, Grant, Eau Claire, Trempealeau, Pepin, LaCrosse, Juneau, Racine, Chippewa and Dunn.

Professors Denniston, Fassett and Richtmann also True and Cheney have observed Monarda punctata L. in many localities without recording them. The writer has gathered the plant, and seen large fields of it growing between Mazomanie and Arena (Iowa Co.) as well as having observed its growth in other localities of Iowa, Dane and Crawford counties.

Monarda punctata L. has been collected in quantity at Pine Bluff, Arena, Lodi and Spring Green for the experimental studies which have been pursued at Wisconsin for forty years. In addition, it has been carefully cultivated for many years in the Wisconsin Pharmaceutical Garden under the direction of Dr. Wm. O. Richtmann.

The two species native to this state, viz. M. punctata L. and Monarda fistulosa L. reveal a relation to soil that is most striking. The following observations made by Dr. Edward Kremers in the vicinity of the Wisconsin River region may serve to illustrate this striking peculiarity.

"West of Mazomaine, the sandy river valley is covered with Monarda punctata whereas on the clay soil plateaus on either side of the valley, Monarda fistulosa L. will be found. Following a drive half way up the bluff, one will find M. punctata in the exposed sandstone soil, but Monarda fistulosa L. will be found in pockets into which clay had been washed from above. A still more striking instance was observed, e. g., at Lone Rock, some distance farther west. This place derives its name from the solitary island of rock formation toward the south side of the valley. Naturally, it is surrounded by Monarda punctata L. The 'rock' had traces of original clay soil left on top, and here grew a specimen of Monarda fistulosa."

Canada

Although Logie reports the occurrence of this species at Bellhouse Farm, East Flambro, Ont., the correctness of this report is questioned by Macoun. 1)

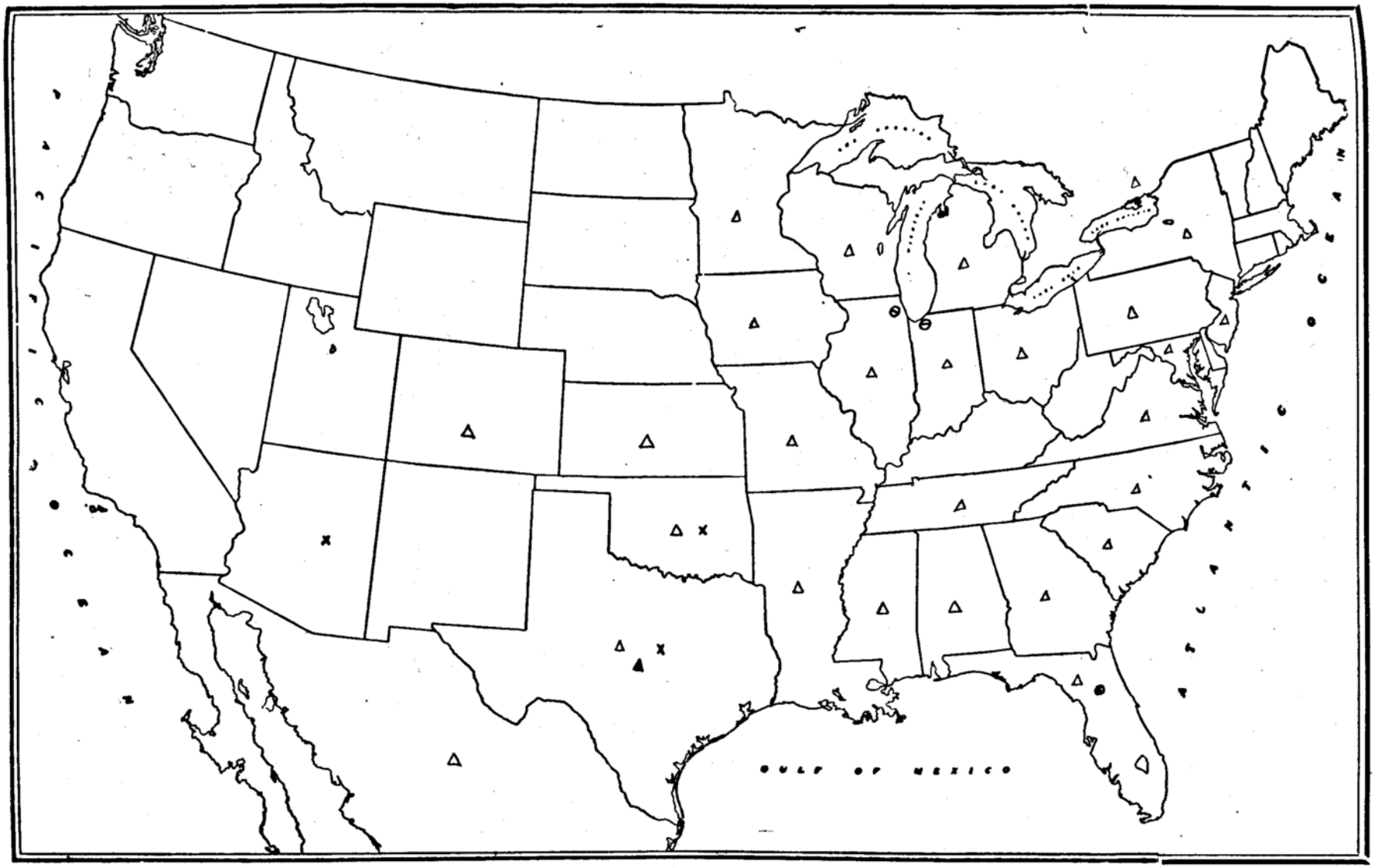
1.) John Macoun, Catalogue of Canadian Plants, pt. 1, p. 386.

Mexico

The occurrence of Monarda punctata L. in Mexico was recorded by Kearney[1] who states that the plant had been seen in Mexico and the Antilles, a statement verified by Small.[2]

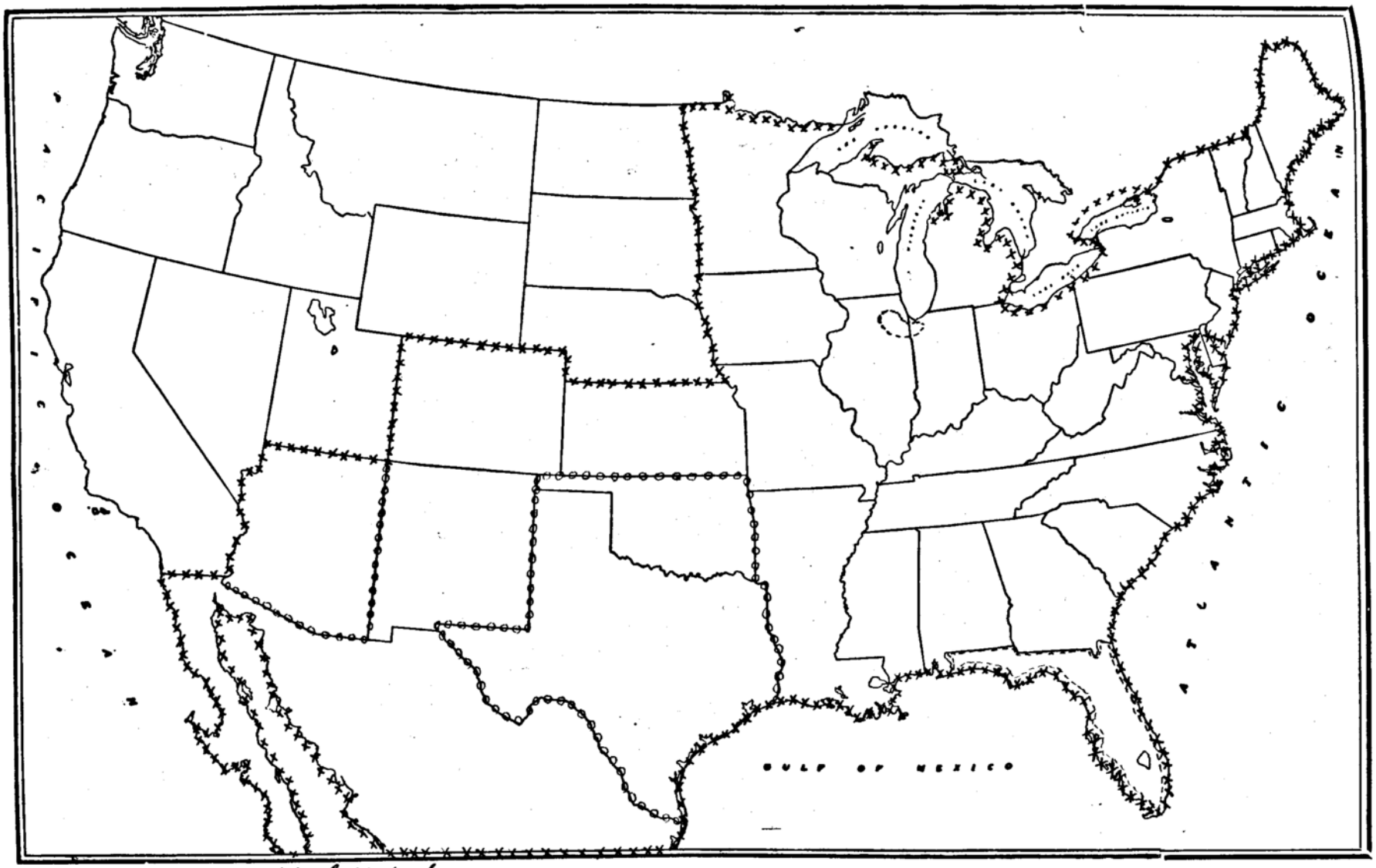
1.) J. Kearney, Contrib. U. S. Nat. Herb. (1901), vol. 5, #6, p. 458.
2.) J. K. Small, Flora of the Southeastern U. S. (1903), p. 1038.

States where Monarda punctata L. and varieties have been observed.



Monarda punctata L. ..... △
Monarda punctata lasiodonta, Gray X
Monarda punctata leucantha, Nash ..... ⊙
Monarda punctata villerosa, Pennell ..... ⊖
Monarda punctata immaculata, Pennell ..... ▲

General Areas where Monarda punctata L. and varieties may be found growing.



oooooooooo Monarda punctata Lasiodonta, Gray
---------- Monarda punctata Leucantha, Nash
---------- Monarda punctata villicaulis, Pennell
▲▲▲▲▲▲▲▲ Monarda punctata immaculata Pennell
xxxxxxxxxx Monarda punctata L.

U. S. Pharmacopoeial History

It has been pointed out (see Chapter on Therapeutic uses) that Monarda punctata L., and its volatile oil were introduced into medical practice by Atlee in 1819. Although a survey of medical literature revealed that very few of the authors of medical texts mentioned the plant or its volatile oil, yet both were given recognition in the United States Pharmacopoeia from 1820-1870 inclusive.

In all of the United States pharmacopoeias from 1820 to 1870 inclusive, with the exception of the 1830 revision (New York) the section dealing with materia medica was divided into two lists, a primary and a secondary one, and the drugs were arranged alphabetically. Attention has been directed to this particular division, because in preparing the tabulation for Monarda punctata L., which will be presented later, it becomes apparent that the plant was introduced into the United States Pharmacopoeia of 1820 in the secondary list, but in the revision of 1830 Washington it was changed to a position in the primary list where it remained until it was deleted in 1880. Whether it merited this change because of its therapeutic properties, or an increase in its use, is not known.

In order to review all the changes in nomenclature, the following tabulation is offered.

1820[1] (secondary list) (Washington)

MONARDA Monarda punctata WI. 126.

Monarda Herba The herb.

1830[2] (New York)

MONARDA PUNCTATA Monarda punctata

Mountain Balm. Horsemint

Prop. Odour, fragrant, taste aromatic, pungent

Med. Oper. Stimulant, carminative, diaphoretic.

1830[3] (Washington) (primary list)

MONARDA Monarda punctata W. i. 126

Horse Mint Herb. The herb.

1840[4] (Washington) (primary list)

MONARDA Horsemint.

The herb of Monarda punctata.

1850[5] (Washington)

MONARDA Horsemint

The herb of Monarda punctata.

1.)United States Pharmacopoeia (1820) (Washington), p. 55.
2.)United States Pharmacopoeia (1830) (N. Y.) p. 45.
3.)United States Pharmacopoeia (1830)(Washington), p. 16.
4.)United States Pharmacopoeia (1840) (Washington), p. 27.
5.)United States Pharmacopoeia (1850) (Washington), p. 27.

1860[6] (Washington)

MONARDA Horsemint

The herb of Monarda punctata.

1870[7]

MONARDA Horsemint

The leaves and tops of Monarda punctata.

A cursory glance at this tabulation will review that the properties and medicinal action (Med. Oper.) of the drug were only recorded in the 1830 revision (New York). The synonym, horsemint, appears to be most commonly used although "Mountain balm" was used with the word horsemint for the synonyms in 1830 (New York) revision.

The first change in the part of the plant which was used occurred in 1870, when the "leaves and tops" became official in place of the herb.

The only other instance in which the name of the plant, Monarda punctata L.[8] was used was in 1890, when it was used as a source for thymol.

6.) United States Pharmacopoeia (1860)(Washington), p. 37.
7.) United States Pharmacopoeia (1870) (Washington), p. 38.
8.) United States Pharmacopoeia (1890) (Washington), p. 405.

U. S. Pharmacopoeial History (Volatile Oil)

It was Wood & Bache[1] who pointed out that the herb was admitted to its official position because of the volatile oil which it afforded. However, a review of the pharmacopoeial literature does not attempt to emphasize this importance, as indicated by Wood and Bache, although the latter were members of the committee on revision.

1820[2]

Oleum Monardae

a monarda

1830[3]

Oleum Monarda

from Monarda

1830[4]

OIL OF HORSEMINT

From Horsemint

1840[5]

OLEUM MONARDAE

Oil of Horsemint

From Horsemint

1.) G. B. Wood and Franklin... (Please see following page for footnotes)

1850[6]

OLEUM MONARDAE

Oil of Horsemint.

1860[7]

OLEUM MONARDAE

Oil of Horsemint

Prepare this Oil from fresh Horsemint by the general formula given at page 242.

1870[8]

OLEUM MONARDAE

Oil of Horsemint

Prepare this Oil from fresh Horsemint by the general formula given at page 233.

Footnotes continued from preceding page:
1.)...Bache, The Dispensatory of the U. S. (1833), p. 434.
2.) United States Pharmacopoeia (1820) (Washington), p. 170.
3.) United States Pharmacopoeia (1830) (New York), p. 119.
4.) United States Pharmacopoeia (1840) (Washington), p. 157.
5.) United States Pharmacopoeia (1830) (Washington), p. 149.

6.)United States Pharmacopoeia (1850),(Washington), p. 179.
7.)United States Pharamcopoeia (1860), (Washington), p. 245.
8.) United States Pharamacopoeia (187), (Washington), p. 236.

It is quite evident from this tabulation that there were few changes in the references to the volatile oil. In the 1860, and 1870 revisions, we find that a method of distilling the oil was suggested, but even this suggestion is none too descriptive. In view of the chemical investigations[9] which had been performed as early as 1857, in which the physical constants of the stearptene (thymol) had been determined, it is surprising that more information had not been added.

9.)Ann. 115, p. 143.

Ethnobotany

Ethnobotany[1] has been defined as the botany that treats of the name, lore, and uses of plants as illustrative or typical of the customs of a race. In this study of Monarda punctata L. an indigenous North American plant, a survey was made of the literature dealing with the North American Indian for the purpose of learning the plant names, lore, and uses.

That only two references were found which indicate the use of the plant among the Indians seemed surprising in view of several facts. First, the plant had been observed growing in Virginia as early as 1680 by Banister[2] and secondly, a comparison of a survey of Indian tribal locations with a survey of the general distribution of the species clearly indicates that the plant was widely distributed in areas where the greater number of Indian tribes were living.

The reader might be tempted to assume that inasmuch as the references are of recent date from the reports of American ethnologists, which only have been issued since 1879, that the study of ethnobotany is one of recent origin.

1.) Webster's New International Dictionary (1927).
2.) J. Ray, Historia plantarum (1688), vol. 2, p. 1927.

However, this erroneous opinion cannot be held since it has long been known that Columbus wrote concerning the plants which he collected, and took to the Indians for identification. We have, also, ample historical evidence from the diaries of missionaries (Jesuit Relations) explorers, traders, and colonists that much of the knowledge of the medicinal value of plants was taught to the white man by the Indians. That these early conversations with the Indians would constitute what is known today as Ethnobotany, cannot be disputed.

It becomes apparent that the plant might not have been well known, when it is learned that well known botanists as Kalm,[3] Barton,[4] Smith[5] and Schoepf[6] failed to mention the species in their writings. The fact that these men gave particular attention to the collection and identification of plants emphasizes the point that the plant must not have been widely distributed in the areas through which they traveled. If this fact was also true in the case of the Indians, it may account for its absence in the literature.

3.) Per. Kalm, Travels into North America 1716-1779.
4.) B. S. Barton, Collection for an Essay towards a Materia Medica for U. S. (1798).
5.) Peter Smith, The Indian Doctor's Dispensatory 1812.
6.) Johann D. Schoepf Materia Medica Americana 1787.

This study has revealed that the study of the Ethnobotany of Monarda punctata L. will always remain an incomplete one, because the data is fragmentary and incomplete. Even in the references cited, the dates of when the Indians used the plant were omitted, although this information would have proved invaluable, in view of the survey which was made of the Indian tribal locations. It must also be indicated that most of the Indians, who knew of the use of this species before the period of segregation into reservations, have died, and their descendent's knowledge of the plant is incomplete. That a discussion of this particular species would arise, only by chance, during a discussion with the Indians, is another factor to consider.

