DITTRICHIA GREUTER – GENUS

Order: Asterales Link

Family: *Asteraceae* Bercht. & J.Presl

The genus *Dittrichia* Greuter (1973) belongs to the family Asteraceae and includes only two species: *Dittrichia viscosa* (L.) Greuter, native to the Mediterranean basin and Macaronesia, and *Dittrichia graveolens* (L.) Greuter, whose native range extends from the Mediterranean basin to Western Himalaya [POWO].

D. viscosa has four subspecies. Apart from the nominal subspecies (*Dittrichia viscosa* subsp. *viscosa*), native to Macaronesia and the Western Mediterranean areas (Albania, Algeria, Azores, Baleares, Bulgaria, Canary Islands, Corse, East Aegean Islands, Egypt, France, Greece, Italy – included its main islands, Sicily and Sardinia – Libya, Madeira, Morocco, Portugal, Spain, Tunisia, ex-Yugoslavia), the following infraspecific taxa are recognized [POWO]:

- *Dittrichia viscosa* subsp. *angustifolia* (Bég.) Greuter (syn.: *Dittrichia orientalis* Brullo & De Marco, *Inula viscosa* var. *angustifolia* Bég.), native to the East Mediterranean areas (Cyprus, East Aegean Islands, Egypt, Greece, Crete, Lebanon-Syria, Libya, Palestine, Sinai, Turkey);
- *Dittrichia viscosa* subsp. *maritima* (Brullo & De Marco) Greuter (syn.: *Dittrichia maritima* Brullo & De Marco), localized on a very short coastal stretch of SW Portugal;
- *Dittrichia viscosa* subsp. *revoluta* (Hoffmanns. & Link) P.Silva & Tutin (syn.: *Dittrichia revoluta* (Hoffmanns. & Link) Brullo & De Marco, *Inula prostrata* Rothm., *Inula revoluta* Hoffmanns. & Link, *Pulicaria revoluta* (Hoffmanns. & Link) Nyman), exclusive of SW Portugal, where it occurs mainly in the coastal zones.

Also, hybrids between two subspecies frequently occurs in the respective contact zones.

Dittrichia *in botanical history*

Finding in the writings of ancient and Renaissance authors clear references to the species currently belonging to the *Dittrichia* genus is a rather complex operation because, as highlighted by Michele Tenore in his memoir "*Dell'erba Baccara degli Antichi*" [Tenore], they fall into a group of plants in some way historically connected to the plants *Baccara* of Dioscorides and Virgil and *Conyza* of Dioscorides and Theophrastus, and with respect to which botanists, over the centuries, have caused a lot of confusion.

Michele Tenore (1780-1861) states that Dioscorides' *Baccara* is *Inula odora* L. (currently *Pulicaria odora* (L.) Rchb) and Dioscorides' *Conyza major* is *Inula viscosa* L. (now *Dittrichia viscosa*

(L.) Greuter), but many botanists, especially his predecessors, have provided very different opinions regarding the identification of these plants[1]. [Tenore, Tenore2]

For example, Pietro Andrea Mattioli (1501-1577) matches the *Conyza major* of Dioscorides to *Pentanema squarrosum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort., as it can be easily noticed looking at the image sketched in his herbarium and at the Italian (*pulicaria*) and foreign (German: *Geele muntz*, *Durruurtz*[2]; Spanish: *attadegua*; French: *herba aux puces*[3]) names attributed to the plant, all pointing to *Pentanema squarrosum*[4] (see also [Tenore, Tenore2]).

John Gerard (1545-1612), despite explicitly stating to follow Mattioli and de l'Obel (Lobelius) as well as Dodoens, in his paragraph about *Conyza major*, rather than referring to *Pentanema squarrosum* (as Mattioli does), in fact he deals with *Dittrichia viscosa*, as can be noticed from the description of the plant ("*hard, woody, ...*", "*The whole plant is fatty and glutinous, with a strong, not yet altogether unpleasant smell*"[5] [Gerard]) and from the image (bearing peripheral flowers with well-developed ligules) depicted in his "*The Herball*"[6]. [Gerard]

Castore Durante complicates the matter even more. According to what appears from the images and descriptions contained in his "*Herbario nuovo*", he calls:

- *Conyza major* the present-day *Pentanema squarrosum*;
- *Conyza minor* (probably) the present-day *Dittrichia viscosa*[7];
- *third kind of Conyza* presumably the present-day *Pulicaria dysenterica*;
- *Conyza minima* (*Conyza minima vera*) a plant whose picture is identical to that of Gerard's *Conyza minor vera* (*Dittrichia gravolens*), but about which he states that "*mostly has a single, smooth stem, a cubit and a half tall, with rare leaves, smaller than those of Toad-flax*"[8]. [Durante]

While on the one hand the identification of the *Baccara* of Dioscorides and Virgil is still a debated question, on the other hand contemporary authors generally agree with Tenore in identifying the *Κόνυζα* (*Conyza major*) of Dioscorides and the *Conyza mas* of Theophrastus with *Dittrichia viscosa* (see, for example, [Caruel, Stokes, Targioni Tozzetti] and also Caspard Bauhin, "*Pynax Theatri Botanici*", as reported in [Tenore]).

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1 In fact, to date, while the identity of Dioscorides' *Conyza major* seems now certain, not all botanists agree with Tenore's opinion on the identity of *Baccara* (see below).

2 For *Geele Müntz* and *Dürr-Wurtz* respectively.

3 For *herb aux puces*.

4 In Mattioli's book, the plant called *Conyza minor* is the present-day *Pulicaria vulgaris* Gaertn., while *Conyza media* is the present-day *Pulicaria dysenterica* (L.) Bernh. (see also [Tenore2]).

5 *Pentanema squarrosa* is not woody, does not have sticky ("*glutinous*") leaves, nor does the whole plant emanates a strong smell. In fact, only the flowers, which have a rather slight odor, and the roots are scented. The roots give off a rather intense smell that recalls a mixture of camphor and turpentine, with a vague hint of cinnamon when they are fresh. *Dittrichia viscosa*, on the other hand, is entirely viscous and all its parts are strongly smelling.

6 Gerard's *Conyza minima* is *Dittrichia graveolens* (L.) Greuter, as it appears from the description of the plant ("*it is diuided into little branches, and also rough and glutinous as the precedent, but more greene. The leaues are three times lesse than those of the former, somewhat shaped like those of Toad-flax, yet hairy and vnctious. […] The root is single and annuall, and the whole plant more smelling than the former*"). About it, the author writes: "*This is iudged the* Conyza fœmina *of* Theophrastus*; and* Con. minor *of* Dioscorides*: it is the* Con. minor *of* Gesner*,* Lobelius*,* Clusius *and others.*" [Gerard]

7 Both for the figure in the herbarium which clearly shows flowers with well-developed ligules and for the description ("*Conyza minor has leaves [...] which, when chopped, stick to the fingers*" [Durante]).

