

THE MACCHIE OF THE NEAPOLITAN COAST REGION.

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(WITH FOUR FIGURES)

It has occurred to the writer, after some two years of observation of the xerophilous shrubs and undershrubs of the territory surrounding the bay of Naples and of the islands of Ischia and Capri, that a brief account of this peculiar flora and of its conditions of existence might interest American botanists. Most of the literature of the subject is to be found in Italian botanical periodicals, or in monographs not readily accessible to the American student, and the vegetation in question is well worthy of study, since it constitutes a series of well-defined plant societies of a pronounced, though not extraordinarily xerophytic, character.

The soils of the mainland near Naples generally consist of weathered tufa, of decomposed volcanic scoria and pumice, or of disintegrated lavas of many kinds. Much decomposed vegetable matter is often present. As a rule the soils are deep, warm, and fertile loams, though occasionally feldspathic rocks are found to have been reduced by the action of steam impregnated with sulphur dioxide to a white clay, which is rather sterile. Yellow brick clays sometimes occur.

The soils of Ischia are in general not dissimilar to those of the mainland. Capri is underlaid by a moderately pure limestone, which outcrops in many places, but is usually covered with a somewhat shallow clayey loam, derived in the main from the decomposition of the subjacent limestone.

The climate in the neighborhood of Naples is characterized by mild rainy winters, during which there are few frosts at sea level, and long, hot, and dry summers. The greatest vegetative activity is therefore found in the months from October to May inclusive, and many annual plants complete their growth and blossom at some time during the period from November to April inclusive. Areas which are tenanted mainly by annual

species or by herbaceous perennials, therefore, often present hardly any appearance of plant life during the drier months.

Outside of the many orchards and groups of walnut trees, together with occasional carefully preserved woodlands of small extent, the country is generally treeless. Thickets and considerable tracts covered with undershrubs form, however, an important feature in the physiognomy of the region, as they do of much of the Mediterranean coast, from Spain to Syria. These *macchie*, as they are called in the mainland of Italy and most of the Italian islands immediately about the bay of Naples, usually occupy small tracts of uncultivable land. These are often on steep hillsides, hilltops, or the flanks of mountains, at a height ranging from fifty to more than five hundred meters above sea level.

The plant societies of the *macchie* consist of many shrubby species, largely Leguminosae and Cistaceae. Most of the commoner species are indigenous, and a few, such as *Cistus salvifolius* L., *Daphne Gnidium* L., and *Euphorbia dendroides* L., are highly characteristic Mediterranean species.

The *macchie* of the island of Ischia consist of the following species and varieties:¹

(1) *Myrtus communis* L.; (2) *Pistacia Lentiscus* L.; (3) *Quercus Ilex* L.; (4) *Quercus pubescens* Willd.; *Phillyrea variabilis* Timb. & Lor., (5) var. *media* L. and (6) var. *angustifolia* L.; (7) *Arbutus Unedo* L.; (8) *Calycotome villosa* Link.; (9) *Cytisus triflorus* L'Her.; (10) *Cytisus monspessulanus* L.; (11) *Coronilla Emerus* L.; (12) *Spartium junceum* L.; (13) *Cistus monspeliensis* L.; (14) *C. salvifolius* L.; (15) *C. villosus* L.; (16) *Lonicera implexa* Ait.; (17) *Rosa sempervirens* L.; (18) *Erica arborea* L.; (19) *Rhamnus Alaternus* L.; (20) *Daphne Gnidium* L.; (21) *Smilax aspera* L., var. *mauritanica* Desf.; (22) *Clematis Flammula* L.

The list for the island of Capri is similar to that above given with the omission of numbers 5, 6, 10, and the addition of the following species:

Pinus halepensis Mill.; *Smilax aspera* L.; *Quercus Cerris* L.; *Q. Aegilops* L.; *Thymelaea hirsuta* Endl.; *Phillyrea variabilis* Timb. & Lor., var. *latifolia* L.; *Euphorbia dendroides* L.; *Euphorbia spinosa* L.; *Rubus*

¹Slightly modified from the list given by GUSSONE, *Enumeratio Plantarum Vascularium in Insula Inarime*, p. X. Naples, 1854.

discolor W. & N.; *Rosmarinus officinalis* L.; *Ulex europaeus* L.; *Calycotome spinosa* Link.; *Cytisus hirsutus* L.; *C. spinescens* Sieb., var. *ramosissimus* Ten.; *C. Laburnum* L.; *Colutea arborescens* L.; *Anthyllis Barba-Jovis* L.; *Ceratonia Siliqua* L.

