A proposed partial decoding of the Voynich script

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Abstract

The intriguing 15th century Voynich manuscript has often been called "the most mysterious manuscript in the world". Filled with beguiling images of plants, stars, and strange designs and people, the manuscript has perplexed readers for centuries. We know nothing about its purpose, origin, or authorship. It has been called by the New York Times the 'white whale of the code-breaking world' (Markoff 2011, np). Until now, not a single word of the manuscript has been convincingly interpreted or decoded.

This paper offers a *proposed partial* decoding of the Voynich script. It adopts a 'bottom-up' approach, following the method employed successfully to decode Egyptian hieroglyphs and Cretan Linear B script in the past. Through analysis of a number of illustrations in the manuscript, including one constellation (Taurus) and seven plants, then drawing on European and Middle Eastern mediaeval manuscripts and contemporary nomenclature, the paper proposes the identification of a set of proper names in the Voynich text, giving a total of *ten words* made up of *fourteen* of the Voynich symbols and clusters. The resulting scheme is set out in Appendix 1 (page 56) of the paper. The aim of the paper is to attempt to lay the groundwork for an eventual full decoding and complete decipherment of this fascinating document.

The evidence shows that the manuscript is not a hoax, and is probably an explanatory treatise on nature. The script was possibly devised to encode a previously unwritten language or dialect, perhaps by a small community which later died out or disappeared.

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Introduction

The Voynich Manuscript, MS 408 in the Beinecke Rare Book & Manuscript Library at Yale University, has been called "the most mysterious manuscript in the world" (Brumbaugh 1977: title). Description of the document can be found on the Yale website (Yale Library 2013), and the manuscript can be seen in full at Jason Davies's interactive pages (Davies 2013, http://www.jasondavies.com/voynich/), and is discussed most fully and insightfully on René Zandbergen's extensive website: http://www.voynich.nu/ (Zandbergen 2004-2013). The vellum of the Voynich manuscript (VM), which makes up some 240 pages of writing and illustrations, has been authoritatively dated between 1404 and 1438 (University of Arizona 2011).It was rediscovered in Italy in 1912 by the bookseller Voynich after whom it is now named, and has hitherto not yielded up the meaning of a single word of its text. In the words of Taiz and Taiz:

> *"Despite the best efforts of some of the world's top code-breakers, including William Frederick Friedman, America's chief cryptoanalyst during World War II. who cracked Japan's notorious 'Purple Cipher', the text of the Voynich manuscript remains as opaque today as the day it was discovered."* (Taiz & Taiz 2011:20).

As a result of this complete failure to decode any part of the extensive text, it has been called by the New York Times the 'white whale of the code-breaking world' (Markoff 2011, np) with some authors recently asserting that it must be an ingenious hoax possibly constructed with elaborate mechanical grilles (Rugg 2004, Rugg 2013, Schinner 2007).

This article attempts to offer a partial solution to this enigma. Drawing on salient historical examples of cryptoanalysis and decipherment, including the decoding of Egyptian hieroglyphs and of the Cretan Linear B script, I adopt a hitherto untried approach to the decoding of the VM so as to identify a number of plants and matching plant names in the Voynich text, on the basis of comparison with early herbal manuscripts and medieval plant nomenclature. This results in the provisional decoding of 10 words, and the identification of the approximate sound values of a total of 14 of the Voynich symbols and clusters. These are arguably the first words and signs in the manuscript to be convincingly identified, with results which could potentially offer a springboard for the full decoding and eventual decipherment of the manuscript as a whole. The purpose in publishing these results is to elicit peer review of the analysis, and to stimulate further research, as a step towards an eventual full translation of this intriguing document.

Advances in understanding the Voynich manuscript

Although progress since 1912 on understanding the VM has been frustratingly limited, and none of the language itself has been decoded, some small steps have been made over the years in understanding other aspects of the manuscript. Perhaps the most significant has been the carbon dating of the vellum to the 15th century, which effectively ruled out a number of theories of later workmanship. Another important

insight came earlier, in the 1970s, when Currier convincingly identified the hands of a number of scribes in different parts of the text, and a degree of variation between their work at the level of letter and word sequences, suggesting that "there was more than one individual involved, and that there is more than one ''language'' involved". (Currier 1976:np). This has been generally accepted; Currier was rash, however, in calling these variations different 'languages', since this has misled some analysts into believing the variation between the hands to be huge. In fact, to anyone familiar with scribal practice in mediaeval manuscripts, all of Currier's examples can be explained straightforwardly as no more than idiosyncratic scribal differences when writing the same language, of a kind and a degree typical of the period.

The variation Currier identified in the VM, in other words, is commonplace in medieval manuscripts with languages which were not yet standardized. For example, in one mediaeval English manuscript no fewer than six different scribes using six different dialects have been identified, each using idiosyncratic conventions of spelling and grammar, yet all in the same language, namely English (Runde 2010). In many other manuscripts of the period we find wide variation of spelling even by the same scribe on the same page, for example in some Chaucerian manuscripts where the same page written by the same scribe contains diverse spellings such as dreem/dremes, seith/sey/seyn, blak/blake and so on (Yule 2001 and cf. Hans 1999). This scribal variation was so normal and extensive, indeed natural in handwritten mediaeval manuscripts, that the single word *'though'* has survived from Middle English texts in no fewer than 500 variants (Markus 2000).The extent of such scribal variation demonstrates that Currier's identification of variation between hands in the VM is in fact to be expected, and in no way supports either the notion that the manuscript is written in different languages, or that is in any way a hoax. It rather points to its authenticity, and alerts us to expect similar variation in our analysis.