8 An ambiguous description which seems to correspond only partially to Gerard's *Conyza minor vera*, i.e. *Dittrichia graveolens*. In fact, for example, the stem of *D. graveolens* is not smooth but rather glandular-viscous.

Below are reported, for some of the plants historically connected in some way to *Conyza major*, the correspondences of the present-day botanical names with some of the names attributed, over the centuries, by different authors (see [Boerhaave, Caruel, Gerard, Salmon, Stokes, Targioni Tozzetti, Tenore, Tenore2]):

Present-day botanical name	***Synonyms and common names***
Dittrichia viscosa (L.) Greuter	*Conyza major* (Dioscorides (*Κόνυζα*), Dodoens, Clusius, Gerard) *Conyza mas* (Theophrastus) *Erigeron viscosum* L. (basionym for *Dittrichia viscosa*) *Inula viscosa* (L.) Aiton *Cupularia viscosa* (L.) Godr. & Gren. Ita.: *Enula cepittoni*, *Inula vischiosa*, *Ceppica*; Eng.: *False Yellowhead*, *Woody Fleabane*; Spa.: *Olivarda*
Dittrichia graveolens (L.) Greuter	*Conyza fœmina* (Theophrastus) *Conyza minor* (Dioscorides) *Conyza minor vera* (Gerard) *Erigeron graveolens* L. (basionimo per *Dittrichia graveolens*) Ita.: *Enula cespita*, *Inula fetida*, *Bistorno*; Eng.: *Stinkwort*
Pulicaria vulgaris Gaertn.	*Conyza minima* (Dodoens, Moris, Gerard) *Conyza minor* (Mattioli) *Conyza minima* (Gerard) *Inula pulicaria* L. Ita.: *Incensaria fetida*, *Pulicaria fetida*; Eng.: *Small fleabane*
Pulicaria dysenterica (L.) Bernh.	*Conyza media* (Mattioli, Dodoens, Fuchs, Moris, Gerard) *Inula dysenterica* L. (basionym for *Pulicaria dysenterica*) Ita.: *Incensaria comune*, *Pulicaria dissenterica*; Eng.: *Fleabane*, *Meadow False Fleabane*
Pulicaria odora (L.) Rchb.	*Baccara* (Dioscorides (*Βαχχαρισ*), secondo [Tenore]) *Inula odora* L. (basionym for *Pulicaria odora*)

	Ita.: *Incensaria odorosa*, *Pulicaria odorosa*; End.: *Mediterranean fleabane*
Pentanema squarrosum (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort.	*Baccharis monspeliensium* (Clusius, Lobelius, Gesner) *Conyza major* (Mattioli, Lobelius, (excl. Lobel. Adv.), Tabernaemontanus) *Conyza major vulgaris* (Bauhin) *Conyza mayor altera* (Dodoens) *Conyza pynax* (C. Bauhin) *Conyza squarrosa* L. (basionym for *Pentanema squarrosum*) *Inula conyza* DC. Ita.: *Enula baccherina*, *Inula coniza*; Ger.: *Dürrwurz*; Eng.: *Ploughman's spikenard*, *Baccharis*; Fra.: *Herbe aux puces*

And, reorganizing:

Historical name	***Present-day botanical name***	***Authors***
Conyza major	*Dittrichia viscosa* (L.) Greuter	Dioscorides (*Conyza major*, *Conyza major vera*, *Κόνυζα*) Dodoens, Clusius, Gerard Bauhin (*Conyza major monspeliensis odorata*)
	Pentanema squarrosum (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort.	Mattioli, Lobelius, (excl. Lobel. Adv.), Tabernaemontanus Bauhin (*Conyza major vulgaris*) Dodoens (*Conyza major altera)*
Conyza media	*Pulicaria dysenterica* (L.) Bernh.	Mattioli, Dodoens, Fuchs, Moris, Gerard
Conyza minor	*Dittrichia graveolens* (L.) Greuter	Dioscorides Gerard (*Conyza minor vera*)
	Pulicaria vulgaris Gaertn.	Mattioli
Conyza minima	*Pulicaria vulgaris* Gaertn.	Dodoens, Moris, Gerard

What has been stated so far implies that if we intend, for example, to refer to Mattioli's herbarium we have to bear in mind that the paragraph on *Conyza major* contains information related to two distinct plants: the first part of the paragraph, being a quotation from *Dioscorides*, deals with *Dittrichia viscosa* (L.) Greuter, while the subsequent part, written by the Tuscan author, contains information that is probably related to both *Dittrichia viscosa* and *Pentanema squarrosum*. Below is the part of the text reported from Dioscorides:

"*Conyza is of two species. The smaller is more odoriferous, and the larger is a taller plant, and has broader fronds, and a stronger odor. The fronds of both are similar to those of olive trees, hairy, fat. The stem of the larger one grows to the height of two cubits, and that of the smaller one adds to a foot. The flower is fragile, yellow, and slightly bitter, which splits into volatile flakes, its roots are useless. The entire plant repels the Snakes, that is, scattered on the ground and equally fomented, it repels the Mosquitoes, and kills the Fleas. The fronds are conveniently plastered on snake bites, on boils and wounds. The flowers and leaves are drunk with wine to induce the menses and childbirth, and similarly for the strangury, overflow of gall, and pain in the bowels: when drunk with vinegar they help with falling sickness. The decoction placed in the baths, which are made to sit in, cures the defects of the matrix. The juice applied makes women abort. The herb is efficaciously anointed with oil in case of cold, and tremors. Lightly anointed, the lesser cures headaches. There is a third species, which produces a thicker and more tender stem, and the leaves larger than the minor: not fat, and smaller than the larger one: but with a much stronger and less cheerful smell, although not so valiant. It is found in damp places.*" (see [Mattioli])

Presumably, it is also correct to assign also the description of *Conyza major* made by Galen (and reported by Mattioli) to *Dittrichia viscosa*, rather than to *Pentanema squarrosum*: "*Conyza major, and minor, similar in faculty and temperament, appear bitter and sharp to the taste. They apparently warms by plastering the fronds with their twigs (because it is a bushy plant) on any member of the body, or by applying the oil in which they have been cooked; because it is seen that this oil heals periodic and circular tremors, and also the cold. Their flowers also have similar virtues, and therefore there are some who give them crushed together with the branches to drink in wine to strongly provoke menstruation and childbirth. There is a third species, which is found in damp and watery places, with a stronger odor and a lesser virtue than the others. But the first ones already discussed heat and dry in the third degree.*" (see [Mattioli])

John Gerard in Chapter 131 "*Of Fleabane*" of Book 2 of his "*The Herball*" describes ten species of *Conyza*, including *Conyza major* (*Dittrichia viscosa*), *Conyza minor vera* (*Dittrichia graveolens*), *Conyza media* (*Pulicaria dysenterica*) and *Conyza minima* (*Pulicaria vulgaris*). Although he distinguishes them from a morphological and botanical point of view, he reports the same properties for all:

*"*The Temperature.