The writer does not wish to appear as severely criticizing those who have collected the ethnobotanical data because it is recognized that the collection of this particular data is only a small portion of the work required of these investigators, but it would have been helpful, if the readers of their reports had not been left to assume that the Indians used the plants, while residing in the same areas, in which they were interviewed.

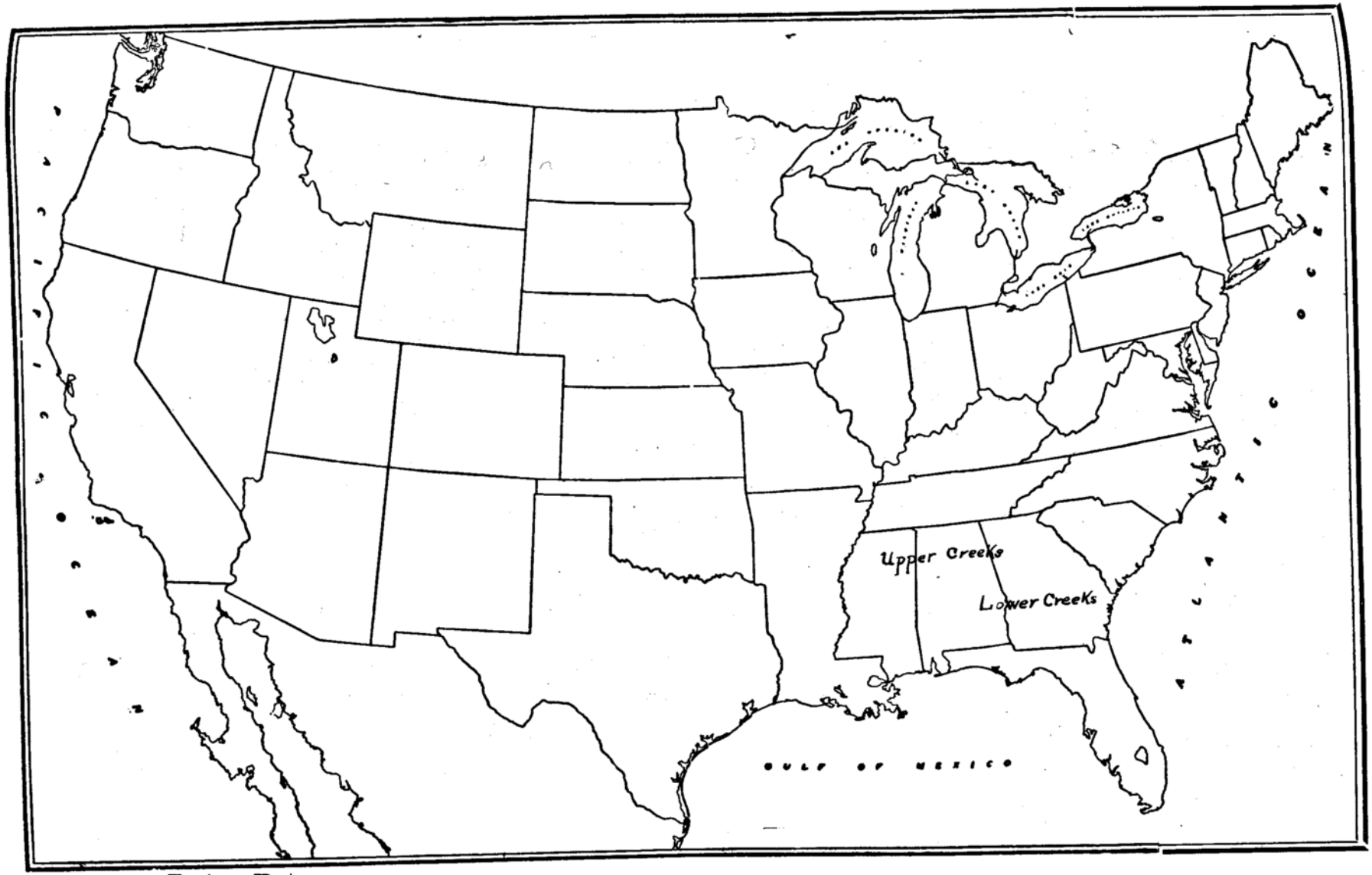
Densmore[7] in his report on Teton Sioux Music records that the plant Monarda punctata L. had been used by the Teton Sioux Indians as a stimulant carminative, sudorific,

7.) F. Densmore, Bur. Am. Ethn. (1918), 61, p. 270.

diuretic, and anti-emetic. He also records that Monarda fistulosa L. was sometimes used as a substitute. Although the second reference by Swanton[8] does not mention Monarda punctata specifically, it points out that horsemint a species of Monarda was used by the Creek Indians, who gave it the name Kofutcka lako. Inasmuch as it is generally recognized that horsemint is the common synonym for Monarda punctata L., this reference will be admitted. Swanton[9] states that the entire plant was used in an infusion to induce perspiration and when boiled with everlasting was used in dilirium. He also indicates that a man named Coley Proctor used it with another plant called niko hoyanidja to cure dropsy and swelling in the legs The Alabama, he points out, called it tcinok tilaile and used it for rheumatism and as protection against the ghost of the dead, who might afflict one with deafness.

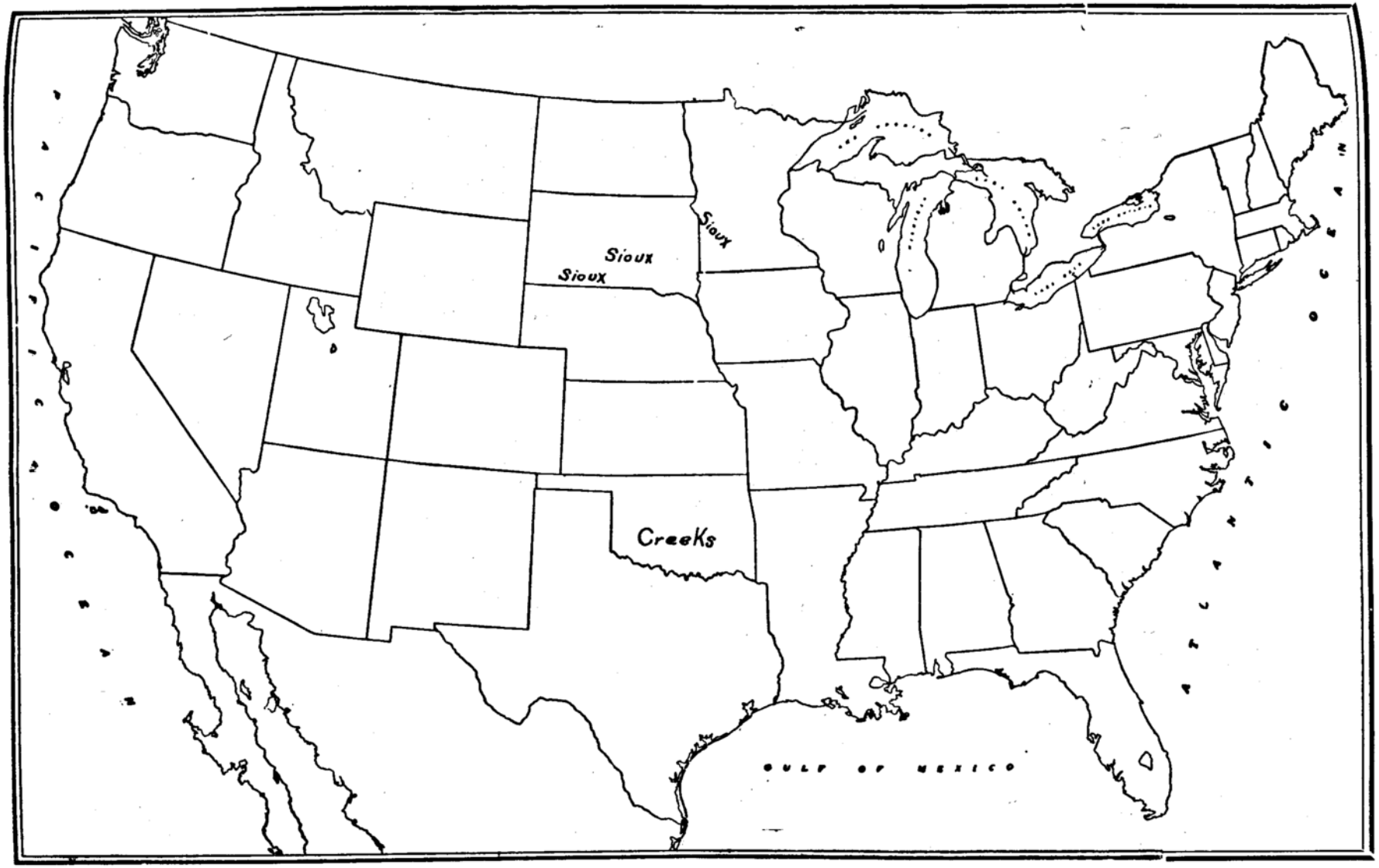
Each of the accompanying maps will indicate the names of the tribes who used the plant, and their location during definite periods of U. S. history.

8.) J. R. Swanton, 42nd Ann. Rept. Bur. Am. Ethn. (1927), p. 657.
9.) Ibid.

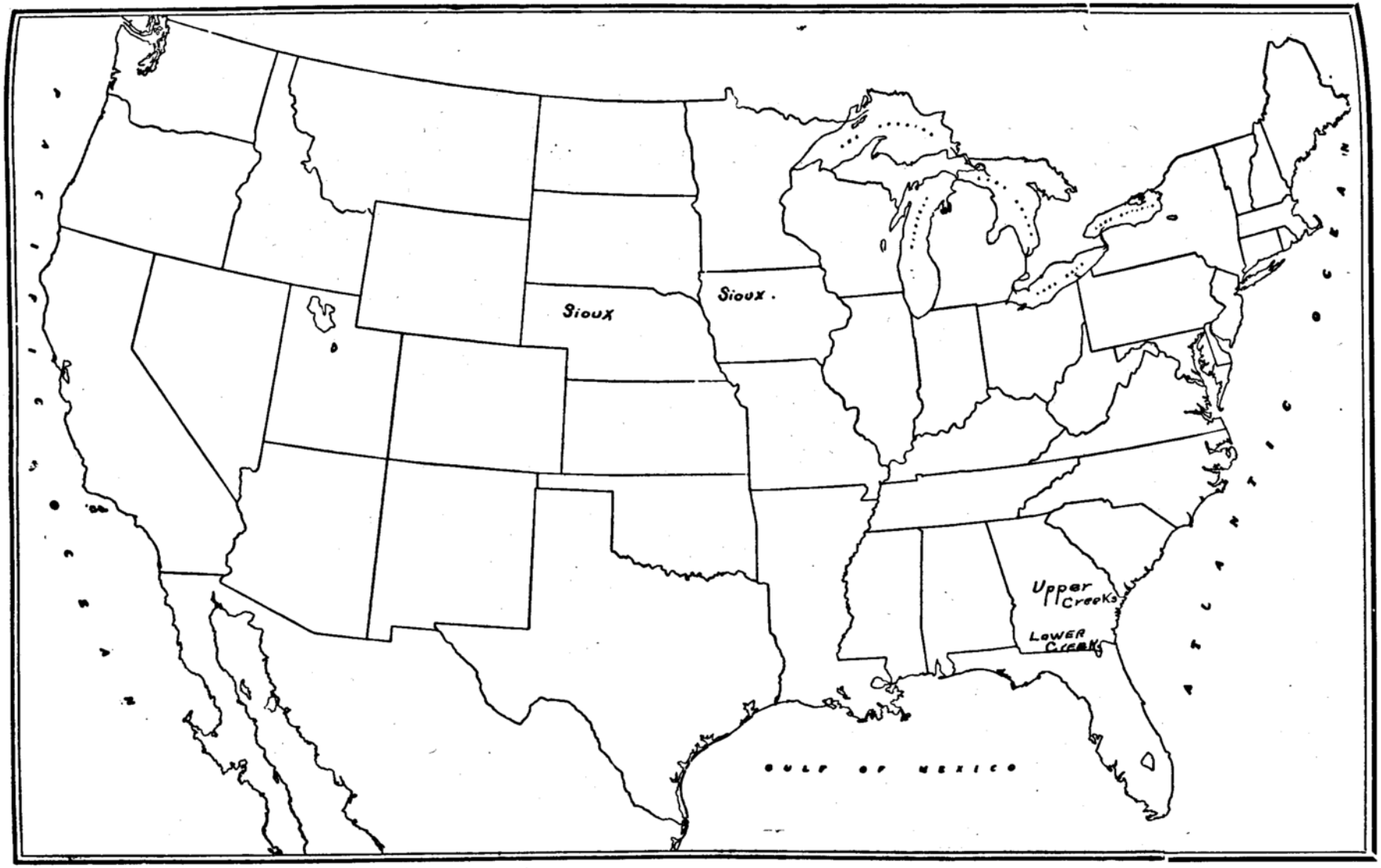


LOCATION of INDIAN TRIBES IN 1790

see A Century of Population Growth 1790-1900
BUREAU of CENSUS Bull. (1909), p. 38.



Location of Indian Tribes in 1840 (George Catlin's map)
see Rept of Indians .... etc., Eleventh Census (1890), p. 45.



Location of Indian Tribes in 1833 (George Catlin's map.)
see Rept. of Indians... etc., Eleventh Census (1890), p. 45

Cultivation

Of the several species of this genus, Monarda didyma, producing a very showy flower, has been cultivated extensively as a garden plant. [1] Five horticultural varieties thereof have been produced, e. g.:

Amaranth Beebalm (M. didyma violacea superba)

Blazing Beebalm (M. didyma splendens)

Rose Beebalm (M. didyma rosea)

Salmon Beebalm (M. didyma salmonea)

White Beebalm (M. didyma alba)

Though of no mean economic importance as a bee plant and a producer of thymol, Monarda punctata has received less attention, possibly for the reason that for commercial purposes the production of individual plants, no matter how showy, will not suffice but that mass production must replace that of individual specimens.

With labor demanding the high price which it does in the United States, such methods as are employed in Japan in the cultivation of peppermint, must prove a financial failure. Hence propagation from seed would seem to be the only method to be employed with any hope of financial

1.) J. H. McFarland, Standardized Plant Names, (1924), p. 287.

success. Yet this method has proven unusually difficult. Whereas a promiscuous scattering of seed resulted in a fair germination, a careful sowing thereof gave, as a rule, all but negative results at least during the early trials.

The seeds of the wild Wisconsin plants mature early in September, when the entire flower heads may be harvested. Delay may cause the loss of some of the better seeds. The flower heads in which the seeds have matured are spread out on canvas to dry. The seeds may either be threshed out or the dry heads rubbed on a 12 to 16 mesh sieve.

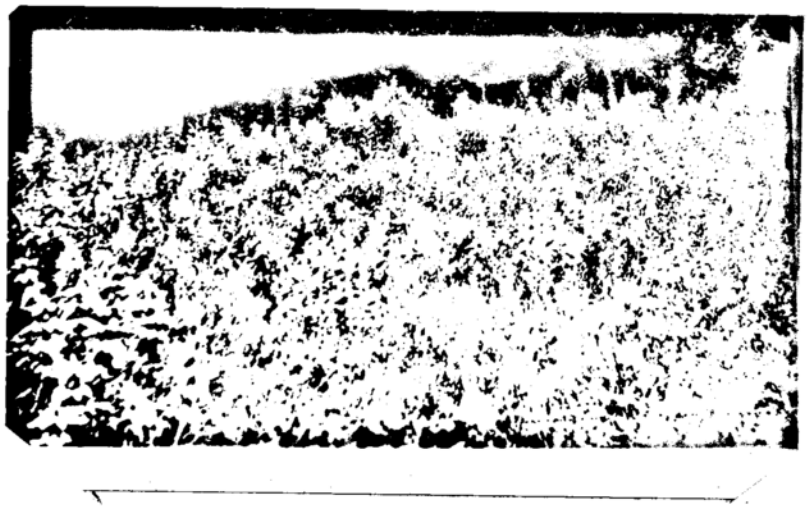
As already stated, the early attempts at sowing seeds in drills was not very successful. Imitation of natural conditions, by dropping seed on a meadow, etc., were more so. But, as was to be expected, the plants thus obtained had too much competition for proper development. In one experiment made at Highlands in 1914 in which rye was used as cover crop, excellent results were obtained. The rye was sown in early fall and raked under. The Monarda seed was then scattered over the raked soil. For purposes of experiment, the rye was infected with ergot which important drug it was difficult to obtain from Europe at the time. When the rye was harvested during the following season, the numerous monarda plants were from four to six inches high. The non-flowering first year plants were

not harvested but allowed to remain as their own cover crop. Under these conditions the plants survived the winter admirably and produced a splendid flowering crop during the second season. This was harvested during the next summer at the time the flowers were in full bloom and sought by innumerable bees as food.

