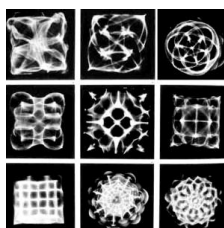


## VARIATIONS IN THE FREEDOM OF NATURE

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*(In collaboration with Massimo Mercati and Aboca herbal products in Italy)*



### Introduction

Though herbs have been used since antiquity for healing and prevention of sickness, scientific discoveries in the 19<sup>th</sup> century supplanted the traditional remedy with what was considered a superior knowledge of pharmaceutical agency. A herb was then reduced from its chemical diversity to an active principle that could be isolated and synthesised as a chemical drug. The testing of a reproducible effect at the micro level supplanted the need to consider the working of the herb at a macro level.

In this paper, we move beyond a strict underlying analytical order and will encounter the herb in its essential wholeness, embracing once again the living aspect of the herb and its qualities. As the typical properties of a complex system are in strong relation with the number of components of the system, variation is considered a measure of the quality of living health granted by the herb. This approach is used to interpret results from metabolomic fingerprinting, characterizing the fluidity of the micro-level composition of the herb, and to explore its macro-scale signature by principal component analysis.

### Micro and macro

The question addressed here: 'is there such a thing as the whole herb that defies description into its parts?' What is it about the internal structure of the herb that allows us to identify its taste, recognise its smell and trust in its particular healing properties? There are three approaches one might use to explore the whole character of the herbal phytocomplex, here defined as the total constituents of the living herb.

A molecular approach might separate the different parts to highlight their connection in relationship. This research inquiry, full of its own terms for entities, processes and interactions, relates, through an exquisitely conceived logic, to another piece of research equally delicately conceived about a proximate collection of functions. A layman is astonished that this logic, which is a perfect exposition of the necessary connection to allow both systems their small but required place, occurs in a minute context with no sense of the whole that will be realised through their interaction.

A holistic perspective on the other hand might begin with the whole qualities and work down into the manner of operation. A treatise on the herb interprets areas of function simply for their contribution to inform the whole encounter, be it in taste, smell, healing, as if the character of the whole determines identifiable parts in their proper place. The logic of the research is paradoxically hidden as if behind a veil in the clarity of qualitative response and the surety of the world it makes visible.

Finally it is the task of complexity theory to investigate the dynamic between molecular and holistic approaches. The micro-level is seen as an active potential, which influences and is influenced by the macro-existence. The potential at the micro-level, instead of committing itself to a fixed order, realises qualities at the macro-level that characterise the whole herb dynamically according to context.

### Information

Mathematical theory explores the world at the boundary between the potential at one level of existence and the properties of bounded though unpredictable order that occur at a higher level.

Information differentiates an object from its surrounds by separating a property when one asks the right question of it. A redundancy of possibilities at the micro-level is interrogated to reveal properties of the macro-existence. The more freedom in the micro-layer, the more questions we can ask to differentiate which way a potential is constructed to arrive at the whole.

The point about information is that it describes a quality or property of an object by making use of a redundancy of description at a micro level compared to the macro-level existence. A quality is present to the whole existence only due to an excess of possibilities at the micro-level, which can code for that information.

A quality slips in, through the discrepancy between two layers of description of phenomena. If there was only the micro-layer, a taste would have no significance, but be an arbitrary side-product, like heat dissipation. If there were only the macro-layer then there would be only a sameness in all circumstances without differentiation. It is in having both, that the property realised by one potential path at the micro-level is identified with the common whole experience at the macro-level.

Thus we have an example of how information stands between the scientific arena of the small and the holistic domain of large principle as an intermediary notion.

We can follow this journey from the micro to the macro in complexity theory. In complexity theory too, it is possible to generate computer models which track the development of associated variables to the whole emergent forms they realise. Again one finds that a simple prescription of interacting variables have attractors that limit and organise the phenomena at a higher level.

The original and most famous exploration is the Lorenz attractor that defines the micro-level through the variables (such as temperature) that characterise a simple atmospheric model. The variables are joined by equations depicting their interaction. Computer simulation then gives a visualisation of the three-dimensional macro-attractor regulating how the qualities of micro-variation play out. Again if there was only the micro-level there would be no constancy in weather pattern for life to evolve; if there was only the macro-level there would be no variation; it is in the interplay that the dynamic is born where coherent qualities of climate are recognisable and utilisable by life.