Conyza is hot and dry in the third degree.

The Vertues.

The leaues and floures be good against the strangurie, the jaundice, and the gnawing or griping of the belly.

The same taken with Vinegar help the Epilepsie or falling sicknesse.

If women sit ouer the decoction thereof it greatly easeth their paines of the Mother.

The herb burned where flies, gnats, fleas, or any venomous things are, doth driue them away." [Gerard]

Obviously, it is rather difficult for these ten plants to actually share the same properties. Rather, Gerard's description is at least partially comparable with that of *Dioscorides* about his *Conyza major* (*Dittrichia viscosa*).

Castore Durante writes for *Conyza major*:

"*QUALITIES. It heats, & dries in the third order, & is bitter, & sharp.*

VIRTUES. Inside. The flowers and leaves are drunk to induce menstruation, and childbirth, and similarly to the strangury, the overflow of gall, and the pains of the bowels; & drunk with vinegar they help against falling sickness; & its decoction made in wine helps with the oppilation of the liver. This herb kills the goats, which eat it.

VIRTUE. Outside. The whole plant repels the snakes when scattered on the ground, and equally fomented, it also repels mosquitoes and kills fleas: its smoke drives away snakes and snails: the fronds plastered draw out the poison of snake bites and purges, & heal all sorts of wounds, applied to the forehead they help the frenzy: pounded & applied to the soles of the feet they stop the fluxes: The decoction placed in the baths, which are made to sit in, cures the defects of the mother. The herb is efficaciously anointed in case of cold, & in the trembling of fevers. The herb placed on wheat preserves it for a long time, & defends it from moths." [Durante]

Castore Durante also states that the properties of the other kinds of *Conyza* he describes are more or less similar to those of *Conyza major*, adding that *Conyza minor* and *Conyza of the third kind* are mainly useful in case of dysentery, being drunk "*powdered in red, & austere wine*" [Durante].

DITTRICHIA VISCOSA (L.) GREUTER

Primary functionality:

Secondary functionality:

Nature:	hot and dry in the third degree
Taste:	aromatic, pungent/acrid, bitter, slightly astringent and slightly saline (leaves)
Tropism:	skin, mucous membranes, pelvis and uterus, urinary system, gastrointestinal system and afferent organs
Humoral actions[9]:	increases yellow bile, resolves stagnation of tension, phlegm, blood and melancholy, supports correct tension, eliminates "toxic" damp heat; it moves particularly downwards
Clinical actions:	abortifacient, analgesic, anthelmintic, anti-anemic, anti-bacterial, anti-diabetic, antifungal, anti-hypertensive, anti-inflammatory, antimalarial, antimycotic, anti-parasitic (nematodes), antiphlogistic, antipyretic, antiseptic, antispasmodic, anti-ulcerogenic, anti-viral, astringent, balsamic, blood cleanser, cicatrizing, digestive, diuretic, emmenagogue, expectorant, febrifuge, fungicidal, general fortifier, general tonic,

9 See the "*Notes on humors*" paragraph.

	hypoglycemic, insecticide, muscle relaxant, nematicidal, reconstituant, tonic, vermifuge, vulnerary
Used parts:	leaves, aerial parts (either flowering or non-flowering), roots

Description

Dittrichia viscosa has been used in medicine since ancient times, so much so that Dioscorides and Galen already mentioned its properties. The use of this plant continues in some traditional medicines, especially in the Middle East and some African countries (e.g. Morocco). In some regions it has been considered one of the most effective medicinal plants for centuries.

According to Rivkah Asoulin, "*called 'the cure for 40 ailments' by the Arabs, it is almost easier to list what Inula viscosa is not used for.*" [Asoulin]

This notwithstanding, it is now quite forgotten as a medicinal plant, at least in the Western Mediterranean countries. Indeed, very few modern herb books mention this plant.

In Spain, the plant has been used as a tobacco substitute and is part of a whole group of plants known as "arnica", which obviously also includes *Arnica montana*. [Obón, Palacin]

This association already suggests that *D. viscosa* has anti-traumatic properties. In fact, the plant is mainly known, in all traditions, for its effectiveness in the treatment of wounds and trauma (bruises, hematomas, sprains) in both humans and animals [Obón, Palacin].

The plant, in fact, has hemostatic, cicatrizing and antiseptic properties which make it an all-round vulnerary. In case of wounds, even when open and bleeding, the leaves (fresh and bruised; cooked; dried and reduced to powder, possibly plastered with oil), the decoction of the flowering or non-flowering aerial parts, or the macerate obtained by infusing (traditionally for a month) the flowers in oil can be applied to the affected part. In all these cases, the plant acts as a vulnerary and antiseptic, promoting the correct healing of damaged tissues and preventing the appearance of infections. [Aleo, Dioscorides, Palacin, Parolin, Qasem, Salhi]

D. viscosa also has antiparasitic (nematodes and helminths) [Abbas, Al-Dissi, Asoulin, Darias, Parolin, Talebi], antifungal [Askarne, Asoulin, Cohen, Mahmoudi, Mrid, Parolin, Rhimi, Talebi, Wang], antiviral [Parolin] and antibacterial activities [Parolin, Mahmoudi, Mrid, Qasem, Rhimi, Talebi].

Its powerful anti-fungal properties make *D. viscosa* useful also in the treatment of plant fungal disease, like citrus fruit blue mold, downy mildew of grapes, and foliar diseases induced by pathogens from Oomycetes, Ascomycetes, and Basidiomycetes families. [Askarne, Cohen, Talebi, Wang]

In Moroccan Traditional Medicine, *D. viscosa* is also used as an expectorant, a diuretic, an anti-anemic, and its decoctions are employed to treat hypertension and diabetes mellitus. [Talebi]

The whole plant is a powerful emmenagogue and for this reason it is used to "*strongly induce menses, and childbirth*" (Galen, as reported in [Mattioli]). Indeed, it has also important abortive properties [Al-Dissi, Dafni, Dioscorides, Parolin, Talebi] which manifest even just by putting the juice in contact with the vagina [Dioscorides], inserting the leaves into the anus or practicing steam baths with an infusion of the leaves [Dafni]. Anti-implantation, mid-term abortifacient, and luteolytic activities have been experimentally demonstrated [Al-Dissi].