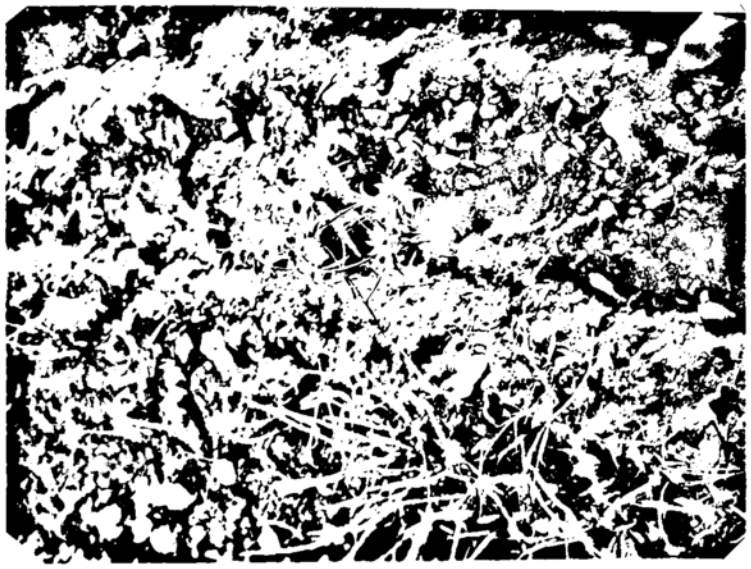
(Please see photograph on following page)

Though economically unprofitable, other methods were tried out for experimental purposes. Thus Brandel in 1902, while distilling oil from wild plants in the neighborhood of LaCrosse, transplanted some of the wild plants. Mere transplanting in the same sandy soil, accompanied no doubt, by hand cultivation and weeding, resulted in a most remarkable improvement of the individual plants. Plants which, under the ordinary conditions prevailing, grew to a height of about a foot and a half and which produced half a dozen laterals, developed into fine specimens that could not be covered by a bushel basket. Transplants from the Wisconsin River valley set out in the clay soil of the Pharmaceutical Garden, at first on Camp Randall and later on the Olin Forty, yielded striking results, as did earlier experiments in Wingra Park (1908) and later at Highlands. Even after the cultivation experiments at Highlands had been abandoned, the plants continued to propagate themselves in a soil that was heavier

Monarda punctata L. growing on the edge of the Sand Dunes at Saugatuck, Michigan.

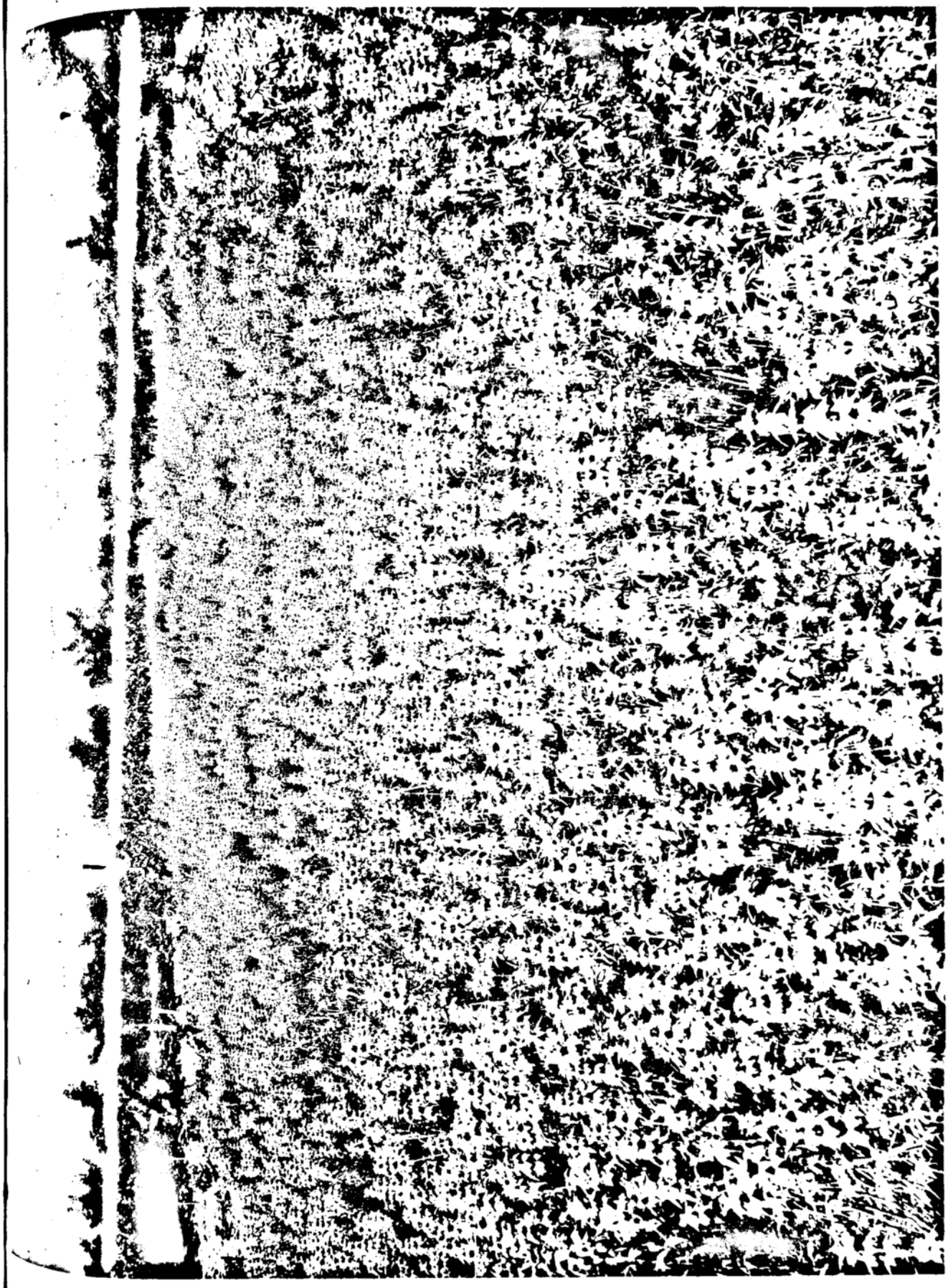


A field of Monarda punctata L. found growing along the river beds at Pleasant View Park, Lake Wisconsin, Wisconsin.



Monarda punctata L. raised at Camp Randall,
Madison, Wisconsin.

Monarda punctata L. raised in Flats at Camp Randall,
Madisom, Wisconsin



Field of Monarda punctata L. grown by Edward Kremers.

than that of their native habitat, though, as was to be expected, they did not attain any appreciable size because of the competition caused by grasses, etc.

Economically more advantageous is the division of large root systems. This method was practiced in the Pharmaceutical Garden, also by Thomas Fairchild[2)] in England as early as 1714. He experimented with M. fistulosa, M. oblongata, M. didyma, and M. punctata. It does not become apparent what success he had with M. punctata. Moreover, he was interested in the propagation as an horticulturist, not as a farmer trying to develop an agricultural chemical industry.

The transplanting of seedlings, whether raised in green house or cold frame, affords no particular difficulty. While satisfactory for experimental and horticultural purposes, it is too expensive if the desired object is a large crop for distillation purposes.

2.) Abraham Rees, the Cyclopoedia (1819), vol. 23 (pages are not numbered)

In his report on the production of alcohol as an agricultural industry, Edward Kremers[1] points out that in the reclamation of sandy soil for agriculture by the cultivation of potatoes as crude material in the production of alcohol,[2] it ought to prove advantageous to supplement the distillation of alcohol with the distillation of monarda oil. The boiler used for the distillation of alcohol during the winter could be used for the distillation of Monarda during the summer. The engineer necessary to operate the alcohol distillery during the winter would thus be given all year employment which would prove beneficial to the alcohol plant because of his mere presence and constant superintendence.

To begin with, the native Monarda could be distilled. Inasmuch as the cutting of the flowering plant by a horse drawn mower apparently injures the root system so that the cut plant may die during the dry summer season[3] a forty thus harvested might be set aside for potato cultivation. In districts where strong winds are apt to cause the sand to drift, single, or better, double rows of jack pine might be planted as wind break. Jack pine is suggested because this sows itself on sandy soil. If experience shows that more satisfactory species will thrive these might be used.[4]

In the rotation of crops, potato (deep cultivation) might be followed by a cereal, e. g. winter rye, with which Monarda seeds should be sown, the rye serving as cover crop for the Monarda seedlings. The rye having been harvested during the second summer, the Monarda would have an opportunity for full development during the third year.[5]

The third year of the rotation scheme would not only be given to the harvesting of the Monarda crop, but to the utilization of the blossoms as bee food.[6] Hence apiculture should enter into the scheme.

Even the casual observer will have noticed that neither cattle nor sheep will touch Monarda. Brandel, however, succeeded in disposing of his spent herb at the price of hay during his LaCrosse experiment. It should be stated that the season was a poor one for hay. For the same reason that man does not care to have his food contaminated with phenol (carbolic acid), animals avoid fodder containing thymol, a homologue of phenol.[7] However, after the phenol has been removed, cattle and sheep will eat the distilled herb.

Additional fodder harvested from sandy waste lands admits of additional heads of cattle. While distilling Monarda near Lone Rock in 1917 it was observed that a small section of a large corn field which had been given the benefit of barnyard manure developed fine stalks whereas the

rest of the field revealed but stunted growths. Hence every additional head of cattle will provide so much more manure for the successful raising of potatoes. Incidentally, each head of cattle for which fodder can be supplied will add to the dairy output.

With a proper rotation of crops, therefore, it ought to be possible to reclaim sandy waste land. This enterprise would involve partial reforestation, cultivation of potato as the basis of the production of alcohol as an agricultural industry, increased dairy output, supplementing of the alcohol industry by the distillation of Monarda oil and the furthering of apiculture as an adjunct to the cultivation of Monarda.

1.) Bull. U. S. Dept. of Agriculture, No. 182.

2.) At the Dearborn Conference in May, 1935, the production of alcohol as an agricultural industry was one of the principal topics discussed. The revival of the subject was due, no doubt, not only to the thought that agriculture should be industrialized, but also to the possibility of using alcohol as a fuel in internal combustion engines should gasoline give out in the not very distant future.

3.) Having distilled Monarda oil near Lone Rock during the summer of 1917 Norbert Mueller considered the possibility of a commercial enterprise only to find that the field which had yielded a good harvest during the previous summer was almost devoid of horsemint.

4.) Thus in southern France, the sandy Department des Landes has been reclaimed for turpentine orcharding.[1]

5.) The element of chance enters into all agricultural enterprises. Yet, no matter how abundantly Monarda may grow in certain sections at a given time, it would be foolish to attempt to build up an industry on native plants and their hap-hazzard distribution. Rational cultivation of the plant should be regarded as an essential prerequisite.

6.) While distilling Monarda in the Wisconsin river

1.) The Volatile Oils, II, 2nd ed. p. 69.

valley, several farmers viewed the enterprise with some concern lest their bees be deprived of an important food-plant. It was reported that bees traveled as far as four miles from the uplands to the valley while Monarda was in bloom. A considerable part of the season's harvest apparantly depends on this plant. Yet it had not been known as a bee food to Professor Pammel, economic botanist of State College at Ames, Iowa. Monarda fistulosa apparently does not serves as bee food for the simple reason that the corolla is long, hence the bees cannot get at the nectar.

7.) For like reasons neither M. punctata nor M. fistulosa have been used as tea substitutes, whereas M. didyma, devoid of phenol, commonly known as Oswego tea, has been used as such.

8.) The oil contains about 50 p.c. of thymol. The remaining 50 p.c. consist largely of terpenes which can be fractionated for the manufacture of high grade varnishes. The non-phenol alcohols can be separated by the same operation.

Botanical Description

Mr. Karl Rang has started an anatomical study of Monarda punctata L. which will include a study of the roots, stems, leaves and petioles similar to his anatomical study of Monarda fistulosa L. Until this is completed, this section on botanical description will be postponed.

Chemistry

The earliest mention of a chemical constituent of Monarda punctata[1] is found in Flueckiger's[2] reference to Brunn's observation, made in 1796, of a crystalline deposit in the oil[3] which apparently had been imported from the United States.[4] The earliest known reference in American literature is found in a communication by E. O. Atlee, in 1819,[5] who comments on the appearance of a straw-colored "camphor" in the oil. He also records the name of the original distiller, viz. Bethuel Borton,[6] near

1.) Arch. d. Pharm. 212 (1878), p. 488.
2.) Flueckiger states that he was an apothecary in Guestrow (in the grand duchy of Mecklenburg-Schwerin.)
3.) According to Flueckiger's statement, the oil had been obtained from Monarda didyma L. This is, no doubt, a mistake, for Monarda didyma yields but the merest traces of volatile oil free from thymol. Unquestionably, the oil from which the crystalline deposit had separated had been distilled from M. punctata.
4.) Flueckiger does not state anything as to its commercial source. Inasmuch as the genus is a distinctly American one, there can be little, if any, doubt as to the source.
5.) Am. Med. Recorder, 2nd ser., 2, p. 466.
6.) The original reference may here be quoted: "Some time in 1810, while engaged in the drug business a quantity of horse-mint oil was brought to my store, by the original distiller, Bethuel Borton,...(Please see bottom of following page)

Morris-town, N. J.

The solid which separated from the oil upon standing attracted attention, as shown in the recorded observations of Brunn and Atlee, for the simple reason that organic individuals were still scarce in the materia chemica. Hence, when the Philadelphia College of Pharmacy was founded in 1821 and when the members of the College met at their "Pharmaceutical Meetings" to discuss matters of professional interest, we learn that horsemint oil and the "camphor" which had separated therefrom are mentioned repeatedly. Possibly the earliest College reference is that to the observation made by S. F. Troth and Charles Ellis but no date is recorded.[7] A like observation was reported by Procter in 1845[7] in connection with an oil that had been presented to the College by Edward Wayne.[8] Procter

Footnote 6.) cont'd from preceding page:...who lives near Morris-town." Atlee practiced medicine in Philadelphia (Index Surg. Gen. Libr. 1st ser.) where he also conducted a drug store on Str. (See City Directory.) It would seem therefore that the oil had been distilled on a commercial scale at an early date. Hence it is likely that the apothecary Brunn of Guestrow in Germany had obtained a sample of such an oil.

7.) Am. Journ. Pharm. 17, p. 86.

8.) The Philadephia City Directory for 1844 and subsequent years records an Edward F. Wayne as "clerk" at le Montgomery Ct.

records the m.p. of the "camphor," which he calls monardin, at 118°F (48°C) and the b.p. at 438°F. (225°C.) In 1853, C. F. Bonsall[9] reports that when the stearoptene of M. punctata is oxidized with nitric acid, it yields oxalic acid.[10] In 1856, Procter enumerates "Monarda Camphora, a stearoptene from Ql. Monardae punctatae," among the specimens of "a collection of American drugs presented to the Museum of the Pharmaceutical Society."[11] (of Great Britain)

While the crystalline constituent of Monarda punctata received attention near the place of its production - the sandy lands of New Jersey where it is indigenous, this product of a typically American genus of plants was not without interest to European scientists. Thus a year after Procter had recorded his first observations, A. E.

9.) A student at the P. C. P. class of 1853 who did the work reported as part of his thesis. He lived in Trenton, N. J. His preceptors were Bullock and Crenshaw of Philadelphia. (J. W. England, The first century of the P. C. P.)
10.) Am. Journ. Ph. 25, p. 200.
11.) Pharm. Jour., 16, p. 273.

Arppe[12] records the m.p. of the stearoptene at 48° and the b.p. at 220°? He also reports the results of an elementary analysis[13] without, however, computing a formula. In 1856 Stenhouse[14] expresses[15] agreement with Gerhardt that the crystalline substance isolated by Arppe from Monarda oil is identical with Lallemand's thymol,[16] and with Doveri's "less volatile constituent of the oil of thyme."[17]

Thus the solid which, according to early observers, had separated from Monarda oil, the Monarda camphor, or stearoptene, the "monardin" of Procter, had been identified with thymol, the thyme camphor[18] first observed by Casper

12.) Arppe was a Finnish student working in Woehler's laboratory in Goettingen (Ann. 115, p. 143.)
13.) Annalen 58 (1846), p. 41.
14.) Ann. 98, p. 314.
15.) The original not being available, the reference to Traite de Chimie organique, III, p. 610 could not be verified. Neither could the statement be verified from the German edition.
16.) Journ. de Pharm. 57(1853), IIIser., p. 274.
17.) Ann. 64 (1842), p. 174.
18.) Phil. Trans. Roy. Soc. London 1724, p. 135; through Gildemeister and Hoffmann, The vol. oils (2nd ed.) vol. I, p. 189.

Neumann in 1719. From now on its chemical history is that of this phenol, the isomer of carvacrol[19] later isolated from M. fistulosa. (See chapter on Genetics.)

However, the interest in this particular source did not cease with its identification. In fact, it became a matter of importance as a possible American source of thymol as opposed to the commercial product obtained first from European and African thyme oil[20] and later from the Indian Carum ajowan.[21] Thus Thomas S. Wiegand[22] in 1883 reported at one of the Pharmaceutical Meetings of the P. C. P. that "Mr. Wallace Procter[23] presented on behalf of Messrs. John M. Maris and Co.[24] a gallon bottle nearly full of Oil of Monarda, which had been in their possession for thirteen years, and in which there was a

19) A phenolic isomer of carvone from which it was prepared by Schweizer in 1841 by the action of P_2O_5 on the ketone, hence "acid carvone" or carvacrol. J. pr. Chem. 24, p. 247; also Ann. 40, p. 329.

20.) Gild. and Hoffmann, the vol. oils (2nd ed.) vol. I, p. 471.

21.) Ibidem

22.) Registrar P. C. P. from 1878 to 1900.

23.) Son of Wm. Procter Jr. (J. W. England, First cent. P. C. P., p. 387.)

24.) John M. Maris was wholesale druggists in Philadelphia where he died April 23rd, 1892. (Ph. Era, (1892), p. 360. See Phila. City Directory.)

deposit of nearly one-third of its bulk of thymol, portions of which seemed to be very pure."[25] The very fact that a wholesale drug firm should have bought a gallon of oil of horsemint in 1870 seems to show that it was regarded as an article of promise. That most of it had remained unsold after thirteen years and that the firm was willing to donate the article to the Museum of the P. C. P. as a curiosity, would seem to indicate that their expectations had not been realized.