Several of these species are also found in Ischia, but as Gussone has not included them in his enumeration of the *macchie* of that island, I have not ventured to put them in.

On the mainland, from Cape Misenum to the end of the Sorrento peninsula, the *macchie* consist mostly of some combination of the elements found in the preceding lists. A partial idea of the numerical proportions of the species which compose these plant societies may be gathered from enumerations to be given in a subsequent paper on this topic.

A typical Neapolitan *macchia* does not usually contain half of the species comprised in either of the lists above given, and may even consist of but three or four species, as is the case on the flanks of Monte Nuovo, at the base of Cape Misenum. Here the undershrubs are so scattering as to give no appearance of a thicket, and are in general less than a meter in height. The prevalent species are *Spartium junceum*, *Cistus salvifolius*, *Pistacia Lentiscus*, and *Erica arborea*. In other cases, as in Capri, at the foot of Monte Solaro, near the so-called Baths of Tiberius, from the abundance of such large shrubs as *Arbutus Unedo* and well-grown saplings of *Quercus Ilex*, much of the thicket is not less than three meters in height. It is also, in this instance, peculiarly difficult to traverse, on account of the abundance of such climbers as *Smilax aspera*, *Clematis Flammula*, and the very prickly, herbaceous, trailing *Asparagus acutifolius*.

What Drude calls *Bestände*, and Hult, Kjellman, and others call "plant formations,"² rarely occur among the Neapolitan *macchie*. Arid mountain slopes sometimes show patches of *Spartium* almost unmixed with other undershrubs, and *Cistus* of a single species sometimes covers considerable areas, to the exclusion of other woody forms, but during the wet season many herbaceous plants occur intermingled with these species.

A large proportion of the shrubs which constitute *macchie*

² WARMING, Lehrbuch der ökologischen Pflanzengeographie, zweite Auflage. Berlin. 1902, p. 9.

are evergreen, but some are winter deciduous and others are summer deciduous.

Few areas can be found in which thickets are allowed to grow undisturbed. All of the shrubs which have much fuel value are cut to the ground and used for heating ovens and even for firing limekilns or kilns of tile or coarse earthenware.

It should be kept in mind that herbaceous vegetation flourishes vigorously among the macchie, during all but the driest months. A large proportion of the 700 species of phanerogams and vascular cryptogams which occur in Capri, of the 900 or more species of Ischia, and of the 1,000 or more of the mainland immediately surrounding the bay of Naples may be found among the plant societies which constitute the macchie of the region.

In attempting to look up the literature of the subject of this paper the writer has been impressed by the apparent lack of any moderately full bibliography of the topic. Much material of the sort exists, but it does not appear to have been systematically catalogued for the Neapolitan region, as it has been for other Mediterranean territory. A large number of titles will be found in Beck von Mannagetta's "*Vegetationsverhältnisse der illyrischen Länder*," pp. 25-45. Many are also given in Wilkomm's "*Pflanzenverbreitung auf der iberischen Halbinsel*," pp. 23-27; but each of these books naturally refers mainly to the works which relate more or less directly to its own region.

The list at the close of this article, for which the author is indebted to his friend, Sig. Giovanni Ettore Mattei, librarian of the Royal Botanic Garden at Naples, contains some of the most important titles of works which will aid in the study of Italian macchie.

ENUMERATION OF PLANTS IN MEASURED AREAS.

In order to give a somewhat definite idea of the completeness with which the ground is covered in macchie of various types and of the relative abundance of different species, the author has counted the individual shrubs occurring in plots of ten meters square. The task of counting was no easy one, as in many cases each bushy clump had to be uprooted in order to ascertain

whether it consisted of more than one individual. Of course single areas of no greater extent than a hundred square meters would in no case contain all the characteristic species of the macchie of a region, but the attempt was made, in every instance, to select fairly representative plots.