The oil macerate made by cooking the leaves in olive oil is used topically to treat hemorrhoids and various gastrointestinal disease. This oil makes a great aromatic salve that can also be placed over the lungs, on the chest or back, to combat upper respiratory infections of all sorts and to strengthen the heart and cardiovascular system. [Asoulin]

According to Bashar Saad, the roots are used against cough and catarrh, as an antiseptic and expectorant, which loosens phlegm and supports mucus membranes. [Saad]

It keeps fleas at bay: fresh leaves can be made into a tea or vinegar and sprayed on animals, or made into a bath; powdered leaves can be sprinkled on animals or added to a dust bath. [Asoulin]

According to Khadija Laghrifi, the fresh and dried flowers are frequently used in traditional Mediterranean cuisine as an additive. They have a bitter, astringent taste, which complements a wide variety of foods. They are extensively used in cooking, and a distinct mustard smell gives off while they are burned, therefore, they are often used to flavor foods while barbecuing. [Laghrifi]

In rare cases, the fresh plant, tincture or oil preparations can cause sudden allergic reactions. Powdered leaves are significantly less allergenic. [Asoulin]

Composition

Several studies have been carried on *D. viscosa* composition and the plant has been found to contain flavonoids, among which rhamnocitrin, methylaromadendrin and hispidulin (a benzodiazepine receptor ligand which possesses antifungal, anti-inflammatory, antimutagenic, antineoplastic, anti-osteoporotic, anxiolytic and pro-cognitive, liver protective properties, an estrogen-like activity and an antiepileptic profile), phenolics (mainly chlorogenic acid and caffeoylquinic acids), several aliphatic (farnesol and nerolidol derivatives), eudesmane (α-costic, β-costic, isocostic and ilic acids and derivatives), germacranolide (tayunin), guaianolide and secoguaiane (tomentosin) sesquiterpenes, sesquiterpene lactones (inuviscolide and the already mentioned tomentosin), a digalactosyl-diacylglycerol (inugalactolipid A, that showed notable effects in a murine-chronic-dermatitis model), and an essential oil. [Abrham, Ceccherelli, Dor, Gökbulut, Grauso, Kavvadias, Máñez, Patel]

The composition of the essential oil appears to be quite variable according to the provenance of the plant. For example, the main component appears to be:

- an oxygenated carboxylated bicyclic sesquiterpene (12-carboxyeudesma-3,11(13)-diene or α-costic acid) when the oil is extracted from plants harvested in Apulia (Italy);
- the monoterpene alcohol borneol when the plants come from Turkey; or
- the allylic tertiary alcohol fokienol when the plants come from Spain (see, for instance [De Laurentis, Madani, Pérez-Alonso]).

D. viscosa is rich in epicuticular flavonoids, and more than 20 flavonoid aglycone structures were found in foliar exudates, including some flavanones. The flavonoids' spectral profile shows maxima in the harmful UV-B (280-320 nm) region, with a peak at 290 nm [Parolin].

A high-boiling fraction of seven azulenes, two of them identified as 1,4-dimethyl-azulene (about 50%) and chamazulene (32%), has been identified [Lauro].

Dittrichia viscosa *in agrosystems*

The plant can be a useful reservoir of aphid parasitoids. Its flowers are infested by *Myopites stylata*, which causes gall formation and whose larvae are parasitized by the generalist parasitoid *Eupelmus urozonus* associated with *D. viscosa*, and which overwinters in the larvae of *M. stylata* on *D. viscosa*. Since *E. urozonus* is also one of the main parasitoids associated with the olive fruit-fly (*Bactrocera oleae*), this parasitic complex is very valuable to control this pest of the olive crop. [Parolin]

D. viscosa also exerts an allelopathic effect. The seasonal peak in the concentration of the active material occurs exactly in the period when most Mediterranean plants germinate, when the autumn rains set in and the allelopathic substances are washed into the soil. Leaf epicuticular substances were shown to be strong allelopathy agents for N_2-fixing soil cyanobacteria, decreasing dramatically the photosynthetic assimilation of CO_2 and increasing the heterocyst-to-vegetative cell ratio and most likely the assimilation of N_2 of the cyanobacteria. [Parolin]

D. viscosa strongly inhibits spore germination and mycelial growth in a variety of hystopathogenic fungi. Downy mildew of grapes was controlled by extracts of *D. viscosa*. The phytotoxic effect is differential and tissue specific with concentrations in the following decreasing order: leaf > flower > stem > root. The fungistatic activity of the plant extract increases with plant age, while high temperatures drastically reduce the antifungal effects of *D. viscosa*. Disease control efficacy of leaf extracts was similar from material collected from May to October, suggesting that, for practical use, harvests can be conducted during most of the growing season. Dried leaves of *D. viscosa* stored at room temperature for one year or for 4 years produced an extract as effective as that from newly harvested dried leaves. [Cohen, Parolin]

D. viscosa may also act as insectary plant, which attracts and possibly maintains, with its nectar and pollen resources, a population of insects which are natural enemies of plant parasites, therefore playing an important role in the conservation and/or increase of predator populations in agro-ecosystems. For example, it can be a useful reservoir of aphid parasitoids, phytoseiid mites, predators like *Eupelmus urozonus*, or the mirid predator *Macrolophus caliginosus*, just to name a few. [Parolin]

Dittrichia viscosa *as a bioaccumulator*

D. viscosa has a high ability to grow on soils with high nickel, magnesium, or arsenic concentrations and was proposed as bioindicator plant of these elements in the soil. Moreover, it has a high potential as a bioaccumulator. On contaminated mine-tailing soils in Sardinia, the leaves of *D. viscosa* contained the highest concentrations of trace elements. It displayed very high metal concentrations in aboveground biomass (average metal contents were Zn: 1680 mg/kg, Pb: 420 mg/kg, Cd: 28 mg/kg). In a Mediterranean salt marsh polluted by mining wastes it had the highest metal and arsenic concentrations out of 21 plant species analysed (~270 mg/kg Pb, ~640mg/kg Zn, ~23 mg/kg As). *D. viscosa* showed a high transfer factor – i.e. the ratio of heavy metal concentrations in shoots to that in roots, a good index of translocation in a plant – for all the studied elements and plant species. [Parolin]

Properties

Temperature and taste

Hot and dry in the third degree (*D. viscosa* e *D. graveolens*; Galen, as reported in [Mattioli]).

The leaves have an aromatic, pungent/acrid, bitter, slightly astringent and slightly salty taste.