Nevertheless, the oil continued to attract interest as a commercial possibility as well as a novelty in the volatile oil industry. Thus in 1884, Schimmel and Company report that their New York branch had distilled some of the oil and that Flueckiger had identified the thymol contained therein.[26] A year later, this firm reports that their chemists had ascertained the presence of from 20-30 p. c. of thymol in the oil.[27]

In 1887, Thos. S. Wiegand again reports at a Pharmaceutical Meeting that "Professor Trimble presented

25.) Am. Journ. Pharm. 55, p. 156.
26.) Bericht S. and Co., Sept. 1884, p. 17.
27.) Ibid, Sept. 1885, p. 20.

to the cabinet a remarkably fine specimen of Thymol, which Mr. Jenks[28] had given him for that purpose. It had deposited from a five pint bottle of Oil of Horsemint that had been standing for a long time."[29] Apparently it was due to this incident that Hermann Schroeter[30] undertook to examine the oil under Professor Trimble's direction. He reports the presence of a laevogyrate hydrocarbon, $C_{10}H_{16}$, and of about 25 p.c. of thymol which he records as having been dextrogyrate.[31]

It was this observation which caused a reinvestigation and which, for forty years, resulted in a more or less intensive study of the chemistry of the genus.

28.) Recording Secretary of the P. C. P. from 1873 to 1885 (England, The first cent., p. 364).
29.) Am. Journ. Pharm. 59, p.107.
30.) Member of the Class of 1888, P. C. P. Engl. l.c.p.533.
31.) Am. Journ. Pharm. 60, p. 113.

Chemical Constituents. Studies of a chemical nature have been reported by the following investigators, viz. Procter,[1] Arppe,[2] Bonsall,[3] Stenhouse,[4] Gerhardt,[5] the chemists of Schimmel and Co.,[6] Schroeter,[7] Schumann,[8] and Kremers,[9] Hendrichs,[10] Keho,[11] Fischer,[12] Byron,[13] Wakeman,[14] Miller,[15] the chemists of the Gov. Lab. Leeward Island,[16] Phillips,[17] Sherk,[18] Johnson Merritt and R. E. Dremers,[19] Hewitt,[20] and Harwood.

1.) Am. Journ. Pharm. 17, p. 86.
2.) Annalen, 58, p. 41.
3.) Am. Journ. Pharm. 25, p. 200.
4.) Annalen, 98, p. 314.
5.) Ibid., p. 314.
6.) Ber. S. and Co. Sept. 1885 p. 20.
7.) Am. Journ. Pharm. 60, p. 10.
8.) Pharm. Rev. 14, p. 223.
9.) Pharm. Arch. 2, p. 73.
10.) Thesis U. W. 1907.
11.) Thesis U. W. 1910.
12.) Thesis U. W. 1911.
13.) Science 42, p. 100, also Science 51, p. 397.
14.) Thesis U. W. 1915.
15.) Perf. and Ess. Oil Rec., 10, p. 242.
16.) Journ Am. Ph. A. 8, p. 177.
17.) Journ. Am. Ph. A. 10, p. 82.
18.) Journ. Am. Ph. A. 12, p. 222.
19.) Journ. Am. Ph. A. 17, p. 457.
20.) Journ. Am. Ph. A. 20, p. 631.

The Volatile Oil.

This is the product that first received attention and, for the most part, the only product that was studied chemically. As a rule, it was distilled from the flowering overground portion of the plant. Special oils have been distilled at times from the leaves, also from the florets. Stems and roots failed to yield volatile oil, at least in the amounts subjected to steam distillation. The results having been negative, no record thereof was made in the published reports.

The yield of the oil naturally varies somewhat with the season, but more particularly with the condition of the plant material, namely, whether distilled fresh, i. e., immediately after cutting, or if previously wilted, or, more particularly, if dried.

Of the nature of the plant material from which the early oils had been distilled we know nothing. The first oil concerning which we know something about the nature of the plant material from which it was distilled, is that produced in Madison in 1896 from flowering plants collected near Pine Bluff in early August. This oil was studied by Schumann.[1] The oil distilled from flowering plants collected near Arena during a very dry season, early in

1.) Please see Footnote 1.) following page.

August 1897, was reported on by Hendricks.[2] The oil with which Kebo[3] worked in 1907 and which Fischer[4] reinvestigated in 1910; had been purchased from Henry Haggard, a distiller of wormwood oil near Lodi.[5] The oil with which Byron worked was obtained from the same source having been distilled in 1910; also that reported on by Miller.[6]

In 1915 Nellie Wakeman[7] reported that the terpene, previously assumed to be limonene, failed to yield derivatives corresponding with those of either limonene or pinene. In 1919 the workers of the Government Laboratory at Antigua,[8] British West India, reported on an oil distilled during the previous year from plants raised from seed obtained through the Acting Superintendent of Agriculture for the Leeward Islands, British West India, from the Bureau of Plant Industry, U. S. Dept. of Agr. In 1920 Wakeman[9] substantiated her previous claim that the terpene

1.) Ph. Rev. 14, p. 223:-(Footnote for preceding page)
2.) Ph. Archives 2, p. 73.
3.) Thesis, U. W., 1907.
4.) Thesis, U. W., 1910.
5.) Thesis, U. W., 1911.
6.) Thesis, U. W., 1915.
7.) Science 42, p. 100.
8.) Perfumery and Ess. Oil Rec. 10, p. 242.
9.) Science 51, p. 397.

isolated from the oil is a new terpene. Isovaleric aldehyde was identified by its p-nitro phenyl hydrazone, and carvacrol by its urethane.

The oils distilled in 1918 from materials which were gathered from the Pharmaceutical Gardens, Highlands and Lodi, were studied by Sherk,[10] who separated hydrothymoquinone by diluting the oil with heptane. The cymene obtained from these oils was identified by J. M. Johnston, H. Merrit and R. E. Brenners[11] by means of the following derivatives:

n-phenyl cymene sulphone amide, m. p. 127-128°

n- -naphthyl cymene sulphone amide, m. p. 103-104°

n-cymyl-2-cymene sulphone amide, m. p. 117-118°

10.) Journ. A. Ph.A. 10, p. 97.
11.) Journ. A. Ph.A. 12, p. 222.

Density. No densities were recorded by the early observers. Even if such had been determined for oils from which thymol had separated after years of standing, such constants would be of little value. The densities here recorded, are taken from records that report the source, etc. of the respective oils.

0.9307 at 20° (Schumann and Kremers)[1] 1895)

0.932 at 15° (Henrichs,[2] 1899)

0.947 at 20° (Sherk,[3] 1921, leaves and stems, 1918)

0.9149 at 20° (Sherk, 1921, fresh, flowering herb,)
Florida variety, 1918, Pharm. Garden.)

0.9212 at 20° (Sherk, 1921, Highlands, 1918)

Gildemeister and Hoffmann[4] record the density as varying between 0.930 to 0.940, having taken these data from Nellie Wakeman's monograph.[5] From the above figures it becomes apparent that two of the more recent oils had densities appreciably below 0.930, also that one of the oils

1.) Pharm. Rev. 14, (1896), p. 224 also Proc. A. Ph. A. 44, p. 238 (1896).
2.) Pharm. Arch. 2., p. 72.
3.) J. A. Ph. A. 10, p. 97.
4.) Gildemeister and Hoffmann-Kremers The Volatile Oils. 2nd ed. III, p. 463.
5.) Bull. U. W. Ser. no. 448 (1911) p. 24.

examined by Shark had a slightly higher density than 0.940.

From the data recorded under cohobated oils, it becomes apparent that these may show a much higher density than that of the oil first separated.

Angle of Rotation. Inasmuch as most of the oils distilled were too dark in color to admit of the determination of their optical rotation, but few data are recorded. Thus Schumann and Kremers[1] report the D20° as 0.0588° for an oil distilled in 1896. A few years later Hendricks[2] reported that the oil examined by him was almost inactive. (Presumably these oils were distilled from flowering herb) Taking their data from Wakeman's monograph,[3] Gildemeister and Hoffmann[4] state that the oil is mostly inactive or slightly dextrogyrate.

1.) Pharm. Rev. 14 (1896), p. 224.
2.) Pharm. Arch. 2 (1899), p. 74.
3.) Bull. Univ. Wisc. No. 448 (1911) p. .
4.) The volatile oils, 2nd ed., III, p. 463.

Phenol Content. That the phenol content of the oil should vary with different varities of the same species, also with soil and climatic conditions, and, lastly, with the more or less advanced growth of the plant, was to be expected. Thus Schumann and Kremers[1] found 56p.c. in the oil distilled from wild plants collected at Arena in 1895, whereas Hendrichs[2] found 62 p.c. in an oil from the same source in 1899. In 1926 Lyman D. Fonda[3] distilled a Florida oil that contained as much as 73.21 p. c., whereas the oils investigated by Sherk[4] which had previously been distilled from plants raised in the Pharmaceutical Garden from Florida seeds, contained only 45.9 p.c. and 46.7 p. c. respectively. Following Wakeman's[5] statement, Gildemeister and Hoffmann[6] record 60 p.c.

As was to be expected, echobated oils reveal a higher phenol content.

1.) Pharm. Rev. 14(1896), p. 223.
2.) Pharm. Arch. 2(1899), p. 73.
3.) Lyman D. Fonda, Thesis, U. of Florida (1927), p. 31.
4.) Journ. A. Ph. A. 10(1921), p. 97.
5.) Bull. Univ. Wis. 448(1911), p. 24.
6.) Gildemeister and Hoffmann, The Volatile Oils, 2nd ed., III, p. 463.

Methoxyl Determination

Methyl and ethyl ethers of phenols, more particularly of hydrothymoquinone, are not unknown as plant constituents e. g. dimethyl ether of thymohydro quinone is the principal constituent of arnica root oil, ayapana oil[1] and the oil of Eupatorium capillifolium,[2] while ethyl ether of p-hydroquinone occurs in small amounts in star anise oil.[3] Hence the determination of the methoxyl content of the oil seemed called for. This was determined by Shark[4] for the three oils examined by him.

Description of oil	Percentage of $-OCH_3$
Florida variety	0.36 p.c.
Highlands	0.05 p.c.
Lone Rock	0.17 p.c.

1.) Gildemeister & Hoffmann, the Volatile Oils Vol. I. 2nd ed., p. 479.
2.) Bull. Univ. Wis. No. 693, p. 49.
3.) Gildemeister & Hoffmann, the Volatile Oils, Vol. I 2nd ed., p. 478.
4.) Jr. A. Ph. A. X, p. 417.

Thymol and carvacrol. As stated in the historical introduction, thymol was the first compound of definite chemical composition to be observed and identified.[1] For a time it was assumed that it was the only monatomic phenol present and that it was characteristic of the species. As its isomer carvacrol was regarded as characteristic of the related species, M. fistulosa. Working with larger quantities, however, revealed the fact that whereas thymol was the dominant monatomic phenol present, it was accompanied by lesser amounts of carvacrol.[2] However, working with similar amounts of the volatile oil of M. fistulosa the presence of thymol could not be detected in the carvacrol, the dominant monatomic phenol of that species.[3]

Not only is it an easy matter to separate the thymol well nigh quantitatively from the other constituents of the oil by means of 5 p. c. aqueous alkali, but this procedure is necessary not only for the isolation of the thymol, but also for the satisfactory study of the non-phenol constituents. Hence in the distillation of the oil and after the

1.) Traite de Chimie organique III, p. 610 (see Chapter on Chemistry, footnote no. 15)
2.) Ph. Arch. 2, p. 76.
3.) Ibid, 2, p. 78.

determination of its physical and chemical constants, whenever thought desirable, the isolation of the thymol was the first step taken.[4]

In this connection it should be pointed out, that whereas the 5 p.c. aqueous alkali, when applied repeatedly, will completely extract the phenol, the alkaline solution will also contain some non-phenol constituents, which, while insoluble in either water or aqueous alkali, are not insoluble in the aqueous phenylate solution. Attempts to remove these non-phenol constituents with ether before precipitating the phenol with acid, led to the observation that such immiscible solvents as ether and petroleum ether extract more or less of the phenol as well from its solution in aqueous alkali.

Sherk[5] following Pickles[6] procedure found that carvacrol and hydroxythymoquinone were readily extracted from alkaline phenylate solution by ether, and that only a slight concentration of the non-phenol constituents were found to be present.

As in the case of cymene, thymol and carvacrol were studied and a revised monograph was prepared by Chechik[7] in 1931.

4.) Ph. Rev. 14, p. 224.
5.) Jr. A. Ph. A. I, p. 98.
6.) J. C. S. 93, p. 867.
7.)

Terpenes

It has already been proposed that terpenes may play an important part in the genesis of other cyclic constituents which have been isolated from the plant or whose presence has been indicated. (See Chapter on Genetics.) Although none of the terpenes which have been suggested, have ever been found in the Monardas, yet the presence of limonene in Monarda fistulosa L. was assumed by Hendricks[1] in 1899, when he prepared limonene nitrol benzylamine from the 170° to 180° fraction of the volatile oil. Brandel,[2] in the same year, identified the presence of limonene in Monarda fistulosa L. by the formation of the same derivative with a melting point of 93°.

1.) Ph. Arch., 2, p. 73.
2.) Ph. Arch., 2, p. 76.

Special Oils

Whereas, the volatile oil of this species, whether distilled for commercial or other purposes, is commonly prepared from the overground portion of the plant cut during the following season, the following special oils have been prepared.

Leaves:

Hewitt[1] in 1928 obtained a volatile oil upon distillation of the petroleum ether extractive of the leaves.

In 1930, Harwood[2] reported 210 cc. of volatile oil upon distillation of the concentrated alcoholic extract. The oil from several cohabations were also collected at this time.

Corollas:

A small sample of oil was distilled by Hewitt[3] in 1928 from 72 Gm. of air dried florets. Because of the small quantity of oil obtained the cohobated fraction was added to the original oil in order to ascertain the density.

Calyces:

In 1919, Max Philipps[4] steam distilled the chaff

1.)Journ. A. Ph. A. 17, p. 458.
2.) Journ. A. Ph. A.20, p. 631.(Please see bottom of following page for footnotes 3.) & 4.).

from the calyces and obtained 16.4 cc. of oil. Phenol content was determined, and thymol content was computed by assay. Hydrothymoquinone was identified.

Footnotes cont'd from preceding page:
3.) Journ. A. Ph. A. 17, p. 458.
4.) Journ. A. Ph. A. 8, p. 178.

Density of Special Oils of Monarda punctata L.

Since the density of the oil of Monarda punctata was recorded on oils obtained from the whole herb, it was necessary to compile separate densities from the oils obtained from different parts of the plant.

The densities, here recorded, as in the case of those recorded from the oils of the whole herb are taken from records that report the sources, etc., of the respective oils.

0.952 at 20°C (Phillips,[1] chaff of calyces, 1919)
0.9652 at 20°C (Hewitt,[2] dried florets, 1928)
0.9472 at 22°C (Harwood,[3] leaves, 1931)

In comparison, it will be found that the densities of the special oils are much higher than the densities recorded of the oils obtained from the whole herb.

1.) J. A. Ph. A. 8, p. 178.
2.) J. A. Ph. A. 17, p. 458.
3.) J. A. Ph. A. 20, p. 631.

Fatty Oil. The volatile oil having been removed from the petroleum ether extract of the alcoholic extract by steam distillation, an oily product separated from the aqueous condensate that gave the following chemical constants:-

	I	II
Acid value	24.08	25.37
Saponification value	251.11	252.09
Iodine value	61.96	48.93

From the non-saponifiable portion of this material there was obtained a substance giving the Liebermann test for sterols. After numerous purifications it melted at 136.5°. Its acetate melted at 126.5°. These constants indicate phytosterol.

Another non-saponifiable substance, melting between 62 and 65.5°, was not identified.

The saponifiable fat was found to contain stearic acid, m. p. 69.5°; m.p. of acetophenone ester 64.5°. Other acid materials with melting points of 60° and 81° respectively were isolated, but in such small amounts that their purification and identification was rendered impossible.

Enzyme

It was Rabak[1] who, in 1904, first isolated an enzyme from M. Fistulosa which had the capacity to oxidize hydrothymoquinone to thymoquinone, with the intermediate formation of thymoquinhydrone. This observation has supplied an oxydase reaction which is so unusual in its character that the details of the test[2] may be worth while recording: -

> "To 1/10 gram of hydrothymoquinone was subjected to the oxidizing action of oxydase by allowing the hydrothymoquinone to stand together with 5 cc. of oxydase solution and 20 cc. of water in a wide mouth flask. After standing 43 hours the first change was noticed. Small black crystals appeared in the flask and continued to increase in quantity for a period of 48 hours more, at the end of which time no more black crystals seem to appear. The mixture, however, was allowed to stand and further changes were observed. After standing for another day or more, small yellow crystals made their appearance, and in one week from the time of their initial appearance, all

1.) Ph. Rev. 22, p. 190.
2.) Ibid, p. 191.

the black crystals had formed into the yellow compound."

In the same year Swingle[3] determined its death point to lie between 77 and 81°.

In 1907 Wakeman[4] performed a series of experiments which showed that the greatest amounts of enzyme might be found in the greenest and more vigorous growing leaves, while it was found that leaves obtained from the lower portion of the stem contained only one-tenth the quantity of enzyme when compared with the amount obtained from equal weights of leaves taken from near the growing tip. It was also ascertained that leaves which had prematurely been colored red in autumn yielded smaller amounts of the ferment, and that colored florets contained only about one-tenth the amount of the enzyme found in vigorously growing leaves.

A year later Wakeman[5] reported the occurrence of a like enzyme in the leaves of M. punctata and in 1909 repeated on this species the experiments previously performed with M. fistulosa and confirmed the results.[6]

In 1896, Bourquelot[7] had shown that tyrosinase from

3.) Ph. Rev. 22, p. 190.
4.) Bull. U.W. 448, p. 37.
5.) Ibid.
6.) Ibid.
7.) Compte rend. 123, p. 423.

Russula delica has the capacity to oxidize thymol and carvacrol. Repetition of the experiments by Rabak[8] gave negative results so far as the enzyme of M. fistulosa was concerned. However, Rabak had used strong alcohol which, according to Bourquelot destroyed the enzyme. The error in technique being corrected by Wakeman[9] results were obtained with extracts of M. fistulosa which, while not satisfactory, were not negative.