The following results were obtained :

A.

Capri, on northwest slope of Monte Solard, about 350 meters above sea level.

Name.	No. of Individuals.			
<i>Spartium junceum</i> L.	-	-	-	106
<i>Cistus villosus</i> L. & <i>C. salvifolius</i> L.				603
<i>Myrtus communis</i> L.	-	-	-	15
<i>Daphne Gnidium</i> L.	-	-	-	4
<i>Pistacia Lentiscus</i> L.	-	-	-	1
<i>Erica arborea</i> L.	-	-	-	1
<i>Olea europea</i> L.	-	-	-	1
<i>Quercus pubescens</i> Willd.	-	-	-	1

The predominating shrub in this locality was the *Spartium*, leafless as seen in late summer. It occasionally reached a height of 1.5^m, with a spreading top. On the whole the macchia was scattered and open, most of the shrubs not much more than waist-high. The *Cistus* ranged from 0.2 to 0.5^m in height. At irregular intervals of fifty, one hundred, or more meters were scattered individuals of *Pinus halepensis* L. 2 to 4^m high, with thin foliage, which casts but little shade.

Although no specimens of any of them occurred in the plot just described, there are several species of undershrubs in the immediate vicinity which assume the pillow or cushion form (*Polsterpflanzen*) so common in some alpine floras. The most noticeable of these are *Cytisus spinescens ramosissimus*, *Euphorbia spinosa*, and *Satureia montana*.

B.

Capri, at foot of Monte Solaro (near stairs to Anacapri), perhaps about 130^m above sea level.

Name.	No. of Individuals.			
<i>Arbutus Unedo</i> L.	-	-	-	464
<i>Erica arborea</i> L.	-	-	-	12
<i>Quercus Ilex</i> L.	-	-	-	12
<i>Quercus Ægilops</i> L.	-	-	-	12
<i>Clematis Flammula</i> L.	-	-	-	16
<i>Smilax aspera</i> L.	-	-	-	200
<i>Coronilla Emerus</i> L.	-	-	-	812
<i>Myrtus communis</i> L.	-	-	-	124
<i>Cistus villosus</i> L. & <i>C. salvifolius</i> L.	-	-	-	24
<i>Pistacia Lentiscus</i> L.	-	-	-	44
<i>Rhamnus Alaternus</i> L.	-	-	-	12

The shrubs in this locality formed a close and rather high thicket. Its denseness was in places at least twice that of the measured area *B*. The *Arbutus* was the predominating species from its large numbers and its size, some of the shrubs being 2.4^m high. The *Q. Ilex* in places reached the height of 4^m, but in general was somewhat over 2^m high. The *Coronilla* and the *Erica* showed themselves to be decidedly shade plants, reaching their greatest dimensions and appearing most vigorous when protected by the shade of taller species, *e. g.*, the *Arbutus*.

The much greater luxuriance of vegetation in *B* than in *A* is not mainly due to the lower altitude of *B*, but rather to the richer soil and better water supply. The soil of *A* was a thin layer of clayey loam, derived mainly from the weathering of the subjacent solid limestone, while that of *B* was of similar chemical and physical character, but deeper, and underlaid by a talus of small fragments of limestone (*fig. 1*).

C.

Pozzuoli, on exterior slope of Solfatara hill, facing S.E., altitude over 120^m above sea level.

Name.	No. of Individuals.			
<i>Myrtus communis</i> L.	-	-	-	800-1200
<i>Cistus salvifolius</i> L.	-	-	-	190
<i>Calycotome villosa</i> Link.	-	-	-	143
<i>Erica arborea</i> L.	-	-	-	42
<i>Spartium junceum</i> L.	-	-	-	33
<i>Inula viscosa</i> Ait.	-	-	-	27
<i>Quercus pubescens</i> Willd.	-	-	-	13
<i>Quercus Ilex</i> L. var.	-	-	-	10
<i>Clematis Flammula</i> L.	-	-	-	1
<i>Arbutus Unedo</i> L.	-	-	-	1