Signature

N/A

Tissue Phases

N/A

Actions and indications

Humoral actions

Being a hot plant, it has the ability to significantly increase the heat of the organism as a whole or of its districts, to set fluids in motion and unblock/support organic activities. It therefore resolves tension stagnation and supplements the correct tension (antispasmodic, antihypertensive, healing) and, moreover, resolves "oppilations" (stranguria, urination prevented by the presence of stones, cholestasis, amenorrhea/dysmenorrhea, hemorrhoids). It has the ability to "strongly move the blood" in the pelvic region, thus stimulating menstruation and childbirth (to the point of also inducing abortion). Being dry in the 3rd degree, it is able to resolve conditions characterized by dampness: in particular, it is suitable for resolving hot and damp conditions (fermentations, putrefactions).

Tropism

Skin, mucous membranes, pelvis and uterus, urinary system, gastrointestinal system and afferent organs.

Clinical actions

Abortifacient, analgesic, anthelmintic, anti-anemic, anti-bacterial, anti-diabetic, antifungal, anti-hypertensive, anti-inflammatory, antimalarial, antimycotic, anti-parasitic (nematodes), antiphlogistic, antipyretic, antiseptic, antispasmodic, anti-ulcerogenic, anti-viral, astringent, balsamic, blood cleanser, cicatrizing, digestive, diuretic, emmenagogue, expectorant, febrifuge, fungicidal, general fortifier, general tonic, hypoglycemic, insecticide, muscle relaxant, nematicidal, reconstituant, tonic, vermifuge, vulnerary.

Principal actions:

- *Abortifacient* (both internal and external use) [Al-Dissi, Dafni, Dioscorides, Parolin, Talebi]:

- Anti-implantation, mid-term abortifacient, luteolytic. [Al-Dissi]
- Use: steam bath (woman sits above the steam of a leaf infusion, 3 days after copulation); ground leaves applied through anus. [Dafni]
- Liter.: "*The juice applied causes women to abort*" [Dioscorides]

- Analgesic. [Obón, Side Larbi]
- Anthelmintic. [Abbas, Al-Dissi, Asoulin, Talebi]
- Anti-anemic. [Al-Dissi, Talebi]
- *Anti-bacterial*, microbial inhibitor. [Parolin, Mahmoudi, Mrid, Qasem, Rhimi, Talebi]
- *Antidiabetic*, hypoglycemic. [Abbas, Allali, Asoulin, Parolin, Qasem, Talebi, Yaniv, Zeggwagh]
- Anti-hypertensive [Asoulin, Kattouf, Qasem, Talebi]:
  - the aqueous extract of *D. viscosa* leaves has a dose-dependent negative inotropic effect. [Kattouf]
- Antiparasitic (nematodes), nematicidal [Parolin, Talebi]:
  - Against *Meloidogyne javanica*, *Heterorhabditis bacteriophora*. [Talebi]
- Antiphlogistic, anti-inflammatory. [Abrham, Al-Dissi, Parolin, Saad]
- Antimalarial. [Quer]
- *Antimycotic* [Askarne, Asoulin, Cohen, Mahmoudi, Mrid, Parolin, Rhimi, Talebi, Wang]:
  - Against *Penicillium italicum*, *Plasmopara viticola*, and other Oomycetes, Ascomycetes, and Basidiomycetes (mostly acetone and/or hexane extracts). [Askarne, Cohen, Parolin, Talebi, Wang]
- Antipyretic, febrifuge [Abbas, Al-Dissi, Darias, Obón, Parolin, Qasem, Saad]:
  - Used part: flowering tops (Canary Islands). [Darias]
- Antiseptic [Abbas, Al-Dissi, Martelli, Parolin, Saad]; (roots) [Saad].
- Antispasmodic. [Abbas]
- Anti-ulcerogenic. [Parolin]
- Anti-viral. [Parolin]
- Astringent. [Quer]
- Balsamic. [Parolin]
- Blood cleanser. [Asoulin]
- Digestive. [Obón]
- Diuretic. [Abbas, Al-Dissi, Talebi]
- ***Emmenagogue*** (strong, flowers and aerial parts) [Dioscorides]:
  - Liter.: "*The flowers and fronds are drunk with wine to cause menstruation and childbirth*". [Dioscorides]

    - Liter.: "*Their flowers also have similar virtues, and therefore there are some who give them crushed together with the branches in wine to drink to strongly provoke menstruation and childbirth.*" (Galen reported in[Mattioli])
- Expectorant [Al-Dissi, Qasem, Saad, Talebi]; (roots) [Saad].
- Hemostatic. [Bar-Shalom]
- Insecticide. [Obón]
- Muscle relaxant [Abbas, Qasem, Saad, Said]; (leaves) [Saad]:
    - 200 g plant material is boiled for 5 min in 5 l water and the decoction is used as steam bath or added to regular bath. [Said]
- Tonic [Qasem], general tonic [Abbas, Dafni], general fortifier [Asoulin], reconstituant (root; Morocco) [Bellakhdar2].
- Vermifuge. [Abbas, Al-Dissi, Asoulin, Darias, Talebi]
- ***Vulnerary***, cicatrizing. [Dafni, Dioscorides, Martelli, Palacin, Quer, Saad, Salhi]

Specific indications

Mind

- N/A

Systemic

- Cancer [Abbas, Asoulin, Jaradat, Talib]:
    - Kidney and bladder cancer. [Jaradat]
    - Particularly for the colon. [Asoulin]
    - Traditional remedy for cancer. [Talib]
    - Confirmed experimentally (mainly *in vitro*). [Bar-Shalom, Brahmi-Chendouh, Doudach, Merghoub, Merghoub2, Messaoudi, Mrid, Rechek, Talebi, Talib, Talib2, Toros]
- Infections [Asoulin, Martelli, Parolin, Qasem, Saad]:
    - Bacterial and viral infections of all kinds. [Asoulin]
    - able to act as:
        - an anti-bacterial or microbial inhibitor [Parolin, Mahmoudi, Mrid, Qasem, Rhimi, Talebi]
        - an antimycotic [Askarne, Asoulin, Cohen, Mahmoudi, Mrid, Parolin, Rhimi, Talebi, Wang]
        - an anti-viral [Parolin]
        - a (general) antiseptic. [Abbas, Al-Dissi, Martelli, Parolin, Saad]
- Fever. [Abbas, Al-Dissi, Darias, Obón, Parolin, Qasem, Saad]

- Malaria. [Quer]

Central nervous system

- Epilepsy (flowers and aerial parts) [Dioscorides]:
  - Liter.: "*[the flowers and fronds] drunk with Vinegar help the falling disease*" [Dioscorides]

Head

- Headache. [Qasem]