8.) Ph. Rev. 22, p. 190.
9.) Bull. U. W. 448, p. 37.

Roots

So far the inorganic constituents only have been investigated, viz. by Harwood.[1]

The moisture determination of the air dried material, when ascertained by the xylene method, yielded 4.0 p.c. and 4.5 p.c. respectively.

Upon incineration, the air dried roots yielded the following results:-

	I	II
Total ash	7.63 p.c.	5.74 p.c.
Water-insol. ash	6.67 " "	4.71 " "
Water-sol. ash	0.96 " "	1.03 " "

When analysed, the ash was shown to have the following composition, the percentages being computed with reference to air dried root.

	I	II
Ca	0.25 p.c.	0.24 p.c.
Mg	0.02 " "	0.02 " "
Fe	0.044" "	0.045" "
Al	0.06 " "	0.065" "
Cl	0.015" "	0.014" "
CO_3	0.21 " "	0.22 " "
SO_4	0.132" "	0.144" "
SiO_2	5.81 " "	5.42 " "
Undetermined	1.72 " "	1.46 " "

1.) Jr. A. Ph. A. 20, p.433.

Stems:

There is no specific mention in the literature regarding the distillation of a volatile oil from the stems of Monarda punctata, although Sherk [1] in 1921 recorded a volatile oil which had been obtained from the leaves and stems. However, since the volatile oil obtained from these parts of the plant could not give any definite information regarding the character of the oil of the stems, it may be understood that the stems have not been individually investigated.

1.) J. A. Ph. A. 10, p. 97.

Leaves

Inasmuch as the early interest in the plant centered about its volatile oil distilled from the overground portion of the flowering plant, the chemical studies were restricted to this product. For a better understanding of the biochemistry of this species, as well as of the entire genus, it was necessary to study the non-volatile constituents as well. This was particularly true of the leaves, those organs of the plant which constitute the photochemical laboratories of so many representatives of the vegetable kingdom. Hence the chemical study of the leaves, in accordance with the generally accepted methods of phytochemical analysis was undertaken by Hewitt[1] in 1925. This was supplemented by Harwood[2] in 1931, who made a detailed study of the inorganic constituents as revealed in the ash.

Hewitt's investigation, naturally, resulted in the isolation of a "volatile oil" obtained by steam distillation, not of the leaves as such, but of the petroleum ether extract after the solvent had been removed by distillation. The oil thus obtained (79 g.) represented a yield of 1.51 p.c. It had a density of 0.9490 at 23.3°. In a 50 mm tube, it deviated polarized light 0.27° to the left. Its

1.) Please turn to bottom of following page for footnotes 1.) & 2.)

index of refraction was found to be 1.4927 at 25°. It assayed 73 p.c. phenol.

Moisture. Determined by the xylene method[3] Harwood found the moisture content of the air dried leaves to be 8.0 p.c. and 7.6 p.c. respectively.[4]

Ash. The ash determinations, also the analysis of the ash by Harwood[5] yielded the following results:-

	I	II
Total ash	13.37 p.c.	13.29 p.c.
Water-insol. ash	10.99 " "	10.52 " "
Water-sol. ash	2.38 " "	2.77 " "
Acid-insol. ash	4.77 " "	4.54 " "

In view of the high water-insoluble ash content, the question may well arise whether the total ash content as

Footnotes cont'd from preceding page:-
1.) Jr. A. Ph. A. 17, p. 457.
2.) Ibid., 20, p. 435.

3.) Monatsh., 6, p. 989 (1885).
4.) Jr. A. Ph. A. 20, p. 435.
5.) Ibid.

revealed represents inorganic constituents exclusively. There is always danger of including in this result microscopic particles of soil thrown up against the under surfaces of the leaves by heavy rains.

When analysed, the ash revealed the following constituents, the percentages being computed with reference to the total ash.

	I	II
Mg	0.173p.c.	0.171 p.c.
Ca	1.19 " "	1.14 " "
Fe	0.14 " "	0.14 " "
Al	0.24 " "	0.23 " "
Cl	0.027" "	0.032 " "
CO_3	0.75 " "	0.74 " "
SO_4	0.25 " "	0.26 " "
SiO_3	5.78 " "	5.77 " "
Undetermined	4.78 " "	4.85 " "

The high percentage of silicates might be interpreted as lending credence to the supposition that part of the total ash content is due, not to inorganic constituents of the plant, but to soil adhering to the leaves when incinerated. However the low carbonic acid content when compared with that of the floret ash is noteworthy.

Bracts

The moisture content of the air-dried bracts was found by Harwood,[1] when determined by the xylene method, to be 4 p.c. in duplicate determinations.

Two ash determinations, computed with reference to air dried material, yielded the following results:-

	I	II
Total ash	11.23 p.c.	11.57 p.c.
Water-insol. ash	7.87 " "	7.81 " "
Water-sol. ash	3.36 " "	3.76 " "
Acid-insol. ash	3.39 " "	3.30 " "

The following constituents of the ash were determined quantitatively:-

	I	II
Mg	0.10 p.c.	0.10 p.c.
Ca	0.74 " "	0.75 " "
Fe	0.10 " "	0.10 " "
Al	0.24 " "	0.24 " "
Cl	0.11 " "	0.13 " "
CO_3	0.89 " "	0.86 " "
SO_4	0.35 " "	0.36 " "
SiO_3	4.15 " "	4.04 " "
Undetermined	4.72 " "	4.82 " "

1.) Jr. A. Ph. A. 20, p. 436.

Florets

Although Beck[1] had made a preliminary study of the florets of Monarda fistulosa as early as 1903, those of M. punctata were not investigated until 1928 by Hewitt[2] and again in 1931 by Harwood.[3]

Water Content. The water content of the fresh florets, preserved in xylene as soon as collected and weighed was found to be 69 p.c..[4] For the air dried material, Hewitt[5] found 6 p.c. and Harwood[6] 6.8 p.c. and 6.6 p.c. respectively.

Ash. The air dried florets yielded the following results:

	Hewitt I	Hewitt II
Total ash	10.29 p.c.	10.20 p.c.
Water insol. ash	4.09 " "	3.99 " "
Water sol. ash	6.20 " "	6.21 " "
Acid insol. ash	-	-

1.)Pharm. Rev. 21, p. 111.
2.) Jr. A. Ph. A. 17, p. 457.
3.) Ibid, 20, p. 436.
4.) Ibid.
5.) Ibid., 17, p. 457.
6.) Ibid., 20, p. 436.

Harwood

	I	II	III
Total ash	10.88 p.c.	10.91 p.c.	10.49 p.c.
Water insol. ash	6.00 " "	6.11 " "	5.52 " "
Water sol. ash	4.88 " "	4.80 " "	4.97 " "
Acid insol. ash	1.36 " "	1.31 " "	"

From the above figures it becomes apparent that the total ash content is relatively high, that the percentage of water-insoluble ash of the material incinerated by Herwitt was appreciably lower than that of the florets burned by Harwood, and that the acid-insoluble ash content is not high.

The study of the ash constituents determined by Harwood [7] yielded the following results computed with reference to the air-dried material.

	I	II
Mg	0.046 p.c.	0.042 p.c.
Ca	0.24 " "	0.24 " "
Fe	0.073 " "	0.067 " "
Al	0.242 " "	0.240 " "
Cl	0.24 " "	0.22 " "
CO_3	2.01 " "	2.03 " "
SO_4	0.27 " "	0.31 " "
SiO_3	1.42 " "	1.37 " "
Undetermined	5.71 " "	5.73 " "

7.) Jr. A. Ph. A., 20, p. 437.

It should scarcely be necessary to point out that the results tabulated above afford but an imperfect insight into the inorganic constituents. Thus the carbonic acid content of the ash is, in all probability, not due to the presence of carbonates in the plant but a result of the method of analysis. Again, any nitrates occurring in the plant will not be found in the ash since the nitrogen of the nitrate radicle escapes as element when the nitrates are heated with carbon.

Volatile Oil. When subjected to steam distillation by Hewitt[8] 72 g. of florets yielded 2.7g. of a dark colored oil or 3.45 p.c. To the original oil, the small amount, resulting from four cohobations had been added. $d_{20°}$ = 0.9652.

In this connection it may be pointed out that in the moisture determination by the xylene method, the bulk of the volatile oil is to be found in the xylene distillate. It is of interest to note that neither the xylene nor the aqueous distillate gave reactions for either thymol or carvacrol when the Flueckiger test[9] was applied. The dark color of the oil is no doubt evidence of the presence of quinhydrone.

8.) Jr. A. Ph. A. 17, p. 457.
9.) Ibid.

Inorganic Constituents

As pointed out, the genesis of thymol and carvacrol (See Chapter on Genetics) may depend upon the inorganic constituents which M. punctata derives from a sandy soil and which M. fistulosa derives from the clay soil in which it grows.

In connection with the discussion of the quinhydrone hypothesis of pigmentation, attention has been directed to the role which the metallic elements, no doubt, play in the pigmentation of the florets.

A study of the non-carbon elements and their possible combinations, therefore, was highly desirable. Such a study was undertaken by Harwood in connection with both M. punctata and M. fistulosa.

(Please see table on following page)

Interesting as the above data may be, they do not, at least by themselves, throw any direct light on the genesis of thymol and carvacrol in the plant. What is more, the question of the accuracy of certain results has arisen to plague the speculator. Not only are the results not at all inclusive (see perfentage of undetermined constituents of the ash) but it has been pointed out that possibly part of the ash was not made up of the inorganic constituents of the

	Root		Stem		Leaf	
	M. punctata	M. fistulosa	M. punctata	M. fistulosa	M. punctata	M. fistulosa
Ca	0.25 p.c.	0.34p.c.	0.430p.c.	0.19p.c.	1.19p.c.	0.70 p.c.
	0.24	0.34	0.430	0.18	1.18	0.72
Mg	0.02	0.071	0.029	0.017	0.173	0.11
	0.02	0.071	0.026	0.017	0.171	0.11
Fe	0.044	0.19	0.085	0.046	0.14	0.088
	0.045	0.18	0.085	0.047	0.14	0.088
Al	0.06	0.19	0.11	0.049	0.24	0.16
	0.06	0.19	0.11	0.047	0.23	0.18
Cl	0.015	0.32	0.032	0.028	0.027	0.035
	0.014	0.26	0.039	0.028	0.032	0.024
CO_3	0.021	0.025	0.59	0.84	0.75	0.025
	0.022	0.024	0.61	0.84	0.74	0.024
SO_4	0.132	0.15	0.31	0.16	0.25	0.15
	0.144	0.13	0.29	0.16	0.26	0.13
SiO_2	5.42	9.160	1.68	0179	5.78	9.16
	5.18	10.04	1.61	0.83	5.77	10.04
Undetermined:						
	0.92		2.84	1.95	4.78	0.92
	0.70		2.91	1.84	4.85	0.70

Please see following page for the remaining partt of this table.

	Bract		Corolla	
	M. punctata	M. fistulosa	M. punctata	M. fistulosa
Ca	0.74 p.c.	0.59 p.c.	0.24 p.c.	0.32 p.c.
	0.75	0.58	0.24	0.31
Mg	0.10	0.11	0.046	0.061
	0.10	0.11	0.042	0.059
Fe	0.10	0.10	0.073	0.088
	0.10	0.10	0.067	0.088
Al	0.24	0.14	0.242	0.32
	0.24	0.14	0.240	0.32
Cl	0.11	0.073	0.24	0.025
	0.11	0.073	0.24	0.009
CO_3	0.89	2.40	2.01	1.73
	0.86	1.40	2.03	1.73
SO_4	0.35	0.50	0.27	0.18
	0.36	0.50	0.31	0.18
SiO_3	4.15	5.91	2.42	1.25
	4.04	4.09	1.37	1.36
Undetermined	4.72	5.75	5.71	5.50
	4.82	5.48	5.73	5.39

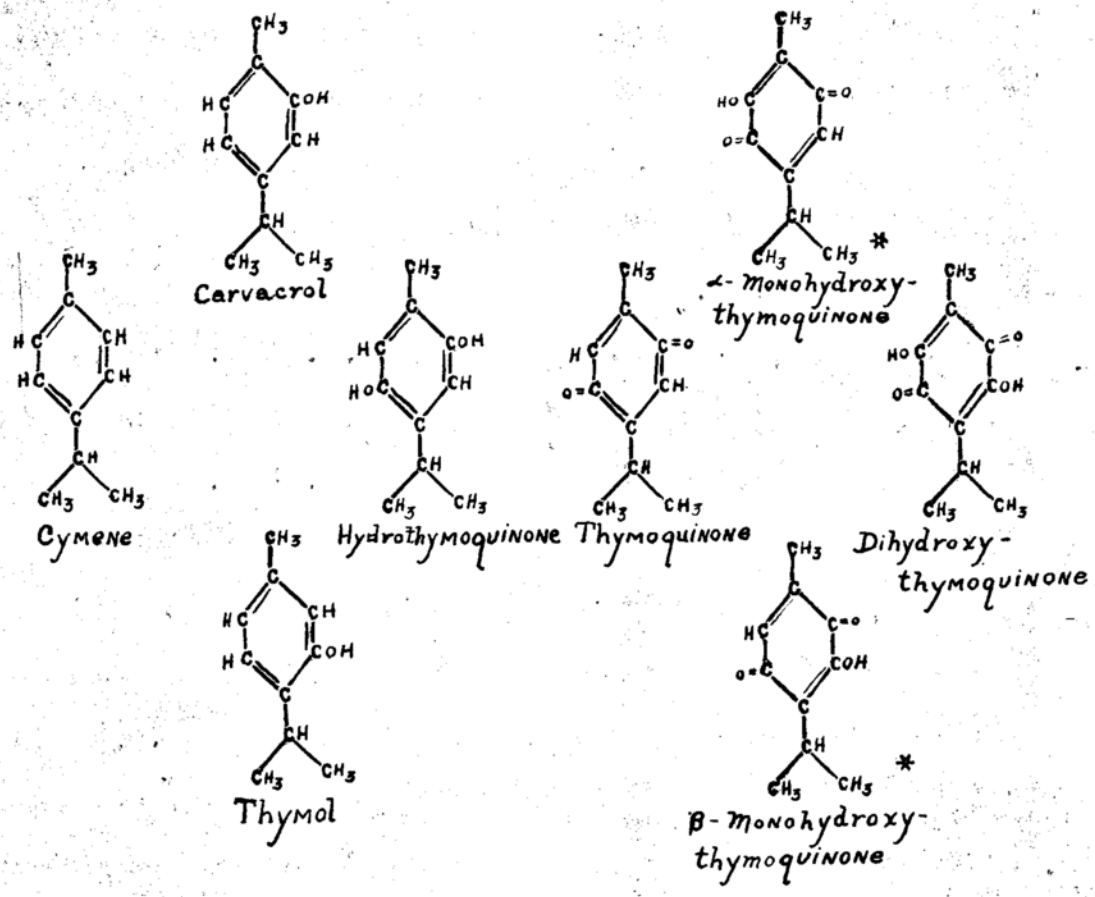
plant, but soil adhering more particularly to the leaves. It may, therefore, be necessary to repeat the work before satisfactory comparisons with the determinations of the inorganic constituents of other species can be made.

It should scarcely be necessary to point out that any

nitrates occurring in the plant are destroyed during the incineration, also that the carbonates recorded are, no doubt for the most part, not to be found in the living plant but are products of combustion. What other changes may be involved cannot be stated with certainty. Nevertheless a continuation of this aspect of the life processes of the plant is greatly to be desired.

Genetics

The isolation of a number of oxidation products of cymene from several species of Monarda is not only interesting but highly significant.



*Although the presence of the monohydroxy-thymoquinones has been indicated, neither has been isolated thus far.

As a basis for classification and nomenclature the definition that organic chemistry is the chemistry of hydrocarbons and their substitution products is highly

satisfactory. However, it is a purely arbitrary generalization though a valuable one. Interesting as is the evolution of such a series of oxidation products as the one revealed above, it throws little direct light on the life processes of the plant.

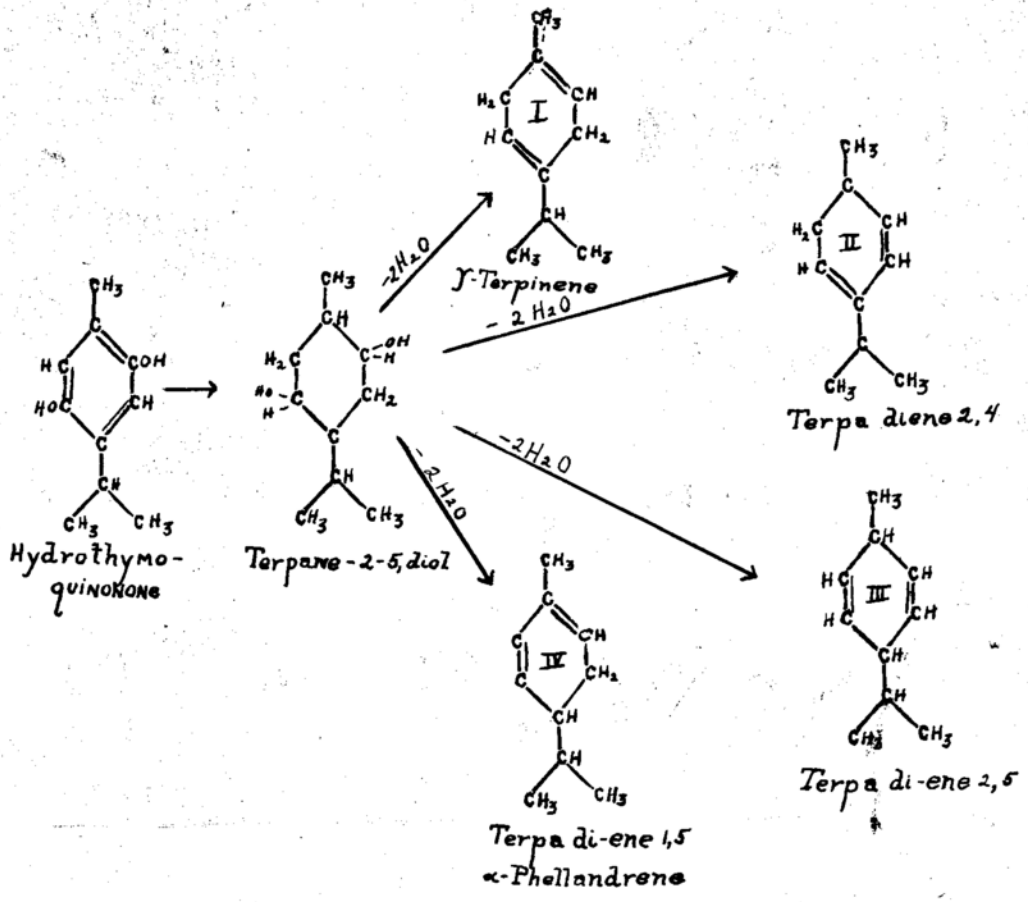
Fortunately for the biochemist who is inclined to delve into the life processes of the plant, this itself, at times, points the way. Thus, in the case of the Monardas, it has been pointed out that the prepresentatives of this genus contain an enzyme that has the capacity to oxidize hydrothymoquinone to thymoquinone. (See Chapter on Enzymes.)