Other scholars have made headway on other parts of the manuscript. Taiz and Taiz have recently offered a convincing argument that the "Biological" or "Balneological" section (folios 75r-84v) possibly offers an account of mediaeval plant physiology following the philosophy of Aristotle and Nicolaus Damascenus (Taiz & Taiz 2011). Another recent insight was provided at the seminar to commemorate the 100th anniversary of Voynich's rediscovery of the manuscript, when Johannes Albus presented a convincing argument that the last page of the manuscript is written in Latin and German, with two 'Voynichese' words, and contains a medical prescription (Albus 2012). Such advances are encouraging; however, none has yet resulted in a convincing decoding of a single word of the manuscript, without which further progress will inevitably be limited.

Hoax vs. real language theories

This failure to decode any part of the text has led, perhaps inevitably, to rather defeatist suggestions that the whole manuscript is an elaborate 15th century hoax. Despite the fact that different scribes seem to have been involved in its construction, which would seem curious in a hoax, such theorists have pointed to a number of statistical and other properties of the Voynich text which they claim could not be found in natural languages, and argue that the best explanation is that of a 'a tidy-minded hoaxer', possibly using mechanical tools to reproduce sets of apparently realistic scripts in order to fool readers for malicious or monetary reasons (Rugg 2004, Rugg 2013, Schinner 2007). Reddy and Knight summarise the statistical debate as follows:

> *"Several works have noted the narrow binomial distribution of word lengths, and contrasted it with the wide asymmetric distribution of English, Latin, and other European languages. This contributed to speculation that the VMS is not a natural language, but a code or generated by some other stochastic process. [sic]"* (Reddy, Knight 2011:80-81).

However, as the same authors go on to explain, several natural language do in fact exhibit "narrow binomial distribution of word lengths", in particular languages such as Arabic which use 'Abjad' scripts which omit most vowels, as will be discussed further below.

Hoax theorists also note that the VM often has the same or similar words repeated in one line, a feature noted earlier by D'Imperio (D'Imperio 1978). However, this property could equally be used as evidence against a hoax, since any 'tidy-minded hoaxer' seeking to sell the manuscript would surely avoid such obvious and odd repetitions. Furthermore, although such repetition is an unusual feature in natural languages, it is not unknown in particular genres (e.g. poetry and incantation), and in fact a number of natural languages such as Hebrew and Turkic languages use reduplication for a number of functions. In its entry on linguistic reduplication, the Encyclopedia Britannica cites the Turkic word 'kara' meaning 'black, which can be repeated to form an 'intensive adjective' meaning 'pitch black'. (Encyclopedia Brittanica 2012b). In short, hoax theorists appear to neglect features of genuine natural languages which may be present in the VM. Indeed in a later part of the paper I shall give evidence that a variant of 'kara' meaning 'black' could be an actual word in the Voynich manuscript which might be repeated or reduplicated in the manuscript in precisely this way.

A further reason to set aside hoax theories is methodological. Not only is the hoax interpretation a sterile one, since logically it would stop all further research on the text completely, it also falls foul of a crucial scientific maxim in theory-building, namely to avoid multiplying complexities unnecessarily. Hoax theories typically contravene this by depending on many rather fantastical scenarios, devices and

characters to explain why such a hoax might have been fabricated. To avoid this danger, I intend to adopt in this article the heuristic of Ockham's razor, namely that "of two competing theories, the simpler explanation of an entity is to be preferred" (Encyclopedia Brittanica 2012a), and I shall operationalise this as the assumption that the VM is probably more or less what it appears to be, namely a 15th century explanatory treatise dealing on plants and other aspects of nature, written in a natural language encoded in an unknown script. My own view, in line with other recent research (e.g. (Montemurro, Zanette 2013, Amancio et al. 2013), and in accord also with my own experience over many years of studying ancient, mediaeval and modern European and Semitic languages, is that all features of the VM script so far mentioned can be fully explained in terms of natural languages encoded in scripts devised for communication rather than obfuscation. Furthermore, since the best evidence against the hoax theory is to demonstrate that the VM is in fact written in a meaningful script and language, by identifying specific words which point unequivocally in that direction, this article proposed to lay the hoax theory to rest by demonstrating precisely this level of meaningful content.

'Big theory' approaches to the VM

Besides the hoax hypothesis, a considerable number of other theories about the Voynich manuscript have been advanced since 1912, dozens of which are listed and discussed on Nick Pelling's informative website[1], including the notion that it is a medical book written in Aztec Nahuatl, or a sixteenth-century hygiene manual written in left-right mirrored Middle High German, or a recipe book in "Old Latin", or a work by a juvenile Leonardo da Vinci. The general procedure of such approaches is to alight on a salient feature of the manuscript and on that basis construct a 'big theory' about the origin, authorship and purpose of the document, then to cite evidence from various parts of the manuscript in support of the theory in question. The reason why none of these has yet been convincing is because they are often selective, failing to explain all the known features or facts about the document. Most significantly, all have failed to offer anything in the way of a convincing decoding of the script itself. Indeed, a major methodological danger of starting with such a 'big-theory' approach is that the analyst inevitably feels obliged to select and even massage some of the facts to fit the theory, in an attempt to persuade and convince, rather than letting the evidence speak for itself in a more neutral way.

In order to avoid this danger, the current paper deliberately avoids advancing, or subscribing to, any overarching theory concerning the manuscript, apart from the basic notions that it is probably a 15th century document with apparent European elements (from the pictures and parts of the script), and with

[1] http://www.ciphermysteries.com/the-voynich-manuscript/voynich-theories

close resemblances in the early pages to herbal/medicinal manuals of the time. It seeks on that basis alone to examine the linguistic evidence piece by piece, and only when a certain amount of evidence has been assembled and analysed does it attempt, towards the end, to offer some broad and highly tentative proposals about the manuscript's possible provenance and purpose (see page 49 et seq.) It is hoped in this way to avoid the trap which others have arguably fallen into, of forcing the facts to bend to the theory, rather than – more properly - attempting gradually to shape a theory to fit the emerging facts.