Eyes

- Eye infection. [Qasem]
- Eye sore. [Obón]

Mouth

- Toothache and oral hygiene (inflorescence decoction, for gargle; steam inhalation of vapors form leaves boiled in water). [Dafni]

Respiratory system

- Catarrh, as an expectorant [Al-Dissi, Qasem, Saad, Talebi]; (roots) [Saad]
- Respiratory infections [Al-Dissi, Asoulin, Qasem], respiratory troubles [Obón]:
  - Upper respiratory infections (external use; oil macerate made by cooking the leaves in olive oil, placed over the lungs on the chest or back). [Asoulin]
  - Lung infections and conditions (dried leaves added to smoking blends). [Asoulin]
  - Bronchitis. [Al-Dissi, Qasem]
  - Pneumonia. [Obón]
  - Tuberculosis. [Al-Dissi]
- Cough [Abbas, Saad]:
  - Chronic cough. [Abbas]
  - Used parts: root. [Saad]

Cardiovascular system and blood

- Cardiovascular complaints. [Asoulin]
- High blood pressure. [Asoulin, Kattouf, Qasem, Talebi]
- To strengthen the heart and cardiovascular system (external use; oil macerate made from cooking the leaves in oil, usually olive, placed over the lungs on the chest or back). [Asoulin]
- Anemia. [Al-Dissi, Talebi]

Gastrointestinal system

- Gastrointestinal disorders [Asoulin, Dioscorides, Obón, Parolin], gastroduodenal disorders [Al-Dissi] (mainly as an antispasmodic):
  - Bowel pain ("*gut pains*"; flowers and aerial parts). [Dioscorides]
  - Bowels ache in animals. [Obón]
  - Stomachache [Obón, Saad]; (leaves) [Saad].
  - Use: external use; oil macerate made from cooking the leaves in olive oil, placed over the lungs on the chest or back. [Asoulin]
- Hemorrhoids (external use; oil macerate made from cooking the leaves in olive oil). [Asoulin, Obón, Qasem]
- Intestinal worms [Abbas, Al-Dissi, Asoulin, Darias, Talebi]:
  - Used parts: powdered leaves added to livestock feed, also as part of a larger formula; also as a preventative. [Asoulin]
  - Used parts: flowering tops (Canary Islands). [Darias]

Metabolism

- *Diabetes* (decoction of leaves or whole plant) [Abbas, Al-Dissi, Allali, Asoulin, Obón, Qasem, Talebi, Yaniv, Zeggwagh]; diabetes mellitus [Talebi]:
  - Moroccan traditional method: 1 g of powdered whole plant mixed with 100 ml water are boiled for 10 min, cooled for 15 min, and filtered. [Zeggwagh]

Liver and gallbladder

- Cholestasis, jaundice (flowers and aerial parts). [Dioscorides]
  - Liter.: "*The flowers are drunk, and the leaves [... for the] overflow of gall*" [Dioscorides]

Urinary system

- Urinary tract diseases [Palacin, Quer], Kidney pain [Obón]:
  - "Mal de riñón"[10] (external use; infusion of leaves and flowers). [Palacin]
- Kidney stones. [Qasem]
- Strangury (flowers and aerial parts). [Dioscorides]
  - Liter.: "*The flowers are drunk, and the fronds [...] for urine distillation*" [Dioscorides]

Sexual organs

- Infertility [Qasem, Said]:
  - Use: 200 g plant material is boiled for 5 min in 5 l water and the decoction is used as steam bath or added to regular bath. [Said]
- *Amenorrhea, dysmenorrhea*. [Dioscorides, Mattioli]
- **Abortion** (induce, both by internal and external use). [Al-Dissi, Dafni, Dioscorides, Parolin, Talebi]

Musculoskeletal system

- Rheumatism, rheumatic pain (external use, for humans and animals: decoction of the flowering aerial parts, oil macerate of flowers, hot poultice of the cooked plant, decoction of roots and leaves, steam bath with the hot decoction of the leaves). [Al-Dissi, Dafni, Obón, Palacin, Salhi, Talebi]
- Muscle ache (as a muscle relaxant). [Abbas, Qasem, Said]
- Bone fractures [Dafni, Qasem]:
  - Liter.: "*'to soften bones' (lamb fat cooked with leaves is applied on bone before second breaking, place of injury is softened with Inula vapors).*" [Dafni]
- Local paralysis [Dafni, Qasem]:
  - Oil extracted boiling leaves, applied directly; steam bath, together with leaves of *Salvia fruticosa*. [Dafni]
- Arthritis. [Qasem]

Skin

- ***Wounds***, open and bleeding wounds (external use, for humans and animals: poultice with fresh leaves, leaf powder, poultice of leaf powder mixed with oil, hot poultice with the

10 Liter.: "kidney pain". An expression that indicates either a generic kidney disease or, more specifically (especially in South America), urinary insufficiency.

cooked plant[11], decoction of the flowering aerial parts or stems, oil macerate of flowers) [Aleo, Dafni, Dioscorides, Martelli, Obón, Palacin, Parolin, Qasem, Quer, Saad, Salhi]:

  - Liter.: "*more effective than Achillea millefolium for animals. It is an excellent hemostatic, stopping bleeding, gaping and pussy wounds in their tracks in animals even faster than in humans.*" [Asoulin]

- *Bruises* [Obón, Palacin, Parolin, Quer]:
  - (external use, for humans and animals: decoction of the flowering aerial parts, oil macerate of flowers, hot poultice with the cooked plant). [Obón, Palacin, Parolin, Quer]
  - Liter.: "*to strengthen weakened or swollen parts following a fall*" (internal use; decoction). [Quer]
- Hematoma. [Obón]
- Sprains. [Obón]
- *Skin diseases* [Dioscorides, Obón, Parolin], skin irritations [Saad], *skin infections* (fungal and viral) [Asoulin]:
  - Boils (external use, poultice with leaves). [Dioscorides]
  - Chronic dermatitis. [Parolin]
  - Eczema. [Obón]
  - Erysipelas. [Obón]
  - Stubborn fungal infections (alone or as part of a formulation, both topically and internally). [Asoulin]
  - Fungal and viral skin infections (such as warts; powdered leaves both alone and in formulation; with near miraculous success). [Asoulin]
  - Warts on foot (stuffed leaves in shoe; foot covered with leaf juice; leaves steam-bath). [Dafni]
  - Scabies (roots cooked in wine; ointment made from roots and leaves). [Quer]
  - Hard skin on foot (stuffed leaves in shoe; foot covered with leaf juice; leaves steam-bath). [Dafni]
  - Painful corns. [Obón]
- Burns (external use; fresh or dried powdered leaves or dried leaves powder mixed with oil). [Obón, Qasem]
- Excessive sweating [Asoulin]:
  - Liter.: "*a few leaves in the shoes to combat sweaty feet or sweatiness in other areas of the body, using the feet as the roots to 'uptake' the medicinal properties of the plant and distribute them throughout the body to where they are most needed; a leaf could be placed in other sweaty areas, or dried, powdered leaves could be used as a deodorant.*" [Asoulin]
- Snake bites (external use, poultice with leaves). [Dioscorides]

11 Presumably not recommended in case of bleeding wounds.

Parts used and their collection

All parts of the plant can be used therapeutically: leaves, aerial parts (either flowering or non-flowering), roots. It is important to avoid ingesting the pappus because it can damage the gastrointestinal mucosa (see "*Contraindications and collateral effects*").