In this connection it should be pointed out that not only do various unknown catalysts, as well as known (enzyme), avail themselves of atmospheric oxygen to oxidize hydrothymoquinone to thymoquinone, but that the former will undergo autoreduction to hydrothymoquinone in indifferent solvents while at the same time it is presumably autoxidized. As has been pointed out repeatedly, the color changes that take place in products of the plant, such as the volatile oil, are truly chamelion-like in character and often wholly unexpected. It is this very lability of several of these substances that cause them to be so interesting biochemically.

If in the chemical properties referred to we find a partial explanation of the life processes, it must be

remembered that even so far as the series of compounds involved are concerned, only a partial explanation has been offered.

If thymoquinone autoreduces itself to hydrothymoquinone, the reduction of the latter to either thymol or carvacrol has not been carried out artificially in the laboratory. Catalytic reduction of hydrothymoquinone has resulted in the formation of terpane-2,5-diol, i. e., in the addition of hydrogen to the double linkages of the benzene nucleus , not in the replacement of either or both of the hydroxy group by hydrogen. Upon dehydration this may yield terpenes as indicated by the following formulas.



This possibility is of interest, not only from the fact that terpenes (q.v.) have been found in Monardas, but more particularly from the observation made by Wallach[1] that when γ-terpinene is oxidized to its erythrol, this upon splitting off three molecules of water will yield either thymol or carvacrol.

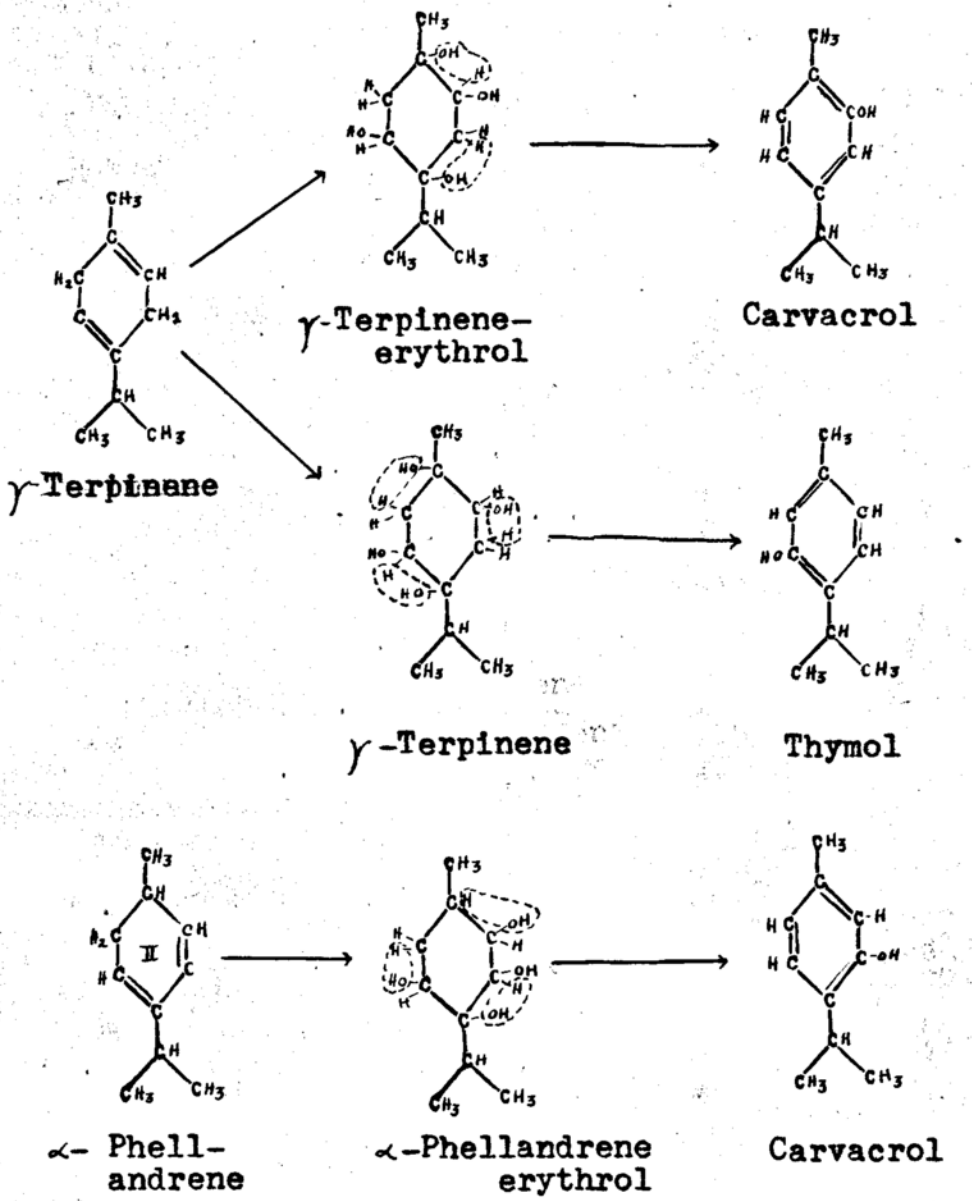
$C_{10}H_{16}$	$C_{10}H_{16}(OH)_4$	$-3H_2O$	$C_{10}H_{13}OH$
Terpene	Terpene erythrol		Thymol, or carvacrol

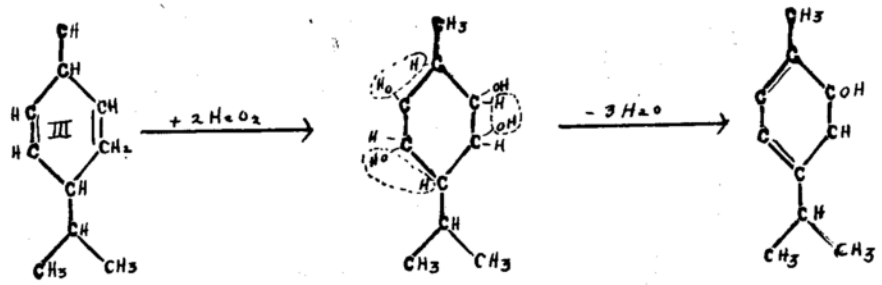
Inasmuch as the production of thymol or carvacrol resulting, depends upon the conditions under which the experiment is conducted, it was thought possible that the inorganic constituents (q.v.) of the plants might be a contributing factor. This seemed all the more probable since M. punctata, which produces thymol, grows on sandy soil; whereas M. fistulosa, which produces carvacrol, grows on clay soil. (See Inorganic Constituents.)

These considerations made a revision of the terpene constituents highly desirable but, unfortunately, these studies were interrupted by the World War and have not been resumed since, partly because of the large quantity of volatile oil necessary to obtain sufficient amounts of the

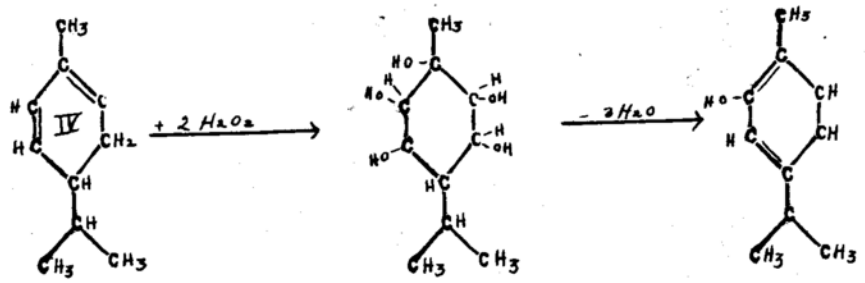
1.) Gildemeister and Hoffman, The Volatile Oils, 2nd ed. v. 1, p. 320.

terpene fractions required for such a study. For the present, therefore, little more can be done than to speculate as to the structure of the terpenes that can yield theoretically the one or the other, or both, of these phenols through the respective erythrols.



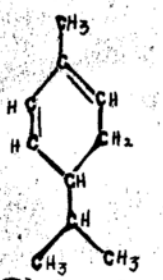


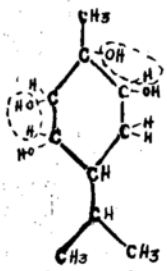
Terpa di-ene 2,5 — Terpane tetra-ol 2,3,5,6 — Carvacrol

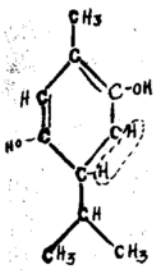


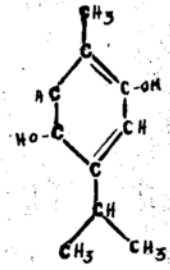
-Phellandrene — -Phellandrene erythrol — Carvacrol

Barcus[1] suggests the hypothetical formation of hydrothymoquinone in the following manner from phellandrene but it does not appear probable that the plant could dehydrogenate two hydrogens from the molecule in such a manner. (See "a" in formula.)


α-Phellandrene

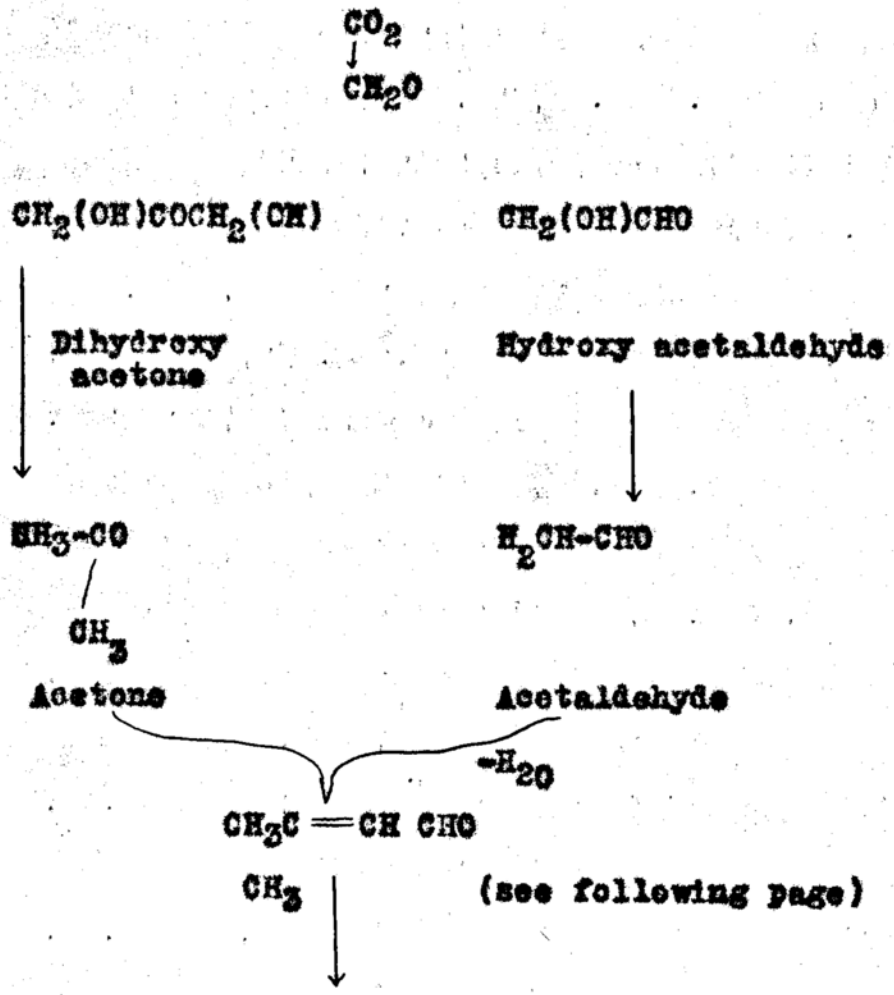

α-Phellandrene erythrol


Di-hydro hydro-thymoquinone


Hydrothymo-quinone

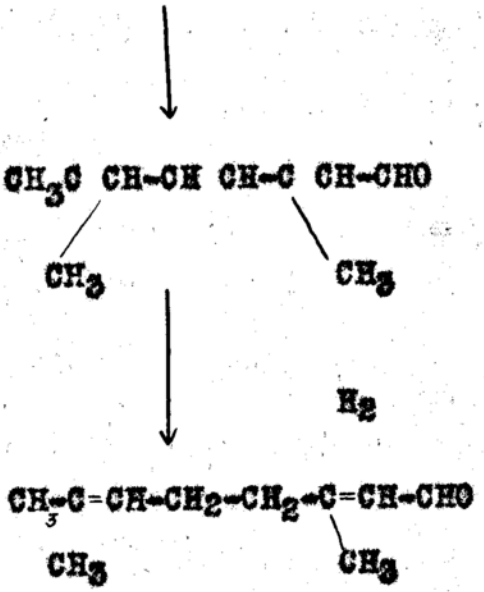
1.) Barcus, Unpublished Thesis, Univ. of Texas, 1935.

All of the compounds considered thus far are cyclic in character. The presence of citral or a citral-like aldehyde in M. citriodora naturally tempts the biochemist to include in his speculations as to the life processes of these plants not only such chain compounds with an equal number of carbon atoms, but also compounds with a lesser number of carbon atoms, indeed to go back as far as some of the simpler products of photosynthesis.

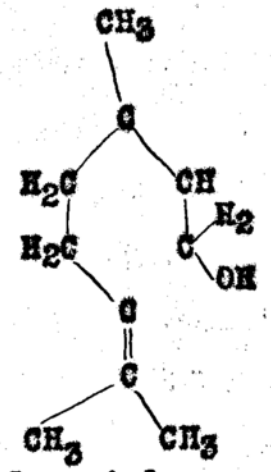


(see following page)

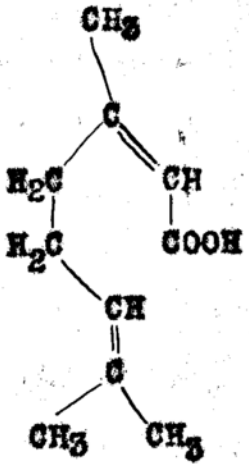
condensation of two molecules



Citral



Geraniol



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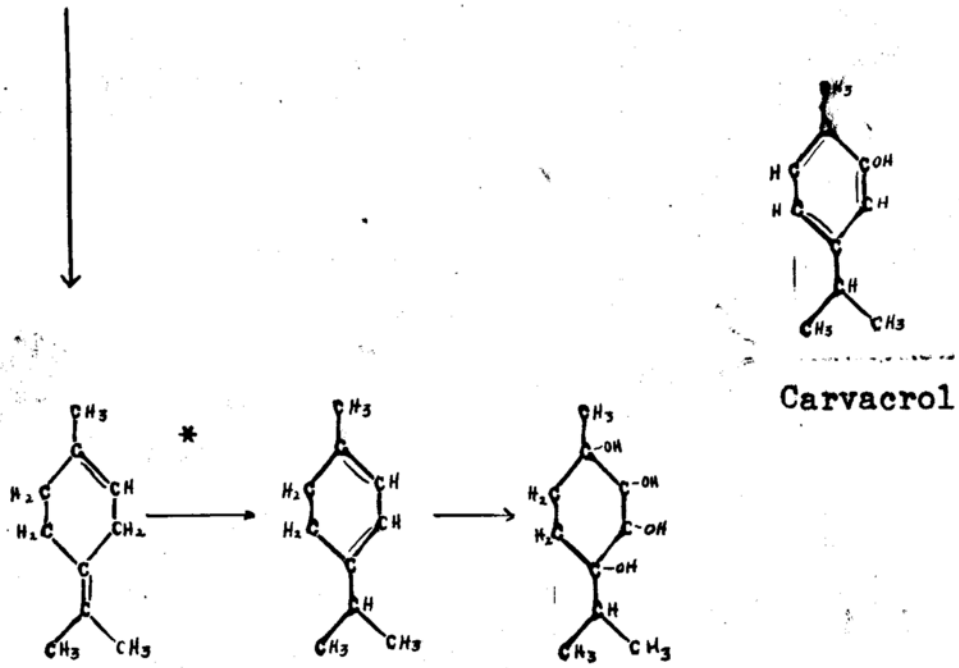


Carvacrol

Terpinolene Terpinene Terpinene erythrol

Thymol

* For this and other changes see Hall, Biogentics in the Terpane Series. Chem. Rev. vol.XIII, p.479

These considerations include only volatile constituents of the Monardas, but these play an important role in both perfume and pigmentation of these plants (See Quinhydrone hypothesis). It did not seem worth while to discuss here such general and well known speculations as those pertaining to carbohydrate synthesis which so many plants have in common. Neither did it seem proper to emphasize the role of that almost universal pigment of higher plants the chlorophyll and the role which it plays in photosynthesis. The object of these biogenetic discussions was not to present a general plan of plant physiology so far as chemical reactions are concerned, but to present a speculative basis of the special life processes of the genus Monarda so far as this may be based on the chemistry of these plants as revealed thus far.