The interweaving of potential and form has a rhythm, which defines an adaptive relation to order. The characterising, fractal, self-repeating pattern is not limited to a pre-existing order, be it space or time. In life, quality is rather something, which defines the order of the micro and the macro-level by characterising potential in some defining act of distinction of the whole existence. Quality embodies the pattern bridging potential and order.

Life typifies itself by the enormous latent potential for different behaviour to emerge according to context. Unlike a table that is committed to a certain order and requires great energy input to become anything else, a plant has latent potential which has many different combinatorial possibilities for realisation. Yet the herb in its fruit and flower demonstrates an aesthetic and effective unity far surpassing any object designed on ordered principles. Where does this coherence come from, if we look beyond a template of order fixed in its genes?

One has to enter into the dimension of the herb to appreciate the completing quality of order out of potential. As the dynamic relation between potential and order reveals itself as pattern when confined to static linear dimensions of space and time, so the herb appears in its qualities when viewed in the intensive dimension of its own completion.

Any analysis of the herb in terms of space and time comes after the herb has defined order for itself through the qualities that mediate with the unordered potential.

Pharmaceuticals have taken the body further and further into order, as if there lies the taming of something unruly, while the healing of the herb in its natural qualities, exists in the tune of the body's own flexibility.

### **Herbal Complexity**

This relationship between micro and macro level existence is illustrated in the production of herbal remedies. The micro-level redundancy of possibilities relates directly to the abundant mix of compounds, the folding of surfaces to align potentials together, the effect of genetic variations, the contextual stimuli, the amount of sunlight to give energy, the availability of minerals in the soil, the competition on resources etc. The herb will

still be recognisable through its qualities of appearance, taste, smell and healing traits at a macro level whatever its particular variation of composition at the micro-level.

There is a choice to be made, whether the pharmaceutical compound is more reliable because it has eliminated redundancy, or whether the multiple possibilities in the herb contribute to its qualities.

The processing of the living herb to make an extract will necessarily diminish the compound richness. Any kind of handling/processing changes and reduces the original complexity of the herb. One assumes that a range exists in which such a reduction in complexity is acceptable, while if the loss in complexity falls below this, the result may be to lose information on which the higher qualities are dependent.

Although one cannot play back the unfolding of emergence, as this occurs outside the frame of repeatability, one can inquire into what are the necessary starting conditions for emergent qualities to emerge.

We can show this diagrammatically as follows:

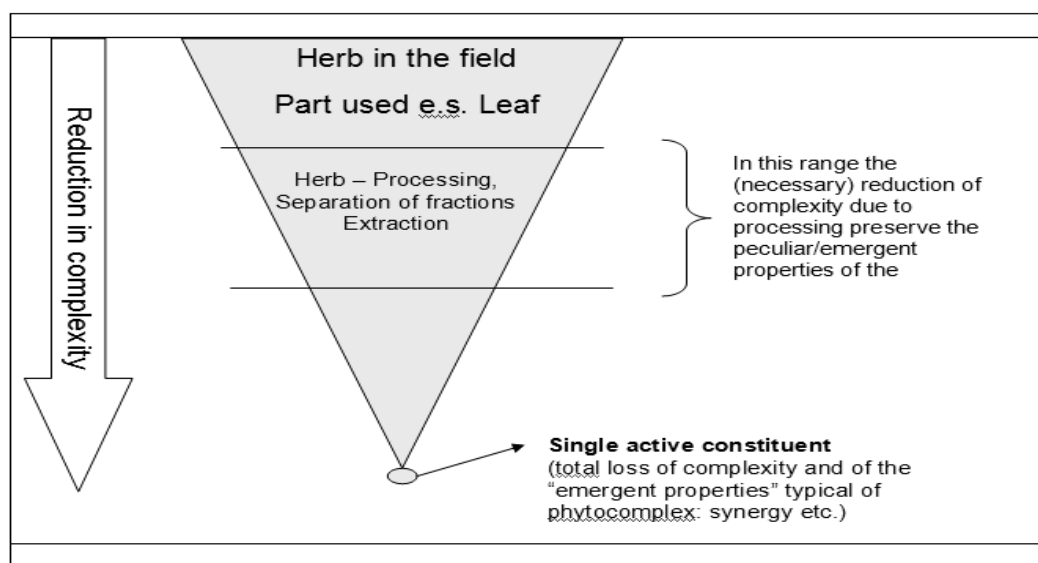


Figure 1 The typical properties of a complex system are in strong relation with the number of components of the system. While a certain diminution of components is tolerated, when the level drops below a certain threshold, the complexity falls away.