Preparation and dosage

The plant can be used fresh or dried for the preparation of herbal teas or decoctions, or fresh for the preparation of the tincture and oil macerate.

Contraindications and collateral effects

Very few studies about *D. viscosa* toxicity have been carried out, but all of them have shown the plant as devoid of any significant toxicity, both in acute and in (sub)chronic administration tests.

In an acute toxicity study, a methanolic extract (obtained from dried and pulverized plants) and the essential oil (obtained by hydrodistillation) from *D. viscosa* plant material collected in Algeria were administered to rats at doses of 300, 600, 1000, 1500, 2000, 2500 mg/kg of methanolic extract and doses of 0.3, 0.5, 1, 1.5, 2, 3 ml/kg of essential oil by orogastric route. The treated groups were observed for three hours following administration, and up to 14 days. The study found an LD_{50} higher than 2500 mg/Kg for the methanolic extracts and higher than 3ml/kg for essential oils. [Side Larbi]

In another study designed to find acute and sub-chronic toxicity of *D. viscosa*, the n-hexane and methanolic extracts of leaves and flowers (obtained from samples collected in Algeria, dried, pulverized and extracted with the solvents in a Soxhlet apparatus) were orally administered to Swiss albinos mice as single doses of 400 mg/kg and 800 mg/kg (acute toxicity) and as daily doses of 400 mg/kg et 800 mg/kg to Wistar rats over 28 days (sub-chronic toxicity). The results obtained in the acute toxicity study show that none of the doses caused death in the treated mice. The study of sub-chronic toxicity revealed a slightly significant change in the biochemical balance (a decrease of AST in groups of rats treated with methanolic extract of leaves at the dose of 800mg/Kg, and an increase of urea in groups of rats treated with methanolic extract of flowers at the dose of 800mg/Kg, when compared to control group). No significant changes were observed in the hematological balance. The organs studied have also remained intact. So, the study showed no acute toxicity or sub-chronic toxicity at the doses studied. [Ouahchia]

An acetone extract of *D. viscosa* administered intraperitoneally to mature male rats for 60 days has produced no significant deleterious effects. A one-generation fertility study performed to detect teratogenic effects of this plant has produced no statistically significant difference in sperm count, sperm morphology, total serum testosterone level, or number and weight of newborns. No gross morphological defects were observed in newborns of treated and control groups. A histological study demonstrated normal spermatogenesis. In addition, a normal architecture of prostate, liver and kidney was observed. However, some morphological alterations were detected in seminal vesicles (the height of mucosal folds in seminal vesicles were shorter in the *D. viscosa*-treated groups). Furthermore, liver and kidney tests were normal. This study reported no toxic effects of *D. viscosa* extract in male rats. [Abbas]

Bashar Saad reports, for leaves, an LD_{50} value of 11.9 g/kg weight, but no reference is given for this. [Saad]

In a single study, the authors conclude that, when applied in high doses, *D. viscosa* crude leaf extract shows cytotoxic and genotoxic activity on *Allium cepa* root meristem cells, suggesting that, although *D. viscosa* has beneficial effects as a medicinal herb, it can cause serious problems and damage on cells when used improperly. [Çelik]

In literature, some cases are reported of contact dermatitis both from contact with the fresh plant and with its extracts [Asoulin, Gonçalo, Pinedo, Sertoli]. Powdering the leaves significantly lessens the probability of occurrence of such events and makes the herb less irritating [Asoulin].

The plant is sometimes reported as "known to be toxic to stock". This also applies to *D. graveolens* and for exactly the same reason. Serious losses have indeed been attributed to *D. graveolens*, not because of any toxin, but rather because of the mechanical damage produced by seed heads and pappus bristles penetrating the gastric and intestinal mucosa of the animals. This damage may cause enteritis and predispose to enterotoxaemia. The animal may die of pulpy kidney disease. Death may be sudden. [Parsons, Philbey]

Contact dermatitis, tainting of milk and meat and exacerbation of carbon tetrachloride toxicity[12] have been attributed to exposure to *D. graveolens*. [Philbey, Setchell]

Being traditionally considered abortive, the use of the plant, its parts or its derivatives is absolutely contraindicated during pregnancy, both by ingestion and by direct application on the mucous membranes of the vagina and anus, and for baths, sitz baths or fumigations of the vagina and perineum (vaginal steaming).

Homeopathy

There are no known in homeopathic trials of the plant.

NOTES

Notes on humors

According to the Hippocratic-Galenic medicine, four humors rule the human body:

- *Bile* (or *Yellow Bile*), corresponding to the Fire element, responsible for all the caloric activities of the human body, both in a physiological sense (e.g., body heat) and in a pathological sense (fever, inflammation, etc.);
- *Blood*, corresponding to the Air element and to the physical blood;
- *Phlegm* (also called *Pituita* or *Lymph*), corresponding to the Water element, responsible for everything that is fluid in the body (body fluids, lymph, blood plasma, synovial fluid, cerebrospinal fluid, etc.)[13];

12 Carbon tetrachloride, a strongly hepatotoxic substance, was once administered to sheep in small doses as an anthelmintic. In [Setchell], the loss of three sheep is reported, due to co-administration of *D. graveolens* and carbon tetrachloride, but the conditions of the experiment are rather poorly clear.

- *Melancholia* (also called *Black Bile*), corresponding to the Earth element, responsible for everything that is hard and structured (bones, teeth, but also growths, polyps, stones, tumors, etc.).

Heat and body fluids are governed by Yellow Bile and Phlegm respectively. When there are no further specifications, the terms "heat" and "fluids" can be used, in this text, to indicate the corresponding humor.

The functioning of the whole body is governed by the mixing (*crasia*) of such humors: if the ratio between the humors is proper (we speak of *eucrasia*), the body functions at its best and the health is guaranteed; if they are blended improperly (we speak of *discrasia*), illness results.