Methodology for decipherment of the text

Besides a 'big theory' approach, some analysts have also considered a 'big data' or 'top-down' approach to be the most promising route to deciphering the VM, for example by using computers to find large patterns in the text as a whole (e.g. Stolfi 2000). In this article by contrast I adopt what we could call a 'small data' or 'bottom-up' approach, identifying individual linguistic patterns piece by piece, and gradually building up our decoding of the text sign by sign. One reason for this is because previous examples through history of significant decipherment have successfully adopted a similar 'bottom-up' approach, while few if any have ever succeeded through the use of computers alone. As Singh explains in his informative work on codes and scripts entitled "The Code Book" (Singh 1999), Young and Champollion's decipherment of Egyptian hieroglyphs, and also Ventris' decipherment of Cretan Linear B with the help of Chadwick, both made successful use of essentially the same systematic 'bottom-up' approach: finding individual proper names in the data and gradually building up from them a set of letter-sound correspondences, then finally identifying the underlying languages as Coptic and Greek respectively.

By contrast, earlier attempts to decode Linear B using 'big data' computational techniques were unproductive, Chadwick having tried "techniques he had learnt while working on military codes" (Singh 1999, page 238). One possible reason for this failure of top-down computational techniques in the case of Linear B is that the script in question did not present a one-to-one correspondence of sound to letter, because it used syllables, among other things. This might arguably be a reason why computational approaches have likewise failed with the VM, i.e. because the sound-letter correspondence is partially unsystematic, as indeed it is in most natural languages and scripts. In the case of Egyptian hieroglyphs this was clearly the case as well: it became apparent to Champollion that "the scribes were not fond of using vowels, and would often omit them; the scribes assumed that readers would have no problem filling in the missing vowels" (Singh 1999:214), the relative paucity of vowels being a common feature also of Abjad scripts such as Arabic.

Champollion discovered this through the successful identification of the known proper names of Pharaohs, and on that foundation gradually worked out the full details of the symbol-sound system piece by piece, in effect filling in the vowels himself. In the case of Linear B also, although each symbol represented not a single phoneme but a syllable, Michael Ventris similarly worked from known proper names, in this case of prominent towns in Crete such as Knossos (ko-no-so), and through a systematic and intuitive process of elimination and comparison, used what he found as the basis for reconstructing the script's full symbol-sound relationship (Singh 1999:235). The 19th century explorer and linguist Henry Rawlinson likewise described the importance of identifying proper names in deciphering the cuneiform inscriptions at Behistun (Rawlinson 1846:6). In all three cases, then, this focus on proper names and sound-symbol matching, in a step-by-step comparison and elimination process, was the crucial basis for the final leap, which came with the identification of Coptic, Greek and Old Persian as the respective underlying languages.

To my mind, these examples offer an illuminating point of departure for the decoding of the VM, in a way which has not been systematically attempted before. Although unfortunately the VM does not seem to offer us the proper names of pharaohs or towns, it does instead include a host of plants, for example, from which we could arguably make progress if only we could succeed in first identifying any plants and plant names with confidence, and then matching them with words in the corresponding VM text – a similar process to that adopted by Champollion, Ventris and Rawlinson in using known proper names to match unknown words and their constituent parts. In doing so, we need to be aware that, as with Linear B and Egyptian hieroglyphs, there might not be a full and straightforward one-to-one correspondence between sounds and symbols, and also that we could be dealing with a language which omits some vowels as an Abjad does, or has syllabic elements. Nonetheless, taking account of this caveat, the general methodological direction is clear to see, and is the one adopted in this paper.

In order to succeed with this approach it is important to study herbal manuals contemporary with the VM, and to analyse the names used historically for the plants they identify. Although numerous writers have examined the plants in the VM, many have dismissed them as inventions, even deriding them as of poor quality, "crudely executed … [and] stylized" (Taiz & Taiz 2011:19). With the notable exception of Zandbergen (Zandbergen 2012), it is surprising how few scholars have seriously researched herbal manuscripts contemporary with the VM, and most significantly, none has made any progress in identifying plant names in any language to match any of the pictures convincingly. One reason for this - a suggestion which I aim to substantiate in this paper - is that scholars have tended to focus almost exclusively on European herbals and European languages, and ignored the potential value of herbal manuscripts from other cultures, for example in the Near East.

Characteristics of mediaeval herbals

This is not the place for a full analysis of relevant herbals, but it is nonetheless useful to point out here some key elements of medieval herbal manuscripts which will be of relevance to the discussion of the VM pages. (A list of the herbal manuscripts referred to in this article is given at the head of the bibliography, page 58 below). Typically such herbals exhibit some or all of these characteristics:

a) they often show a *picture of a plant* with herbal value;

b) the picture is usually *on the same page* as the beginning of the discussion of the plant; sometimes, however, the picture is *on a different page* from the discussion. The *Leiden Dioscorides* herbal (in Arabic) has several examples where the picture is on a different page, as does the *Egerton herbal* (Italian) – for example in the *Egerton herbal* Centaurea is pictured on folio 21r, but described only on the next page, folio 21v;

c) the plant name is frequently *the first word* of the accompanying paragraph, or at least *in the first line*. Sometimes it is in a different coloured ink or highlighted in some way. Very occasionally the name is given later, or even at the end of the paragraph (e.g. the *Wellcome Voynich herbal* in Italian), but this is rare;

d) the text frequently gives *the medicinal use* of the plants, and also sometimes the *aetiology*, i.e. the cause or reason for its medicinal use, often expressed in terms of historical or mythical explanation;