### Implication of variability

Using mass spectrometry, L. Mattoli et al analysed the constitution of plants through metabolomic fingerprinting. The abundance and classes of component molecules were recorded for a variety of samples of several different plant types. The herb sample's composition was then classified as a point in a three-dimensional plot using principal component analysis. ('PCA is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called *principal components*, which are linear combinations of the original variables. ('The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for the remaining variability.')

As the iron filings shows the presence of the magnetic field, so the clustering of samples of a particular herb indicate the presence of a morphogenetic attractor, arising out of the complexity of the herb potential. We interpret the clustering of sample constituents about a herb-type as the influence on the different samples of an intangible source of herbal quality.

If we delimit the common spread of samples about a herb-type norm within a box, then *the breadth of the sides of the box measuring relational difference expresses indirectly the depth of quality of the whole herb.*

The greater the diversity of possible sample constitutions to which the herbal quality gives coherence, the stronger the attractor that influences them. The more variation in the herbal compositions, then the stronger is the qualitative attractor of the herbal source. The herb samples express a characteristic quality, despite their differences in compositional make-up.

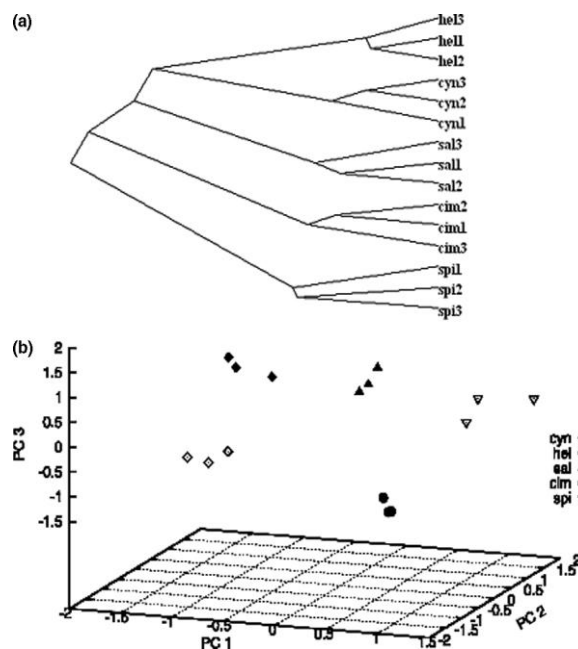


Figure 2 The characterising of the herb on a three dimensional plot demonstrates the balance between variation in potential and the influence of the herbal quality.

Cluster analysis (a) resolution of sample variability is true to herb type; principal component analysis (b) of the negative ions characterises a selective consistency for each of the five considered species:

cyn = artichoke; hel = everlasting;

sal = sage; cim = black cohosh; spi = meadowsweet.

The possibilities at a lower level of the system stays indeterminate and a quality appears at a higher level that encompasses all the potential in what exists below it. As soon as we try to focus upon the question of the parts to determine how the quality arose we lose the insight that every route to the whole is encompassed in the higher quality. If we look down from the higher quality (of the taste of a herb) then it is impossible to extract how the wholeness originates, it bestows a feeling of floating over the world of causes from which it originates.

## Conclusion

Our approach shows how *variation* in the samples allows for the quality of the *whole* herb to manifest. This contrasts with the usual direction in science, where an initial *sameness*, a picture of molecular interactions, accounts for the herb in all its potency through the application of laws that account for *diversity*.

When we try to limit the potentialities to any exact mechanically functioning entity we have a flat picture without informational depth. While allowing variation, the study finds that there is a clear window of identity for each herb. An area/box in the three-dimensional graphical plot of principal component analysis encloses all the variants within a limit of deviation for each herb. The spectra of compounds in different batches are observed to exhibit minor differences, but each sample occurs in a specific region, typical for that plant.

The variability in composition of ingredients that results in the same quality of the plant coheres under the influence of the same outcome of quality. The breadth of relational variability of the plant is a measure of the reach of influence of the assertion of the quality.

The principle of variation being a natural route to explore unity, leads to exciting new ways of applying science to health.

**References**

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