A humor is defined *correct* when both its "quantity" and its "quality" are proper; when it prevails over the others, generating dyscrasia, it is said that it is *superabundant*, and when its quality is not appropriate it is said that it is *corrupt*. We say in general that a humor is *perverse* when it is overabundant or corrupt. In this text, in order to facilitate comparisons between different systems of medicine, we resort to an extension with respect to the classical conception and define a humor as "perverse":

- when its "quantity" is not optimal, that is, it is excessive (superabundant humor) or deficient (deficient humor) with respect to the condition of eucrasia (the classical theory allows only excess; deficiency is due to the prevalence of another humor with opposite qualities), or
- when its "quality" is different from the physiologically appropriate one (corrupt humor)[14].

An excess of heat in the body can overheat and "cook" the humors, altering their characteristics. Phlegm thickens and becomes more viscous, giving rise to the so-called *thickened Phlegm*. If the excess heat is important or lasts for a long time, all humors can end up "burning" (in this case we call them *adust humors*). When burned, humors always produce Melancholia. Unani-Tibb medicine provides four types of perverse melancholia produced by the combustion of humors: *malankholia damvi*, produced by the combustion of Blood; *malankholia safravi*, produced by the combustion of Yellow Bile; *malankholia balghami*, produced by the combustion of Phlegm (generally due to fermentation) and *malankholia saudawi*, produced by the combustion of "correct" Melancholia.

Phlegm is cold in the first degree and damp in the second and is a mobile and flowing humor. When coldness becomes excessive, however, the Phlegm can thicken and become viscous (cold indeed makes viscous), producing once again *thickened Phlegm*.

Phlegm itself, when it accumulates and stagnates for any reason (for example due to a lack of heat or an excess of Tension, see below), generates, by "compression", secondary heat that can condense the humor and make it viscous.

Furthermore, in nature stagnant dampness favors fermentation and putrefactive processes, especially when there is concomitant heat. Also in the human body an accumulation or stagnation of Phlegm may cause the onset of fermentation or putrefaction (phenomena that today's

13 In this sense, it is conceptually different from the *Phlegm* of Chinese medicine, which corresponds specifically to the *thickened Phlegm* of humoral medicine when it is located in the upper part of the organism.

14 Melancholia, for example, can be in excess with respect to the physiological condition of eucrasia (generating excessive structures) or in deficit (generating deficient constructions), but it can also be generated by the combustion of humors by heat (see below); in the latter case, it is always perverse (therefore it is perverse in quality rather than in quantity). In classical humoral medicine these three conditions are usually not so sharply distinguished from each other.

medicine generically indicates as *infections*), which are certainly supported by the natural heat of the body and by any secondary heat generated by compression of the Phlegm. Moreover, the fermentation and putrefaction generate further secondary heat[15]. All these phenomena are characterized by the coexistence of perverse dampness and heat, even if, to be more precise, they should be described as due to the presence of pathological dampness associated with a certain degree of perverse heat (it is therefore more correct to think of them as due to "heated" humidity rather than moist heat). From a clinical point of view, the disorders characterized by this humoral picture include the phenomena known as *putrefaction*[16] which are manifested by the emission or collection of purulent material, often even hardened (e.g., abscesses)[17].

The conditions described so far (thickened phlegm, adust humors, putrefaction) are perverse not due to an incorrect quantity of the humors, but because of their "bad" quality.

Tension

In this text, for the exclusive purpose of simplifying any comparisons between different systems of medicine (for example, Chinese and humoral), we add the pseudo-humor *Tension*[18], which is responsible for the "functionality" of the whole body or its parts (e.g., the organs). In this sense, it corresponds to the *Qi* of Chinese medicine but also to other concepts, such as that of the *Four Virtues* (attractive, retentive, alterative and expulsive) of organs according to Galen (see for example [Giannelli]) and it can also be related to the *vasoconstriction* and *vasorelaxation* conditions of Physiomedicalism and to Matthew Wood's *Constriction* and *Relaxation* tissue states [Wood].

Tension, defined as a *pseudo*-humor because it is not contemplated by the classical humoral theory, can be thought of as formally derived from Fire to which a sort of "constraint", "limitation", or "obstacle" has been applied. Like Fire, in fact, it is a form of "energy", mobile in itself and activating; but whereas Fire tends to move only upwards and centrifugally, thus expanding indefinitely, the movement of Tension is more "structured" and so to speak "oriented" towards specific, defined forms and modalities. We can therefore see it as a kind of Fire to which a structuration (element of "terrestrial" nature) has been applied.

We can resort to an image taken from everyday life as an example. If we pour water on the fire, the latter goes out and the water disperses or evaporates. If we place a hard (i.e., cold and dry) element above the fire (for example, a terracotta or metal container) which prevents the water to directly "mix" with the fire, we are able to let the water heat up without dispersing, and to use it warm for specific purposes (for example, to cook food). By applying a cold and dry "obstacle" (the container) to the fire, we "functionalize" the heat that otherwise would disperse or make the water disperse or evaporate.

Tension can therefore be described, in a humoral sense, as derived from a sort of "functionalization" of Fire by a factor (a principle rather than a material cause) of a cold and dry

15 The fermentation and putrefaction processes are generally exothermic or generate a "hot" response from the human body.

16 Corresponding to the *toxic heat* of Chinese medicine. This condition also includes diseases characterized by macular or maculopapular eruptions (e.g., exanthematous diseases).

17 The conditions known as *Dampness/Heat* in Chinese medicine (which include, for example, problems often related to the urinary tract or gallbladder, some cases of jaundice, etc.) also fall within this picture.

18 Name borrowed from Matthew Wood's tissue states model [Wood].

nature. For this reason Tension is hot and dry, with a lower degree of heat than Fire (because of the cooling due to functionalization).

Even Tension can be correct or perverse and, in the latter case, it can be perverse both in quantity (excess or deficit of Tension) and in quality (think for example of the *Qi ni*, or *counterflow Qi*, of Chinese medicine). Given the correspondence, described above, of Tension with Qi, the various manifestations of perverse Tension will typically have a more or less specific correspondence in Chinese medicine (for example, "Tension deficiency" corresponds to "Qi deficiency"). In general, Tension imbalances correspond to Qi imbalances and/or to "Wind" (intended as a pathogenic manifestation).

An imbalance in Tension can also affect other humors, potentially making them perverse. For example, an excess or a stasis (stagnation) of Tension can prevent the body fluids from being moved correctly, generating stagnation of Phlegm and/or Blood; Tension stagnation can generate "compression" which in turn can produce heat (Chinese medicine speaks, for example, of "implosion of stagnant Qi" which generates Fire, understood here not as the element but as a specific manifestation of heat).

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