e) herbals very frequently *draw on the work of classical writers* such as the famous herbalist Dioscorides, often copying text and pictures directly from earlier authorities rather than from life. For this reason the plants are sometimes very difficult to identify and also vary widely in different herbals;

f) a feature of herbals which has often been underplayed is their role in *cross-cultural interpretation*, for example their role in explaining foreign plants and herbal uses to a new audience, be it by translating Dioscorides' Greek work into Syriac or Arabic for an audience in Baghdad (e.g. the *Oxford Dioscorides herbal* in Arabic), or for an audience in Samarkand (e.g. the *Leiden Dioscorides*). A result of this is a high incidence in all herbals of foreign plant names (e.g. Greek names translated directly into Arabic in the *Leiden Dioscorides*), and also frequent marginal glosses in other languages, as later scholars translated the plant name or added comments (e.g. the Byzantine Turkish, Hebrew and Arabic marginal glosses in the *Vienna Dioscorides* herbal). This multilingual and multicultural dimension is therefore a possible feature also of the Voynich manuscript.

In the analysis which follows I aim to demonstrate, then, that in the Voynich manuscript the first word of a number of the plant pages typically encodes the name of the plant on that same or the adjacent page, and that the text discusses the plant in question, and probably gives the aetiology as well. I identify five plants with some confidence, with their accompanying names as the first word on the same page, and make tentative identification of two more.

Natural languages, scripts, Abjads and Abugidas

A question still unresolved is why the writers of the VM used this script at all instead of another which might have been available to them (such as Latin or Arabic), and then how this particular script was devised. A common reason for devising a new script, if it is not for purely economic reasons, is to support a new national and/or religious identity or to support new cultural elements in a society, as in the case of Armenian for example (Parsumean-Tatoyean 2011). With regard to how scripts are devised, although it is possible to invent a script completely from new, this is rare; 'new' scripts have usually been derived or adapted from existing scripts, for example Ethiopian Ge'ez from South Arabian, with vowelling added probably following inspiration from India (Daniels 1997).

Another fascinating example is that of the Glagolitic Slavic alphabet created in the 9th century. In this case a script was devised for a language which had no script by a small group of people, supposedly two brothers, using signs adapted from Greek, Hebrew, Coptic, Armenian and Samaritan (Sussex, Cubberley 2006, Auty 1968). The most famous document in this invented script, the Kiev Missal, was probably written in Bohemia in the 10th century but was then found in the 19th century as far away as Jerusalem (Vlasto 1970). On the basis of examples such as these, it is well within the bounds of possibility that the VM script could similarly have been developed from a mix of existing scripts by a small group of individuals, aiming to encode an existing language which had no previous script, the manuscript then being transported long distances by circumstance. On the basis of the shapes of some of the Voynich letters, it was in fact suggested many years ago that the VM script was in part adapted from Latin (Currier 1976, D'Imperio 1978) although at the same time other VM symbols are clearly not derived from Latin or any other known script.

It has already been mentioned that not all scripts encode the full vowels of every word, as in the example of Egyptian hieroglyphs. When the Greeks borrowed their writing system from the Phoenicians, it was an Abjad, meaning that it encoded consonants only and perhaps some long vowels, leaving the reader to fill in the remaining vowels from prior knowledge of the word. The Greeks' significant contribution was then to devise a fuller vowelling system in their developed script, from which we get the vowels in Latin and in many other European scripts. However, other languages such as Arabic still continue essentially to

encode consonants and only occasional vowels for clarity or to indicate a long vowel, a key principle of Abjads which I will suggest is also found in the VM. In fact, recent statistical analysis of the manuscript has explicitly suggested that the letter and word quantities and distribution do indicate an Abjad (e.g. (Reddy, Knight 2011, Jaskiewicz 2011); this paper will argue that some plant names clearly use the Abjad principle in part, with the reader required to provide some of the vowels - an approach which directly imitates the practice in contemporary Arabic herbal manuscripts. In addition, some elements will be seen possibly to resemble Abugida script principles, in which the consonant is understood to have an inclusive vowel, often 'a':

> *"In an abugida, each character denotes a consonant accompanied by a specific vowel, and the other vowels are denoted by a consistent modification of the consonant symbols, as in Indic scripts."* (Daniels, Bright 1996:4)

It should also be remembered that a 'script' and a 'language' are not the same thing. In theory any script could be used, with adaptation, to write any language. An interesting example is 'Arebica', which for historical reasons used Arabic script to write (Serbo-Croatian) Bosnian. Such examples alert us to the fact that although the script of the language in the VM could be borrowed in part from Indo-European languages such as Latin, and could be acting in part as an Abjad, like Arabic and other Semitic scripts, the underlying language could nevertheless be from a completely different language family again, such as Turkic. This paper draws no conclusion on this matter, though I offer some discussion of it in my final pages (page 48 et seq.).

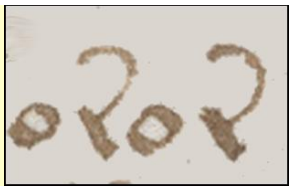
Outline of findings

To assist the reader to see the overall direction of this paper, I will here summarise the results in brief, as a prelude to explaining the detailed reasoning in the remainder of the paper.

Through analysis of a number of illustrations in the manuscript including one constellation (Taurus) and seven plants, and drawing on mediaeval manuscripts and contemporary nomenclature so as to match the illustrations with proper names within the text, I propose the identification of a total of ten words in the manuscript consisting of fourteen of the Voynich symbols and clusters, some more tentatively than others. The two tables in Appendix 1 (page 56) summarise the proposed readings of these symbols in terms of vowels and consonants, and list the words which appear to contain those symbols. It should be noted that all of the identifications are of course provisional, subject to more evidence and analysis.