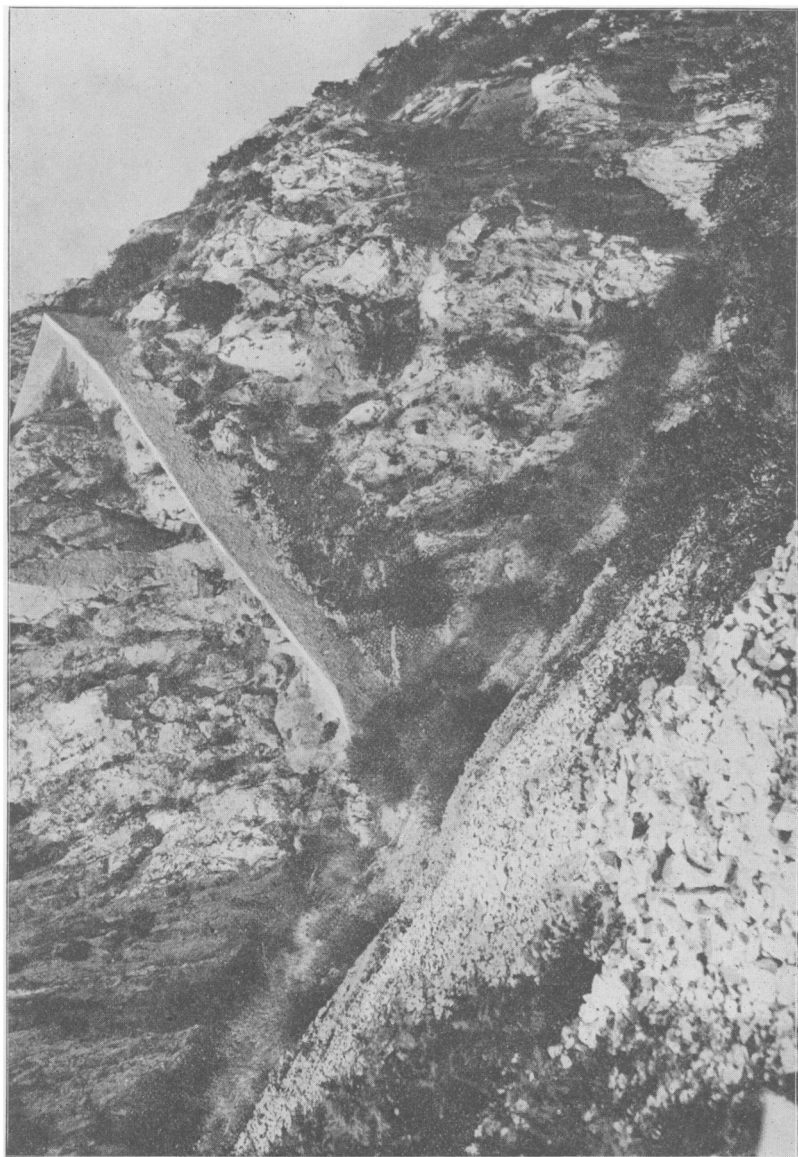


FIG. 1. — Macchia near stairs to Anacapri. Spartium formation in the center. At lower right hand, beginning of Arbutus macchia described under B.

This plot (*fig. 2*) was examined November 12, at which time the *Arbutus* and *Inula* were in blossom, the *Myrtus* and *Clematis* in fruit, and the other shrubs neither in flower nor in fruit. In numbers the *Myrtus* greatly exceeded all the other species combined, and indeed was in places so matted that it would have been impossible to count the individuals, without carefully digging up the entire mass and separating it into its factors. The number above given is therefore only an estimate. Most of the specimens were less than 50^{cm} and many only 20–30^{cm} high. The oaks were young growths from the stumps of saplings recently cut to the ground, and were therefore in no case more than 2^m high. The *Calycotome* appeared as a rapidly growing spiny shrub of 2^m or less in height, many of the specimens being seedlings of about a year old. The *Spartium* and the *Inula* each reached a maximum height of about 1.5^m; the latter a straggling undershrub, woody below, but with all the younger portions of the stems still herbaceous.