The possible role of hydrothymoquinone glucosides has not been discussed for the simple reason that more experimental evidence is needed to make such discussion profitable. For the same reason the discussion of pigments other than those listed above and those derivable therefrom, viz. the quinhydrones has been omitted though the presence of pigments of an anthocyanine character has been indicated.[1] (Ens.)

1.) W. W. Ens., unpublished Thesis 1931, U. of W.

Suffice it to conclude these speculations with the statement that a preliminary survey of other species of Monarda which have not previously been studied is under way at present. Even this preliminary survey may necessitate a restatement of some of the ideas evolved. A more complete study will, no doubt, throw additional light on the life processes of this genus, which, from the standpoint of the plant chemist, occupies a unique position in phytochemical literature.

Quinhydrone Hypothesis

Although Woehler[1] as early as 1844 was the first to observe the formation of quinhydrone, which he named, green hydroquinone, the possibilities of the plant being able to carry out this reaction probably did not occur to anyone, nor was it suggested until 1901 when Brandel[2] isolated thymoquinone from the volatile oil of Monarda fistulosa L. Inasmuch as this was the first time that thymoquinone had ever been isolated from a plant, it is not surprising that interest was aroused in a study of the quinhydrone reaction and its relation to the coloration of volatile oils.

Lieberman[3] had reported in 1885 that thymoquinone would react readily with hydrothymoquinone to form thymoquinhydrone, but this reaction was understood not to be a phytochemical one. However the knowledge of this report, which was indicated, must have helped to point the way for Brandel and Dremers, because in reporting the occurrence of thymoquinone in the volatile oil of Monarda fistulosa L. they placed special emphasis on the probable quinhydrone

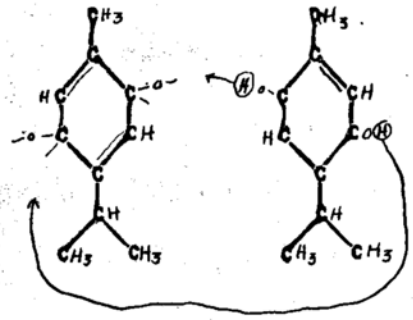
1.) Ann. d. Chem. 51, (1844), p. 152.
2.) Ph. Rev. 19, (1901), p. 200.
3.) Ber. 18, p. 3196.

formation and between thymoquinone and hydrothymoquinone, and the possibility that this formation might be offered as an explanation for the coleration of the oils. It should be pointed out that this hypothetical proposal was made in view of the fact that hydrothymoquinone had never been isolated from a volatile oil, although the presence of this constituent was necessary, as has been pointed out, to bring about the possible formation of thymoquinhydrone. No doubt their study of the possible oxidation products of carvacrol or thymol allowed them to speculate as to its probable occurrence in the plant, because a month later, Brandel and Kremers[5] reported the occurrence of hydrothymoquinone in the volatile oil from Monarda fistulosa L. The isolation of this constituent at once stimulated an new interest in the quinhydrone hypothesis, not only as far as it was applicable to oils containing thymol and carvacrol, but to all phenol-containing oils.

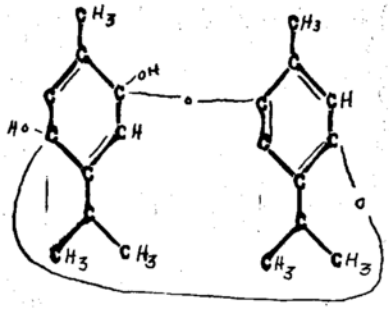
A graphic illustration of one of the possible formations of thymoquinhydrone from one molecule of thymoquinone and one molecule of hydrothymoquinone as suggested by Jackson and Oenslager[6][7] (see Enz. for other possible formations

4.) Ph. Rev. 19, (1901), p. 200.
5.) Ibid., p. 244.
6.) Ber. 28, (1895), p.1614.
7.) W. W. Enz. Unpublished Thesis, U. W. (1931), p. 105.

of quinhydrones).



Thymoquinone Hydrothymoquinone



Thymoquinhydrone

Wakeman[8] in 1911, while initiating a study of the possible plant pigments which might be found in the Monardas suggested a large number of possible quinhydrones which might be formed by the addition of various phenols to the quinones which had already been observed in the Monardas. This study led to a very interesting monograph on the pigments which Wakeman[9] completed in 1913.

Regarding the use which may be made of the quinhydrone hypothesis for the explanation of plant pigmentation occurring in Monarda punctata L., we cannot do more than

8.) Bull. U. W. No. 448, p. 28.
9.) Bull. W. W. No. 992.

assume that quinhydrones may possibly be present in the plant, inasmuch as the purple color sometimes found in the stems and bracts might indicate it, although none of the quinones have ever been isolated from this species.

Therapeutic properties

Monarda punctata L. and its volatile oil were first introduced into American medical practice as early as 1819 by Dr. E. A. Atlee of Philadelphia, who gave an account of their medicinal virtues.

Inasmuch as the herb and volatile oil were both officially recognized in the U. S. Pharmacopoeia in 1820, and in subsequent revisions of the same until 1880, it becomes apparent, that a separate resume of each of their therapeutic properties will help to clarify the positions which they held in American materia medica.

Herb:

That the herb had been used for medicinal purposes previous to 1819 becomes evident. As Atlee[2] states, "The inhabitants of Jersey are not ignorant of its virtues, and some respectable practitioners in that state frequently direct it as a diaphoretic, diuretic, and carminative."[3] Atlee, however, gave it little recognition, because

1.) American Med. Recorder, vol. 2, (1819), p. 496.
2.) Ibid.
3.) Ibid.

he was primarily interested in the volatile oil.

In 1822, Bigelow[4] states, that it "was used as a warm diaphoretic, anti-emetic and carminative; and also used in flatulent colica, rheumatism, etc."

Several years later, Chapman[5] records, that prior to the publication of Dr. Atlee's article, an infusion of the recent or dried leaves had been employed for some time, to allay nausea or to check vomiting, and was a common remedy for these purposes, especially in the treatment of bilious fevers by the late Dr. Kuhn.[6]

Chapman[7] further records, that he thought well of it as an antilithic, and used it freely in ordinary stranguary from blisters, etc. As an emmenagogue, he concurred in the popular notion of the time as to its virtues, placing it on a footing with rosemary, pennyroyal and similar articles.

When it became necessary to classify the herb, therapeutically Chapman[8] states that he was in doubt concerning

4.) J. B. Bigelow, Materia Medica (1882), p. 257.
5.) N. Chapman, Elements of Therapeutics and Materia Medica vol. 2, (1824), p. 296.
6.) H. A. Kelly, Cyclopedia of Am. Med. Biog. vol. 2, p. 78.
7.) N. Chapman, Elements of Therapeutic and Materia Medica, vol. 2, (1824), p. 296.
8.) Ibid.

its action, but inasmuch as he had used it mostly as a spasmodic,* he gave it that position.

The herb, as has already been indicated, was introduced into the U. S. P. of 1820,[9] which records it among the drugs in the secondary catalogue. In the 1830[10] revision, however, it was placed in the primary catalogue of materia medica where it remained until the 1880 revision of the U. S. P., when it was deleted. Wood and Bache[11] state that the herb owed its position in the U. S. Pharmacopoeia "because of the volatile oil which it affords."
The New York 1830[12] Pharmacopoeia was the only Pharmacopoeia to state, that the therapeutic properties of the drug were stimulant, carminative and diaphoretic.

9.) U. S. Pharmacopoeia (1820), p. 55.
10.) U. S. Pharmacopoeia (Wash.) (1830), p. 45.
11.) G. B. Wood & Franklin Bache, The Dispensatory of U. S. A. (1883), p. 434.
12.)U. S. Pharmacopoeia (N. Y.) (1830), p. 45.

*It would appear that Chapman should have used the term anti-spasmodic since in no instance is the term spasmodic by other authors given for the use of the herb, although the term anti-spasmodic is quite prevalent in the literature.

In spite of the fact, that in 1820, because of its pharmacopoeial recognition, its position in American materia medica appeared well established, the herb failed to play an important role in American medical practice. Very few of the commentaries or journals of this early period recognized its virtues. The fourth edition of Thacker's New Dispensatory[13] published in 1821, although favorably recommended by a large number of outstanding physicians, failed to list the herb, and no mention was given to it, in the "American Medical Repository," the first American medical journal of this period.

It becomes apparent that the herb was not extensively recognized at an earlier date, because there is no mention of it in the writings of Barton,[14] Schoepf[15] or Kalm,[16] three well known authors on American materia medica.

In 1827, the editor of Coxe's American Dispensatory,[17] expresses his doubt concerning the therapeutic properties, as he states: "What peculiar virtues have given Monarda a place in our materia medica, I know not."

13.) J. Thacker, New Dispensatory (1821)
14.) B. S. Barton, Collection for an Essay towards a Materia Medica for U. S.
15.) Johann D. Schöpf, Materia Medica Americana.
16.) Per. Kalm, Travels into North America 1716-1779.
17.) J. R. Coxe, American Dispensatory 7th ed.(1827), p. 391.

Wood and Bache,[18] both members of the U. S. P. revision committee of 1830, and co-authors of the United States Dispensatory were in a favorable position to know and judge the therapeutic properties of the herb. In 1833, they write:

"Horsemint is a stimulant and carminative, but it is seldom used in regular practice. In the state of infusion, it is occasionally employed in families as a remedy for flatulent colic and sick stomach, and for other purposes to which the aromatic herbs are applied. It was introduced into the primary catalogue of the U. S. P. on account of the volatile oil which it affords."

The last sentence best explains why the herb became official in the U. S. P. of 1820, and continued to hold its position in subsequent revisions of the U. S. P. until 1880.

It is surprising to find that Wood and Bache quoted the above paragraph through the first fourteen editions of their text during a period of fifty years (1833-1883), even in view of the fact that they were aware of the scientific investigations on the herb and the volatile oil.

18.) G. B. Wood and Franklin Bache, The Dispensatory of U. S. (1833), p. 434.

In 1858 Kost,[19] states that "Monarda is an agreeable stimulant and carminative in all cases in which the other mints are applicable. It is much esteemed by many practitioners as a remedy in fevers especially typhus. The herb is prepared by infusion in boiling water, and drank freely, ad libitum."

It is not known when the herb was introduced into American Electic medical practice yet in 1865, Hollembaek[20] recommends its use as an "anti-lithic, anti-diuretic, anti-emetic, antispasmodic in bilious fevers, carminative, colds, colics, flatulent colics, diaphoretic, serious diarrhea, diuretic, emmenagogue febrifuge, inflammatory fevers, flatulence, gout, grovel, intermittent fevers, nausea, sudorifis and vomiting." In addition he recommends the following formula for making the infusion:

"Leaves and blossoms as.
Boiling water
Drink at discretion "

In American Homeopathic medicine, the herb was not recognized. The various editions of the American Homeopathic pharmacopoeias do not mention it.

In 1868 Wood[21] writes, "Horsemint has the aromatic

19.) J. Kost, Elements of Materia Medica (1858), p. 456.
20.) H. Hollembaek, American Eclectic Materia Medica (1865), p. 257.
21.) G. B. Wood, Treatise of Therapeutics and Pharmacology 3rd ed. vol. 1, (1868), p. 345.

properties of the proper mints, but is more stimulating and less agreeable. It may be used as an anti-emetic and carminative, and as a stimulant to the stomach in languid states of that organ, but is little employed in regular practice. An infusion may be made in the proportion of half an ounce to the pint, and given in a wineglassful doses. Drank warm, and freely, it will often induce prespiration, and has been thought to act as an emmenagogue, and taken cold, it has been supposed to stimulate the kidneys. Hence it has been used in suppression of the menses and of the urine.

In 1874, Stille,[22] writes that the whole herb was employed, that it states "It has an aromatic smell and a warm pungent bitterish taste. It is used in hot infusion as a domestic remedy for flatulent colics and nausea and by the country folk as an emmenagogue, and also to cure intermittent fever. It is more valuable on account of the essential oil." A short reference to Atlee's article was given.

Monarda punctata, as a therapeutic agent, rapidly fell into disuse, probably because of several reasons. In 1856, Gerhardt[23] identified the active ingredient of

22.) Alfred Stille, Therapeutics and Materia Medica, (1874), p.

23.) C. Gerhardt, Traite de Chimie organique III, p. 610.

the oil as thymol, and as is commonly the case, the active ingredient became more important than the plant from which it was obtained. Secondly, the fact that the drug was deleted from the U. S. Pharmacopoeia of 1880 emphasized the fact that medical men felt that it did not fulfill their expectations as a therapeutic agent.

As late as 1879, a year before the herb and volatile oil were deleted from the U. S. P. 1880 Stille and Maisch,[24] co-authors of the National Dispensatory state, "Horsemint is regarded as being diaphoretic, diuretic, carminative and emmenagogue, like most other plants of its class containing an acrid essential oil. It may be used in hot infusion to prevent the formation of catarrhal, rheumatic, and diarrheal affections occasioned by cold. The infusion is usually made with half an ounce of the herb in a pint of hot water, and may be given in wineglassful doses. The volatile oil upon which the virtues of horsemint depend is officinal."

In 1895 Waggaman[25] recognized the herb and states that "horsemint has been used as a carminative, nervine, and emmenagogue given in the form of an infusion."

24.)A. Stille & J. Maisch, National Dispensatory (1879), p. 927.

25.)Samuel Waggaman, A Compendium of Botanic Materia Medica (1895), p. 208.

Felter and Lloyd,[26] co-revisers of King's American Dispensatory, an Eclectic medical reference work, in 1900, write, "horsemint is stimulant, carminative, sudorific, diuretic and anti-emetic. The infusion or essence is used in flatulence, nausea and vomiting, and as a diuretic in suppression of the urine and other urinary disorders. The warm infusion is a stimulating diaphoretic, and has acquired some celebrity as an emmenagogue; it may be drank freely."

The last, and most recent reference by Wren[27] in 1923, records that "the action of Monarda punctata is stimulant, carminative and diuretic. Like all the Mint family, this drug may be serviceable as a stimulating diaphoretic in flatulence, nausea and vomiting. The warm infusion is a pleasant diuretic, and it has also a reputation as an emmenagogue."

Volatile Oil:

It is not definitely known, when, or by whom the first oil of this species was distilled, its first therapeutic use is even more obscure. Atlee[28] however, in

26.) Felter & Lloyd, King's American Dispensatory, 18th ed. (1900), p. 1275.
27.) R. C. Wren, Potter's Cyclopedia of Botanical Drugs ...(Please see bottom of following page)

1819 recommended the use of this oil to physicians, when he states, "Some time in 1810, while engaged in the drug business, a quantity of horsemint oil was brought to my store, by the original distiller, Bethuel Borton, who lives near Morristown, (N. J.) By his recommendation, I was induced to purchase some, and from its sensible qualities was persuaded that it must rank among the most powerful irritants with which I was acquainted. The smallest drop immediately diffused a pungent aromatic heat over the tongue and fauces, which remained a considerable time, and when applied to the back of the hand, excited reddness, heat pain, and vesication."

"Being desirous to submit it to the test of experiment and having a patient labouring under chronic rheumatism, I combined some of the oil with four times its proportion of spirit of wine, with which I ordered the pained limbs to be rubbed night and morning, and had the satisfaction to witness an encouraging effect."

"Sometime afterwards I was called to visit a patient in mania a potu, whom I found so furious, as to require the strength of three or four men to keep him in bed. I

Footnotes cont'd from preceding page:
27.)...(1823), p. 160.
28.) American Med. Recorder, vol. 2, (1819), p. 496.

ordered large doses of opium and calomel, and instead of a blister of cantharides to the back of the neck, which it was impossible to apply, I used undiluted oil, not only to the neck, but over the scalp, which completely vesicated the former. The result was very favorable, the patient rested well during the night, and on the following morning was perfectly sane."

"My eldest daughter had for some months been subject to a hardness of hearing, approaching nearly to deafness, and I resolved, by and with the advice and consent of my wife, to try the effect of this new medicine on her. She had gone to bed and was soundly asleep. We carefully took off her cap, and rubbed her head all over with the oil in its undiluted state."

"The poor girl awoke after ten or fifteen minutes, crying out with the burning pain occasioned by the remedy, and was with difficulty pacified: but the effect exceeded our expectations, for when she came down stairs next morning, we had the pleasure to find her hearing, perfectly restored, and it continues unimpaired from that time now nearly nine years."

"A young woman who kept house for a respectable bookbinder of this city, had for several years laboured under periodic pain of the head, resisting various means of relief. I directed for her the following liniment, the

recipe for which varied a little according to circumstances, is what I generally prescribe, where rubifacients or more powerful irritants are indicated.

℞ Ol. Monard. Punctat. ss.

Tinct. Camphor

Tinct. Opii

To be used night and morning as a liniment."

"By this application she was speedily relieved. The disease was suspended for several periods, and she tells me that when they make their onset, they are much more mild, and soon yield to the liniment.

"I have used it also with much good effect, in hemiplegia and other paralytic affections:

"During the prevalence of the epidemic typhus in our city, a few years ago, I was much pleased with its effects in the remarkable sinking state and coldness of the extremities to which the patients were subject. The arms, breasts, and legs, were bathed with this liniment, omitting the laudanum, and in a few minutes a comfortable glow succeeded.