Language patterns: the case of ORORR / Juniper

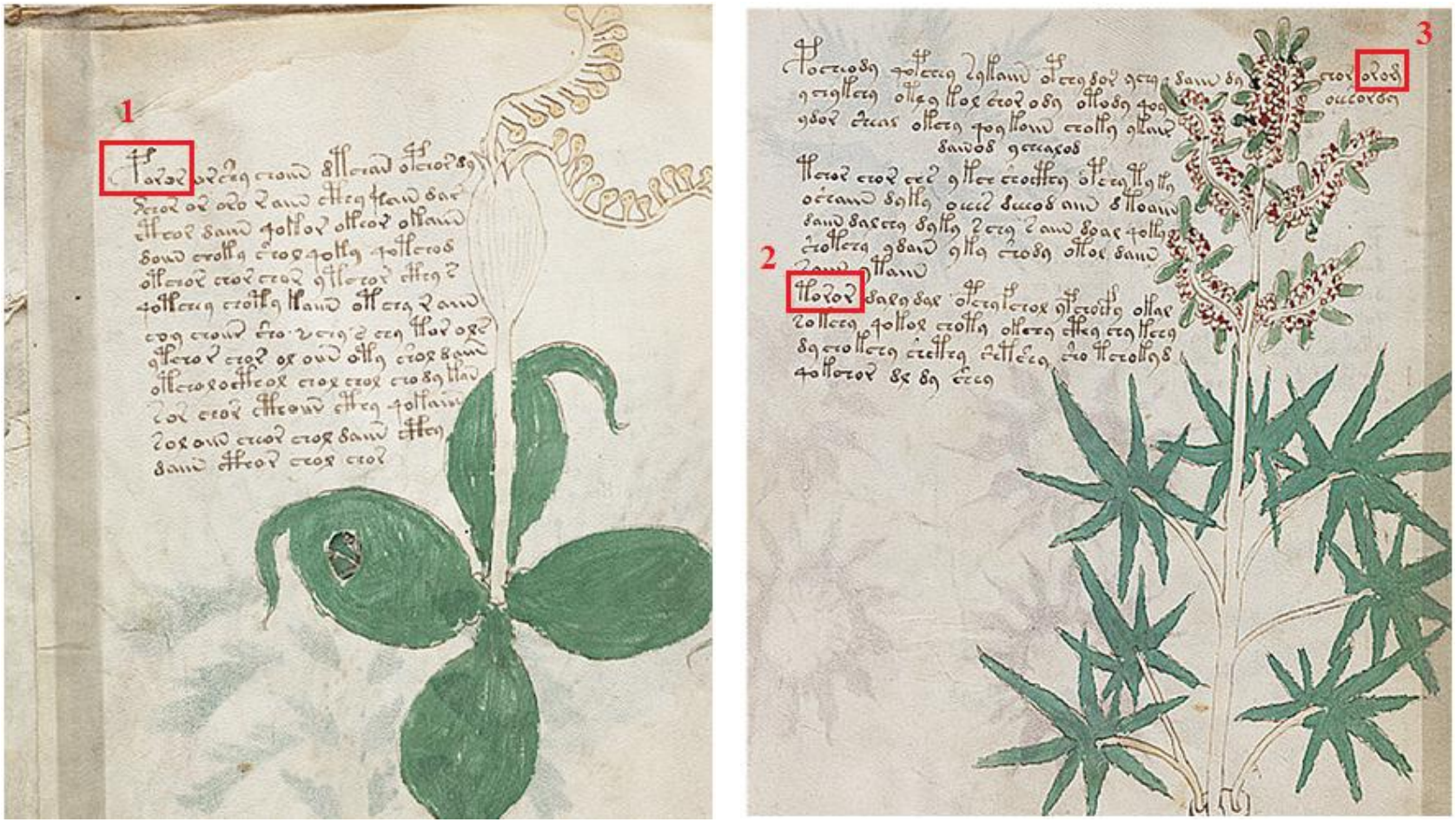
In 2012 I prepared an informal paper for circulation to a few Voynich specialists in which I discussed the pattern in the manuscript transcribed as ORORR (as transcribed in the EVA transcription system[2] developed by Zandbergen and Landini). I proposed that ORORR could be a possible plant name, and could represent the word 'arar', perhaps borrowed from the Arabic/Hebrew word 'arar' (Arabic عرعر and Hebrew עֲרוֹעֵר) for *Juniper* or *Juniper Berry*[3]. This is the pattern ORORR as it appears in the VM itself:



My argument in that paper drew in part on the distribution of the pattern ORORR throughout the VM, but mainly on the identification of the plant on page 16r as *Juniperus oxycedrus*. On the facing pages 15v and 16r of the VM, which you can see in Figure 1 below, the pattern ORORR appears twice, once as part of the first word (on the far left, numbered 1) and again as part of the first word of the last paragraph (on the right hand page, numbered 2), as highlighted. This is interesting, since it has long been thought that the name of the plant might be the first word of the accompanying text (Zandbergen 2004-2013), but no-one has so far been able to substantiate the idea. My argument in that earlier paper suggested that the plant on the right hand page (16r) is probably a depiction of *Juniperus oxycedrus*, a plant common throughout the Mediterranean west to the Apennines[4] and east to Iran. The plant is distinctive for its spiky leaves and red berries, which both appear clearly in the VM picture. Sara Peterson, an art historian specialising in plants, was invited to consider whether the picture might represent *Juniperus oxycedrus* and agreed that it could be possible. At the same time she drew attention to the depiction of *Juniperus oxycedrus* in Koehler's classic book on medicinal herbs (see below, Figure 2, page 16), remarking that:

> "the plant [in Koehler] shares the same shrubby, branching habit around the central stem as the Voynich version. It's also interesting that [the] Voynich depiction seems to show the soft, sappy immature leaves before they become spiky." (Peterson, S. Personal communication 8/11/2013)

[2] For an explanation of EVA see http://www.voynich.nu/extra/eva.html
[3] Note that the letter A in this transcription from Arabic/Hebrew stands for the semitic guttural consonant AYIN, and not a vowel. Of course the Arabic and Hebrew are read from right to left, unlike the Voynich script.
[4] http://www.henriettesherbal.com/eclectic/usdisp/juniperus-oxyc_oleu.html)



15v **16r**

Figure 1: Facing pages of the VM, 15v and 16r

Voynich 16r

Images from:
http://en.wikipedia.org/wiki/File:Juniperus_oxycedrus.jpg

Pictures of Juniperus oxycedrus, for comparison

Juniperus oxycedrus from Franz Eugen Köhler, Köhler's Medizinal-Pflanzen, 1897 http://commons.wikimedia.org/

Figure 2: Images of Juniperus oxycedrus

Besides this apparent resemblance between the VM plant and *Juniperus oxycedrus*, the structure of the Voynich word OROR resembles the name appearing for Juniper in general in Arabic and Persian herbal manuscripts, namely 'arar' (e.g. in an 11th century Persian manuscript from Herat, (Muvaffaq ibn ʿAlī 1972[5], and the 15th century Arabic *Princeton herbal* p143,). In terms of use in medicine, parts of various Juniper species were used historically to make Oil of Cade, a remedy which has been described as follows:

> ***Uses***.—*Oil of cade has been used locally, by the peasantry, in the treatment of the cutaneous diseases of domestic animals almost from time immemorial. More recently it has been largely employed in the treatment of chronic eczema,psoriasis, and other skin diseases of man…*
>
> http://www.henriettesherbal.com/eclectic/usdisp/juniperus-oxyc_oleu.html

This medicinal use of Juniper in mediaeval times as a treatment for skin disease is of special interest because the word OROR also occurs on the very last page of the VM (page f116v), which – as was noted above – has been convincingly analysed as a Latin/German recipe or prescription for wet rot, a skin complaint (Albus 2012). In other words, interpreting OROR to read 'arar' as a variety of Juniper, alongside a picture of what may be *Juniperus oxycedrus*, and the fact that the use of Juniper was common as part of a skin treatment, seemed a convincing and intriguing possibility, and a possible initial step to decoding more Voynich signs[6].

Problems with OROR

Despite the apparently convincing identification of the VM image as a species of Juniper, along with the linguistic evidence of the name 'arar', and the use of Juniper as a medicine, there are a number of problems with the interpretation. Although POROR is the first word of page 15v, the plant depicted there – unlike its neighbour on the facing page - looks nothing like any known form of Juniper, rather resembling a species of Orchis. The fact that OROR occurs here and on the next page with a prefixed P and T also renders the interpretation uncertain, since they could arguably be different words altogether, even though it has also long been felt that the symbols transcribed as P and T might be merely decorative, or prefixes in some way. These and other reservations were noted by readers of my 2012 paper, for example Rich SantaColoma (SantaColoma 2012), who rightly urged caution and called for more evidence

[5] And also in Steingass' Persian dictionary, p844:: http://dsal.uchicago.edu/dictionaries/steingass/

[6] Incidentally, even if this word is borrowed from Arabic or Hebrew, it is unlikely on this evidence that the language of the VM is either of these, because the Arabic and Hebrew letters equating to the A in 'arar' are of very low frequency in those languages, whereas the sign O in the language of the VM is very common.

of the potential of the approach and the analysis. For this reason the interpretation must remain tentative at this stage, until we consider more evidence.

The pattern OROM

Since that correspondence, it was noted that on the same right hand page (16r), at the end of the top line (Figure 1, on the right hand page, numbered 3), is a word transcribed as OROM[7]:

To my mind this could potentially also represent the word OROR/arar. If we look at the last symbol (transcribed in EVA as 'M'), it appears to be drawn exactly like the R sign, but with a final decorative downward flourish. In languages such as Arabic, it is common for the same letter to have different shapes depending on their position in the word, but this might be a variant – unusually - owing to the position of the word in the sentence. In other words it could be merely a variant of R, in line-final or sense-final position. Statistical analysis of OROM in the VM tends to confirm this possibility, revealing 8 instances, all of which are isolates, or in line final position, or apparently decorative, as can be seen in Figure 3 below:

Rank	Item	Frequency	Folio and line	
1	orom	5	16r, 1 71v S1 1 73r R2 1 84v, Top line right 86v6, 31 104v, 43	Line ending Isolate in zodiac ring, after CHAR Isolate in list of words Line ending - not in Takahashi transcription? Line ending Line ending
2	chorom	1	24v, 9	Line ending
3	qoforom	1	36v, 1	Not line ending, but with initial QOF, with decorative aspect
4	oteorom	1	43v, 14	Line ending
		8		

Figure 3: Occurrences of the pattern OROM

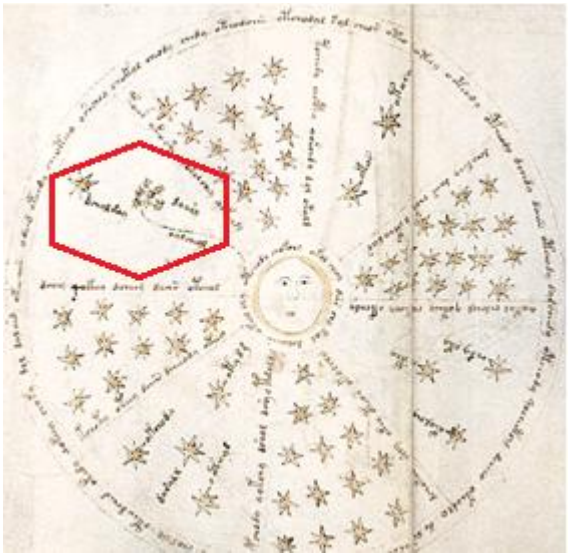
The fact that OROM occurs always as an isolate, as a decorative, or at the end of a line, suggests that it might indeed be the equivalent of OROR, but in an isolate, decorative or sense-ending position. This is an intriguing possibility, since it would give us an additional mention of OROR on the page depicting the possible *Juniperus Oxydcedrus* plant. However, for this to be accepted we would need substantially more

[7] The font for Voynich signs is borrowed from René Zandbergen's website http://www.voynich.nu/.