The *Inula* is not primarily a characteristic shrub of the macchie, but rather of the cliffside societies, but about Pozznoli it is a frequent companion of the shrubs in the list above given.

The soil of this locality was of volcanic origin, composed of finely divided ejecta from the crater of the Solfatara, with some of the feldspathic rocks decomposed by the action of sulfur dioxid into a white earth which is rather characteristic of the region. The mixture was porous and fairly warm, but by no means fertile.

D.

Monte Gauro, near Pozzuoli, east side of crater, west slope. Somewhat less than 200^m above sea-level.

<i>Colutea arborescens</i> L.	-	-	-	-	101
<i>Spartium junceum</i> L.	-	-	-	-	22

E.

Monte Gauro, east side of crater, east (outside) slope. About 200^m above sea level.

<i>Quercus pubescens</i> Willd.	-	-	-	-	32
<i>Spartium junceum</i> L.	-	-	-	-	22
<i>Crataegus Oxyacantha monogyna</i> Jacq.	-	-	-	-	11
<i>Rubus discolor</i> W. & N.	-	-	-	-	8
<i>Colutea arborescens</i> L.	-	-	-	-	3
<i>Clematis Flammula</i> L.	-	-	-	-	3
<i>Cistus salvifolius</i> L.	-	-	-	-	62