"I have lately used it in cholera infantum, where great loss of tone in the stomach and bowels, anxiety, and prostration of strength, with cold extremities, demanded prompt measures. Bathing the abdomen and extremities with it, has by sympathy had a restorative effect and out of

four cases of this kind in which I used it, but one proved mortal.

"In my own person, I have proved its virtue as a carminative and anti-emetic, in a dose of two or three drops on sugar in a wine glassful of water."

After reviewing Atlee's recommendations it is not surprising that the volatile oil found a place in the U. S. P. of 1820. Wood and Bache[29] in 1833, indicate that the herb was admitted to its official position because of the volatile oil which it afforded. The volatile oil, as well as the herb, continued to be officially recognized in the U. S. P. until the 1880 revision, when they were deleted in favor of one of the chief constituents of the oil - thymol. In the 1890 U. S. P.[30] the term, Monarda punctata L. was used for the last time, when it was indicated as a source for thymol.

In 1822, Bigelow,[31] one of the first materia medica authors to recognize the herb, states,

"The distilled oil, according to Dr. Atlee is one of

29.) G. B. Wood and Franklin Bache, The Dispensatory of U. S. (1833), p. 434.
30.) U. S. Pharmacopoeia (1890), p. 405.
31.) J. B. Bigelow, Materia Medica (1822), p. 261.

the most powerful rubifacients."

In 1833, Wood and Bache,[32] in the first edition of their dispensatory make the following statements concerning the volatile oil of Monarda punctata L.

"This is prepared by our distillers from the fresh herb of Monarda punctata L. It has a reddish amber-colour a fragrant odor, and a warm pungent taste. Applied to the skin, it acts as a powerful rubifacient, quikkly producing heat, pain, redness, and even vesication. This property of the oil was made known to the profession by Dr. Atlee of Philadelphia, who employed it externally with advantage in the low forms of typhus fever, cholera infantum, chronic rheumatism, and other affections in which rubefacients are indicated. In ordinary cases, it should be diluted before being applied. It may be given internally as a stimulant and a carminative in the dose of 2-3 drops mixed with sugar and water."

It is of interest to note that the paragraph stated above appeared in fourteen editions, over a period of fifty years. Although, as early as 1856, Gerhardt[33] identified thymol to be the active constituent of the oil,

32.) G. B. Wood and Franklin Bache, The Dispensatory of U. S. (1833), p. 434.
33.) C. Gerhardt, Traite de Chimie organique III, p. 610.

the authors, it seems, were not aware that scientific investigation of the oil had been made. It is probable, that if a greater scientific interest had been manifested, a study of the medicinal properties of the phenol would have been made earlier, and the phenol might have found a place in the U. S. P. before 1880.

During the course of years, those who used the oil looked upon it chiefly as a rubefacient. In 1858, Kost[34] states, "The oil is a good rubefacient, and is found of great benefit to the scalp and temples in periodic headache. The dose of the oil is from 3 to 10 drops." Seven years later (1865) Hollembaek,[35] also recommends the oil for its powerful rubefacient properties, and he includes the following formula given by Luken as a stimulating embrocation for contracted sinews:

"Oil of Horsemint 2 oz, Oil of Sassafras 1½ oz., Oil of Wormwood 2 oz., Oil of turpentine 3 oz., Oil of Neatsfoot 3 oz., Gum camphor 3 oz.,"

In addition, Hollembaek,[36] also recommends the oil for

34.)K. Kost, Elements of Materia Medica & Therapeutics, (1858).
35.)H. Hollembaek, American Eclectic Materia Medica (1865), p. 257.
36.)Ibid.

"anti diuretic, anti-emetic, antiperiodic, antiseptic, carminative on sugar in a wineglassful of water, cholera infantum, flatulent cholica, deafness, diaphoretic, dropsy, embrocation, emmenagogue, epispostic, errluni, flatulence, periodic headaches, hemiplegia and other paralytic affections, intermittent fever, intestinal irritation, irritant, mania a potu, suppression of menses, nausea, nervine, local pains, rheumatism and neuralgia, chronic rheumatism stimulant with olive oil or soap liniment (equal parts) typhoid fever, vesicant, vomiting and in

In 1868, Wood[37] states, "The Volatile Oil (U. S. P. Oleum Monardae) is more used. It may be given as a stimulant and carminative in dose of 2 or 3 drops mixed with sugar and water, but it has attracted more attention as an active rubefacient. Applied to the skin, it causes redness, heat, pain, and sometimes blisters. In cases not demanding a powerful and speedy impression, it should be diluted with olive oil before application.

In 1876 Biddle[38] informs us that the essential oil is used chiefly as a rubefacient, while Stille and Maische[39]

37.) George B. Wood, Treatise of Therapeutics and Pharmacology, 3rd. ed., vol. 1, (1868), p. 345.
38.) John B. Biddle, Materia Medica (1876), p. 210.
39.) A. Stille and J. Maische, National Dispensatory (1879), p. 927.

three years later state, the smallest drop of the oil of horsemint diffuses a pungent, aromatic and persistent heat over the tongue and fauces, when applied to the skin, it excites redness and heat, and, if the application is continued, pain and vesication, too. It may be used for the same purpose as oil of peppermint, etc., but is more employed with soap, liniment or camphorated oil, as an embrocation to relieve the pain of muscular rheumatism, chronic articular rheumatism and neuralgia. It is also applied in liniments in local paralysis, flatulent colic, cholera infantum, and even in low forms of fever. For these purposes, one part of the oil to 3-4 of the excipient may be prescribed. In neuralgia, it may be applied pure. Internally the oil may be given in doses of 2 or 3 drops (Gm.06-0.20) properly diluted with sweetened water.

It is significant that after the herb and the volatile oil were deleted from the United States Pharmacopoeia of 1880, their popularity as therapeutic agents, ceased. Felter and Lloyd,[40] were perhaps the last authors to devote a paragraph to the virtues of the volatile oil, when they state, that "the oil is extremely sharp and pungent,

40.) Felter and Lloyd, King's American Dispensatory, 18th ed. (1900), p. 1275.

and applied to the skin excites heat and redness, and if too long or too closely applied, will produce a painful blister. It is used like peppermint oil internally and is employed locally in embrocations to relieve pain. The full strength oil may be used upon neuralgic parts."

Since 1900, the prominent authors[42),43),44),45),46),47),48)] of pharmacological and therapeutic textbooks have not mentioned the herb or the volatile oil of Monarda punctata L.

42.)J. C. Shoemaker, Materia Medica 4th ed. (1898).
43.)H. A. Hare, Practical Therapeutics (1898).
44.) A. A. Stevens, Modern Materia Medica (1903).
45.)Oliver T. Osborne, The Principles of Therapeutics (1922).
46.)Alfred Martinet, Clinical Therapeutics (1929).
47.)Harry Beckman, Treatment in General Practice, (1930).
48.)T. A. Sollman, A Manual of Pharmacology, 7th ed. (1934).

Material

During the months of August and September, 1928, the overground portion of the plant (Munnada fistulosa L.) were collected in the vicinity of Lake Wingra and Maple Bluff. The air dried material was separated into leaves, flower heads, and stems.

During the months of August and September 1929, the crop in the Wisconsin Pharmaceutical Garden, which had been cultivated under the direction of Prof. Richtmann was harvested. The air dried material was separated in the same manner as that obtained from the plants growing wild. This material was powdered, and the bulk totaled 100 lbs.

Extraction

(A) 50 lbs. of powdered air dried wild leaves, crop 1928, were extracted in four lots by continuous extraction in the Lloyd extractor with 95% ethyl alcohol. The alcoholic concentrate removed from the extractor was steamed distilled to recover the alcohol.

(AI) 50 lbs. of powdered air dried cultivated leaves, crop of 1929 were extracted in the same manner as above. The amount of alcoholic extract obtained from the 100 lbs. of dried leaves was approximately 5.5 kilos or 12.1% of the plant material used. The dregs were saved.

Removal of Volatile and Fatty Constituents.

(a) The alcoholic concentrate (A) was steam distilled to remove volatile constituents. The residue was shaken with petroleum ether to remove fatty oil. The aqueous liquid remaining after removal of the volatile constituents, also/those of soluble in petroleum ether, was filtered to remove water insoluble substances that had been precipitated in the course of the treatment described. The aqueous concentrate was preserved with alcohol. There thus resulted: I Volatile Oil (B), II Fatty Oil (C). Solid substances dissolved by the alcohol in the extraction process, but precipitated when the alcoholic solvent had been changed to aqueous (D).

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(C) Saponification of Fatty Material.

After evaporating the water which had collected during steam distillation approximately 850 Gms. of the fatty material were saponified with N/2 alcoholic KOH by refluxing for six hours on a water bath. The alcohol was subsequently recovered by distillation.

After cooling, the solution of potassium soaps was repeatedly extracted with ether until only a slight yellow colored solution was obtained (Extracted four times each.) This portion contained the non-saponifiable material (CI). The potassium soap, which was insoluble in ether was labelled (CII).

(CII) Separation of the Solid from the Liquid Fatty Acids.

The potassium soap was then acidulated with (1:10) hydrochloric acid. In the flask, the fatty material floated on top of the aqueous mixture, which presumably contained glycerine and potassium chloride. The fatty acids were extracted with ether, and the aqueous mixture was collected and evaporated.

The ether was removed from the fatty acids under CO_2, and the ether-free fatty acids were treated with a concentrated solution of alcoholic KOH until the solution was neutral to phenolphthalein. Then 500 cc. of a 10% solution of lead acetate were added while the mixture was being stirred. The lead soap was then filtered on a suction filter, and dried. The dried lead soap was shaken ether to remove the ether soluble portion CIIa, while the ether insoluble portion CIIb was collected.

(CIIb) Separation of Solid Fatty Acids

The ether insoluble portion of the lead soap was treated with 10% HCl (hydrochloric acid) and the lead chloride precipitatee was washed repeatedly with distilled water. The solid fatty acids were of a dark green color. These were dissolved in 95% alcohol and fractionally precipitated. Two fractions were received. In order to remove the color, the separate fractions were refluxed with N/2 alcoholic KOH for two hours and the alcohol removed by vaccum distillation. The potassium soap of the fatty acids was treated with dilute hydrochloric acid and subsequently shaken with ether. Upon evaporation of ether the fatty acid fractions were of a cream to orange red color. These were treated with benzene and animal charcoal and recrystallized from benzene. One fraction melting at 69°C. would indicate stearic acid, while the other fraction melting at 62°C. would indicate palmitic acid.

(CXIa) Liquid or Unsaturated Fatty Acids.

The ether soluble portion of the lead soap was treated with 10% HCl, the lead chloride precipitate was removed, and the ethereal solution of unsaturated fatty acids was washed repeatedly with distilled water to remove any excess of HCl. It was washed until the wash water was neutral to litmus. The ethereal solution of the unsaturated fatty acids was covered with CO_2 in a tightly closed container and placed in a refrigerator over night.

(CIIa) Bromination of the Fatty Acids and Separation of Hexabromide

A small amount of glacial acetic acid was added to the ethereal solution of the fatty acids, which was subsequently cooled in an ice bath to 5°. A solution of bromine in acetic acid (1:1) was then added until a slight excess of bromine was present. The solution was then placed in a freezing mixture of salt and ice, and allowed to stand overnight in the refrigerator. In the morning crystals of supposedly hexabromides were apparent in a very small quantity. They were separated on a suction filter, and washed with a mixture of ether and acetic acid. The bromine solution of brominated fatty acids was allowed to evaporate a little, and it was again placed in the refrigerator over night. Only a few crystals were recovered. All of the crystalline material was purified by washing with benzene, and recrystallized from absolute ethyl alcohol. The melting point of this substance was 180° - 181° which would indicate the hexabromide of a linolenic acid. A halogen determination was not made because the quantity of the hexabromides was not enough to permit it.

Separation of Tetrabromides

The ethereal solution of the brominated fatty acids which remained as the filtrate after the separation of the hexabromide was poured into distilled water, and the precipitate was filtered off, washed, and dissolved in ether, and dried with anhydrous sodium sulphate. The solvent was removed by vaccum suction, and the residue was extracted with petroleum ether. The petroleum ether extract was of an orange yellow color. This was placed in a freezing mixture of salt and ice, and allowed to remain in the refrigerator for several days. As the crystals formed they were separated, and washed with benzene and recrystallized from petroleum ether. Melting point of the substance was 113° - 114° which would indicate linolic acid tetrabromide.

Four bromine determinations by Stepanov method were made, the latter two gave a bromine content of 55%. Inasmuch as the theoretical value is approximately 53%, this would seem to indicate the presence of linolic acid.

Identification of Oleic acid dibromide

The filtrate remaining after separation of the tetrabromides was evaporated, and the residue dissolved in 90% alcohol, zinc dust was added, the mixture refluxed for 4 hours. The clear liquid was decanted, and the alcohol was distilled off. The residue was poured into distilled water. Dilute sulfuric acid (1:10) was added and the mixture was heated on a water bath for 20 minutes, and then shaken twice with ether in a separatory funnel. The ether was distilled off and the residue heated with N/2 alcohlic KOH. The alcohol was distilled off, and the residue was dissolved in water. Dilute sulfuric acid (1:10) was added and the mixture was shaken with ether. The ethereal solution of oleic acid was dehydrated with sodium sulphate, and the ether was subsequently distilled off leaving a dark reddish brown oily residue. 10 cc. of nitric acid were added to two Gms. of the oily substance. 1 Gm. of sodium nitrite was later added and the mixture was placed in the refrigerator. The solid substance which settled out was separated by filtration and purified by washing with benzene and animal charcoal. It was subsequently recrystallized from absolute alcohol. It melted at 49.5 - 50°C. which would indicate elaidic acid.

(CI) Non-Saponifiable Material.

After evaporating the ether from the solution of non-saponifiable material, there remained 376 Gms. of a reddish orange, oily wax-like substance with a characteristic odor. A small portion of the substance gave positive reactions for Hesse's and Liebermann's tests for phytosterols.

(a) The substance was then steam distilled to remove the volatile oil, CI(a) which was of a reddish orange color. After distillation the reddish color still remained. A fifty Gm. sample of the substance was treated with acetic acid anhydride. Most of it was dissolved in the acetic acid anhydride, while the rest floated on the surface. This was separated by filteration. Two fractions were obtained, the acetic acid anhydride soluble substance CI(b) and the acetic acid insoluble substance CI(c).

(CI,c) Isolation of Phytosterol.

The excess acetic anhydride from the filtrate after the separation of the hydrocarbon was distilled off, and a reddish color still remained. Portions of the remaining material was heated with absolute alcohol. It was observed that a portion of the material was insoluble in absolute alcohol. This had the appearance of a dark red oil in the bottom of the beaker, but solidified rapidly when the hot alcoholic solution was poured off. This alcohol insoluble portion was removed for later investigation. The alcohol soluble product was purified by successive washings with hot absolute alcohol, and animal charcoal was added to remove the reddish color. When allowed to evaporate slowly, wax like, white crystalline material was periodically collected by the use of a suction filter. Many fractions were collected and purified. All gave positive reactions for the Hesse and Liebermann phytosterol tests. The substance melted at 130°C. after acetylation and subsequent recrystallization from absolute alcohol and acetate melted at 118°C. These characteristics indicate a phytosterol.

The portion which was insoluble in hot absolute alcohol gave a positive reaction to both the Hesse and Liebermann phytosterol tests. It was also tested for a

glucoside (Molisch's test) because it was thought that the substance might be a phytosteralin, but the test was negative. This substance melting at 189°-190°C. was given to O. Gisvoldi who received negative results in his attempt to hydrolyse it.

(CIb) Isolation of Paraffin Hydrocarbon.

The portion insoluble in acetic acid anhydride was dried on a porous plate over sulfuric acid, then purified three successive times from benzene, absolute alcohol, and animal charcoal, and filtered thru a hot water funnel. On cooling the substance settled out as a white waxy material. Three portions were carefully recovered on a suction filter, washed with alcohol, and again dried on a porous plate in the desiccator over concentrated sulfuric acid. A small amount was tested with concentrated sulfuric acid and with concentrated nitric acid but it was not affected. It did not discolorize a 1% solution of potassium permanganate. It reacted negatively to a phytosterol test, and melted sharply at 63°C. All these characters indicate it to be a hydrocarbon. A hydrocarbon, $C_{29}H_{60}$ known as unacosane is recorded in the literature with a melting point of 63°C.

Preparation of Water Soluble Portion of the Alcoholic Extract

An aqueous solution of the water soluble portion of the alcoholic extract was treated with a saturated solution of lead acetate. The greenish yellow precipitate was separated by the use of the centrifuge. After clarification the solution was again treated with a saturated solution of lead acetate, but no further precipitation occurred. The solution was then purified by treating with hydrogen sulphide gas. The lead sulphide which was precipitated was removed by filtration.

Determination of Reducing Sugars

A sample of the purified aqueous water soluble extractive from the alcoholic extract of Monarda punctata L. was used for the determination of reducing sugars by the Defren-O'Sullivan method. Two determinations for reducing sugars were made and from the weight of the cupric oxide obtained 14.6% and 14.6% of glucose was determined as present.

Osazone Determination

A purified aqueous solution representing 7.87 Gm. of water soluble constituents of the alcohol extract was mixed with 15.6 parts of phenylhydrazine hydrochloride, 22.4 Gm. of sodium acetate and 156 c.c. of distilled water. This was filtered. The filtrate was refluxed for an hour and a half. Upon cooling the osazone precipitated off the solution in yellowish crystalline material. The crystals were filtered, washed once with cold distilled water, and dissolved in the least possible amount of 50% ethyl alcohol, and filtered while hot. A large amount of the material remained in the alcoholic solution. However, several filtrations yielded a small quantity of the osazone which gave a definite melting point of 205° corresponding to the melting point for fructosazone and glucosazone.