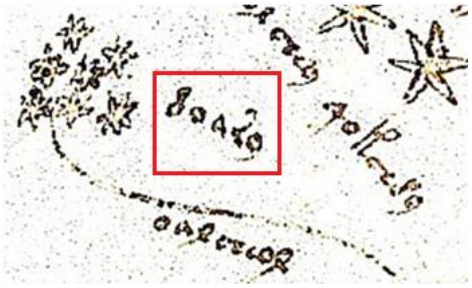
research and investigation into the patterns of the ***M*** symbol in the manuscript as a whole. This reading of the sign must therefore also be treated as speculative at this stage.

Taurus

It was noted at the beginning of this article that no word of the VM has been convincingly translated or glossed, but in fact there is one word which has received a degree of consensus. On page 68r, in a dramatic diagram apparently showing the moon in the heavens, a set of seven stars has been suggested to show the 'Pleiades', sometimes known as the Seven Sisters, in the constellation of Taurus (Figure 4) and the accompanying word has sometimes be interpreted to indicate TAURUS (Zandbergen 2004-2013).



Folio 68r, with 'Pleiades' on the left.



Detail of Folio 68r with the seven stars of the 'Pleiades' and the proposed word T A U R N (centre)

Figure 4: f68r and 'the Pleiades'

Historically the word Taurus is thought to derive from Proto-Indo-*European *tau-ro, *tawros, *teh₂wros*. meaning bull (http://www.etymonline.com); it is also linked with Semitic variants such as the Arabic word 'thaur', which signifies both 'bull' and also the constellation[8]. For this reason, when we come to gloss the VM word positioned to the right of the seven stars in the illustration, it is important not to assume that it represents the Latin TAURUS *per se*, as some commentators seem to do; it could well be a

[8] In addition, the Arabic for the Pleiades is "Al Thurayya", though this is etymologically unrelated to 'thaur'.

variant from another language. Even so, it appears plausible that the word might indeed be read as the name of the constellation. We could posit the idea that the initial letter, shaped somewhat like the numeral 8, represent some sort of alveolar or dental sound in the region of /t/, /d/ and /θ/ (as in the first sound of *th*ing, which is approximately the Arabic sound in 'thaur'), and indeed it resembles the Greek '*theta*' to some extent. The second sign fits with the analysis of OROR and might represent a vowel sound like /a/; the third might be a vowel sound which, when alongside the previous could give a sound of approximately /u/ or /ə/ (like the last vowel in the English word 'doctor') or a full /u/; the fourth also fits with my earlier analysis of OROR and could plausibly be read as /r/ - giving approximately /taur/ or /taər/. Of course, although this reading seems to support and be supported by, the reading of OROR as /arar/, it should still at this stage be treated as speculative.

VM script					
Possible sound	T	A /a/	/ə/	/r/ or /r/ plus vowel	N
Gloss and provenance	/t/	/a/ as in 'arar'	/ə/ or /u/ or /wa/ as in /taərn/	/r/ as in 'arar'	See analysis of 'centaurea' below, page 25

Figure 5: analysis of word possibly meaning 'Taurus'

Below I will give reasons for reading the final sign as /n/ (see pages 25 et seq.), for which reason I propose that the word in full should be read as /taərn/ or similar. (The reason for the final /n/ at the end is not entirely clear, although it could represent or be borrowed from the Arabic/semitic vowelling called 'nunation' in the nominative singular of the word meaning 'bull' and the Constellation Taurus). Figure 6 demonstrates the existence of the word 'thaur' in the singular without the Arabic definite article 'al', used for the constellation in a Persian manuscript.

The Constellation Taurus named with the word 'thaur' highlighted to the top right of the picture: Mu'is al ahrar fi daqa'iq al ashcar (The Free Man's Companion to the Subtleties of Poems) of Jajarmi, Ilkhanid period (1206–1353), Iran, Isfahan, dated A.D. 1340–41
http://www.metmuseum.org/toah/works-of-art/19.68.1

Figure 6: Thaur the bull

The analytical procedure

In isolation, each of the above readings of /arar/ and /taərn/ is insubstantial and must be considered speculative; it will only be possible to verify them if they fit in with a larger emerging pattern which explains other words, for example the names of other plants. The process can be compared to doing a crossword puzzle: at first we might doubt one possible answer in the crossword, but gradually, as we solve other words around it which serve to confirm letters we have already placed, we gradually gain more confidence in our first answer until eventually we are confident of the solution as a whole.

In order therefore to obtain more evidence, I will now proceed to identify and discuss four further plants with their proposed plant names in the text. In methodological terms, however, in order to avoid the danger of 'subjective interpretation' which Kennedy and Churchill rightly critique in previous attempts at decoding (Kennedy & Churchill 2004), it is important to follow a systematic procedure as follows:

Step 1: *Identify the plant* through detailed analysis, preferably with reference to several parts such as leaves and roots. Wherever possible, I will draw on independent identification of the plant by another analyst to ensure greater objectivity.