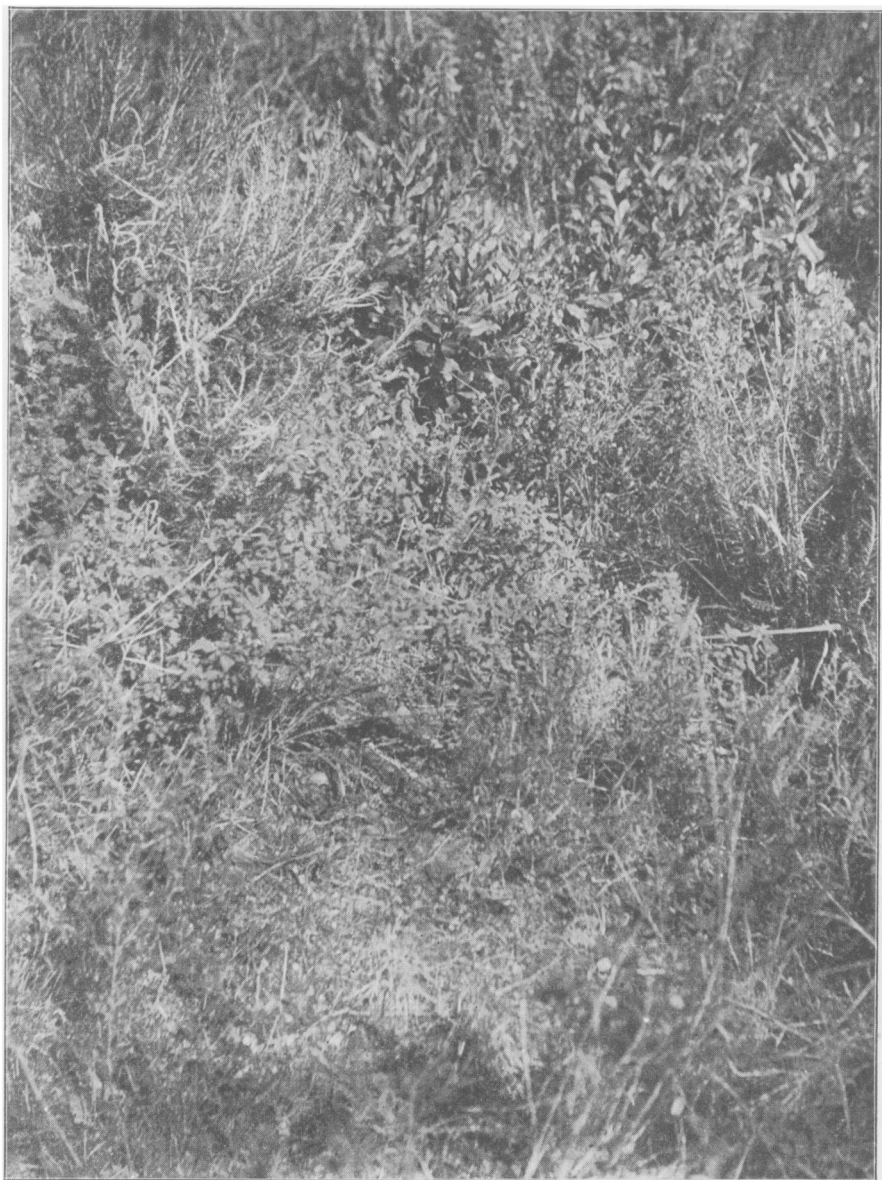


FIG. 2.—Macchia described under C, from exterior slope of Solfatara near Pozzuoli. Most of the broad leaved shrubs are *Arbutus* or *Inula*. The narrow leaved ones are *Erica*.

The soil in both *D* and *E* was a rich loam, formed of decomposed tufa, deeper in the former locality than in the latter. The plant-society of *D* is a rather exceptional one, as the *Colutea* (here sometimes 2.5^m high) is a rare or local shrub. Large

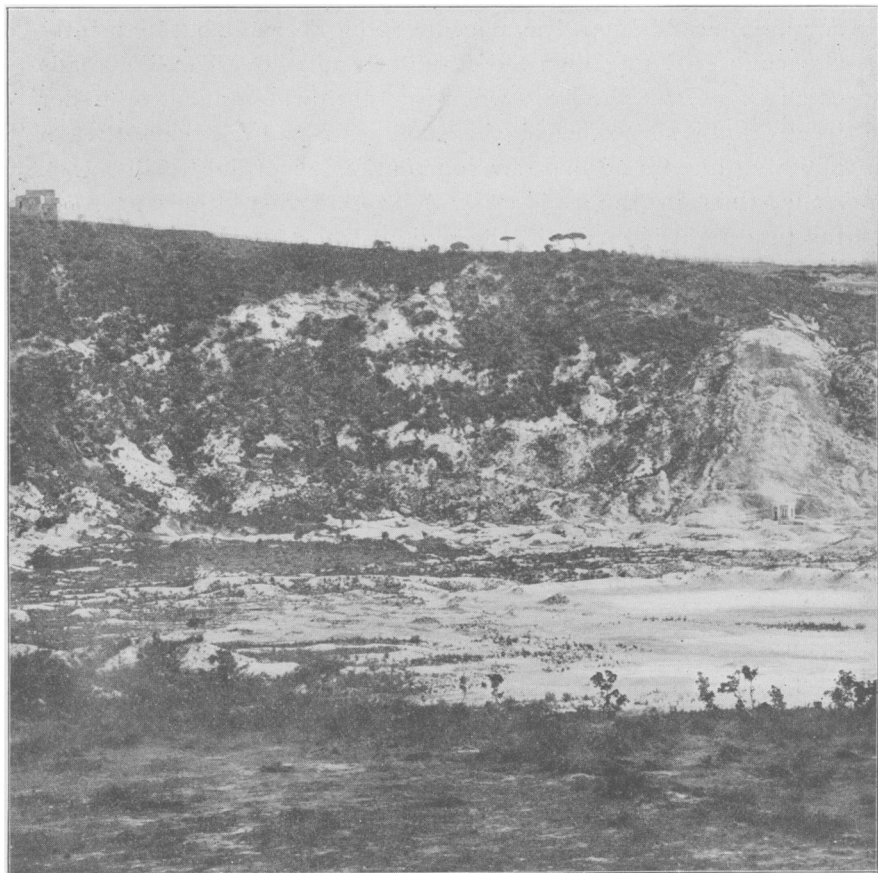


FIG. 3.—Interior of Solfatara near Pozzuoli, with macchia of *Myrtus*, *Erica* and *Calycotome* on north wall of crater.

areas on Monte Gauro are, however, occupied by it, together with a few other species. Near the locality *D* but in scantier soil and more fully exposed to the sun were formations almost wholly composed respectively of *Pistacia Lentiscus* and of *Calycotome villosa*. At a lower level, in rich deep soil, was a consid-

erable tract covered with *Castanea sativa* Mill. (young saplings), and a shrub that appeared to be *Cytisus scoparius* Link.

The society *E* presented the aspect of a very open thicket, with the oaks predominating over all the other species, as many of them were about 3.5^m high. The *Crataegus* is not a common ingredient of the macchie about Pozzuoli, but frequently is encountered singly on the edges of banks, overhanging roads or cliffs. *Cistus salvifolius* when found growing among or under trees or tall shrubs, as in the societies *B* and *E* does not reach anything like its normal development, as, according to Beck (*op. cit.*, p. 126), it cannot bloom without receiving at least 0.23 of the total light intensity of the regions where it grows.

The areas *D* and *E* were measured and counted on December 20, and it is an interesting illustration of the indefiniteness of the seasons, and the imperfectly tropophytic character of the vegetation about Naples that the *Colutea* in many cases bore at the same time dry ripened pods, new leaves, old leaves, and a few flowers, although the regular flowering season is May and June. So too the *Crataegus*, which regularly blossoms in April and May, showed on December 20, in a few instances, new leaves, old leaves, blossoms, and ripe fruit on the same branches. This in spite of the fact that the winter of 1902 has been a cold one for the region, though without frost up to the date above mentioned.

In summing up the enumerations, it may be said that *B* and *C* are the most typical Neapolitan macchie, but the others are good examples of the way in which the grouping of species varies with soil, exposure, and other circumstances.

Side by side with the flora of the Neapolitan macchie there grows another (*fig. 4*), consisting, like the former, largely of woody plants, but for the most part distinct from it. I refer to the larger plants that partially clothe most of the cliff sides and many of the older tufa walls. The principal species are:

- | | |
|--------------------------------------|---------------------------------------|
| 1. <i>Artemisia arborescens</i> L. | 8. <i>Spartium junceum</i> L. |
| 2. <i>Artemisia variabilis</i> Ten. | 9. <i>Medicago arborea</i> L. |
| 3. <i>Helichrysum rupestre</i> DC. | 10. <i>Opuntia Ficus-indica</i> Mill. |
| 4. <i>Helichrysum litoreum</i> Guss. | 11. <i>Matthiola rupestris</i> Dec. |
| 5. <i>Achillea ligustica</i> All. | 12. <i>M. incana</i> Dec. |
| 6. <i>Inula viscosa</i> Ait. | 13. <i>Satureia graeca</i> L. |
| 7. <i>Centranthus ruber</i> Dec. | 14. <i>Euphorbia dendroides</i> L. |



FIG. 4.—Flora of a nearly vertical cliffside at Pozzuoli. Suppose the cut to be divided into four equal vertical bands, numbered from left to right.

1. Top, *Olea sativa*; next, *Spartium junceum*; next, *Artemisia arborescens*; bottom, *Artemisia variabilis*.
2. Two-fifths distance from top to bottom, *Opuntia Ficus-indica* and *Matthiola incana*.
3. Top, *Pistacia Lentiscus* and *Asparagus acutifolius*; next, *Artemisia variabilis*.
4. Top, *Opuntia Ficus-indica*; next, *Artemisia variabilis*; next, *A. arborescens*; bottom, *Opuntia Ficus-indica*.

Of these plants only the *Inula*, the *Spartium*, and the *Euphorbia* are of common occurrence in the macchie. Generally speaking, all the species mentioned are much more xerophytic than their neighbors on more level ground. The Compositae (nos. 1-6) are all aromatic with essential oil; nos. 1, 3, and 4 are densely sericeous or tomentose, and nos. 3 and 4 have strongly revolute leaves, the margins almost meeting; no. 2 has fleshy, linear leaf segments, and no. 6 has pubescent varnished leaves. Of the remaining species, the *Spartium* and the *Euphorbia* are discussed in a later paragraph, the *Opuntia* (an introduced plant) is one of the most succulent of the genus, the *Medicago* has small pubescent leaves, and the *Matthiolas* are hoary pubescent.

(*To be concluded.*)