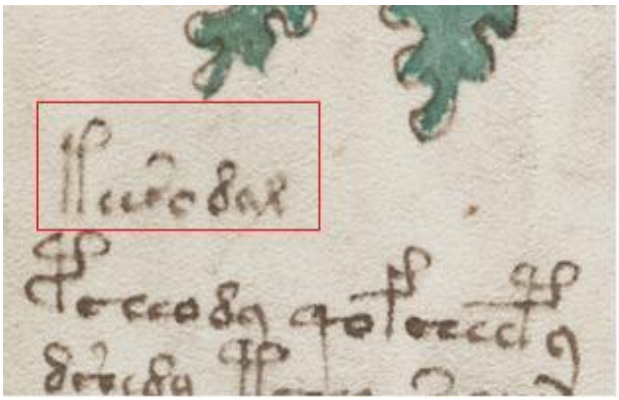
Step 2: *Examine the first word of the page and attempt to correlate that word with the plant already identified*; we have seen with OROR above that this might be promising. The reason for focusing on the first word of the herbal page in particular is that it is too easy to find any word on a page of text and to 'imagine' some relevant reading. For this reason the analysis below will focus strictly on the first word of plant pages, which, as was noted above, was frequently where the plant was named in mediaeval herbal manuscripts.

Step 3: *Obtain the views of other analysts to corroborate, dismiss or adjust the analysis*. This is a central aim of this paper, as it aims to invite debate, critique and development from other analysts. This is in the expectation that some of the analysis and findings will require correction, but also in the hope that this way we can make speedier progress towards decipherment.

Coriander

While examining the plant pages I noted a curious feature of folio 41v, which depicts the plant which you can see in Figure 7 below, a feature which seems not to have been mentioned in the literature previously. This is the fact that above the first word of the text appears to be an extra word written as a marginal gloss (as you can see in the detail in Figure 7). This is rare, if not unique, in the VM, but in many mediaeval herbal manuscripts such marginalia do appear, most commonly giving an alternative name of the plant, perhaps in or from another language (see examples from the *Harley herbal 1585* in Figure 12 on page 28 below, and also e.g. the *Vienna Dioscorides*, which has marginalia in Greek, Arabic and Hebrew naming the plants). To my mind, although the first word of the text itself is still mysterious, this marginal addition in the VM could indeed be the name of the plant, as can now be explained.

Voynich manuscript f41v: coriander, with marginal word highlighted



Detail of f41v, with marginal word highlighted. The top word is proposed to be a variant of Coriander, possible K OO R A T U ?

Figure 7: f41: Coriander

Step 1 (plant identification): The plant itself in f41v has been convincingly identified by Sherwood as Coriander / Cilantro (*Coriandrum sativum*), for example with reference to the leaves at the base of the plant being "broadly lobed becoming more feathery higher up, with umbels of white to pale pink flowers at the top of the stem" (Sherwood 2013, np), though bluish flowers are also common, as in the VM example.

Step 2 (nomenclature): The plant has a wide range of names in different languages. Even those related etymologically to the word 'coriander' (deriving from the Greek 'korion') are very varied in their range of vowels and consonants, including the following sample:

Cilantro (English et al.)
Coentro (Portuguese)
Coriander (English et al.)
Coriandolo (Italian
Coriandre (French)
Coriandro (Italian, Spanish et al.)
Koendoro (Japanese)
Kolendra (Polish);
Koljandra (Russian)
Korander (Dutch)
Koriander (Danish, German)
Koriandr (Russian)
Koriannon (Greek)
Korijander (Croatian)
Korion (Greek)
Koriyun (Greek)
Koryander (Polish
Kothambri (Kannada)

Coriandru (Romanian) Koriandrze (Polish); Silantro (Spanish - Peru)
Culantro (Spanish)

Figure 8 *Selection of variants of the word Coriander (cf.* (Katzer 2013*)*

This selection demonstrates the wide variety of pronunciations and spelling typical of plant names across languages – the list does not even contain the many names of *coriander* in other language families, for example those related to *Dhania* in Hindi. Note that, without vexception, every consonant and vowel in the word has been altered in various ways in different languages, or omitted. In particular there is a regular alternation between the liquid sounds /r/ and /l/, a common alternation across many languages, and also between the (alveolar) dentals /d/ and /t/ (both exemplified in ci**L**an**T**ro v co**R**ian**D**er). Vowels vary even more widely. Such variation in the word *coriander* can be seen in detail in Figure 9 below, which shows how in some variants a sound is missing completely (shown by the shaded boxes), while others vary widely.

	1	2	3	4	5	6	7	8	9	10
1. Greek Linear B	/k/	/o/	/r/	/i/	/ja/		/d/	/a/	/n/	/a/
2. 'Coriander'	/k/	/o/	/r/	/i/	/a/	/n/	/d/	/a/ or /ə/	/r/ or omitted	
3. 'Cilantro'	/k/	/i/	/l/		/a/	/n/	/t/		/r/	/o/
4. 'Korion' (Greek)	/k/	/o/	/r/	/i/	/o/	/n/				

5. VM (approximate)	K	OO	R		A		T	/ə/ or U	??	
6. VM script										
7. Gloss and provenance	Assumed to be /k/	Assumed to be a long vowel, with each element being a single vowel, perhaps /o/	/r/ as in /arar/ and /taərn/ above		/a/ as in /arar/ and /taərn/ above		/t/ as in /arar/ and /taərn/ above	/ə/ or /u/ or /wa/ as in /taərn/ above	Unknown	

Comparison of the sounds of selected variants of 'Coriander', with highly approximate phonemic representation (cf. (Katzer 2013)

Figure 9: Various words for coriander

Drawing from the readings of /arar/ and /taərn/ discussed previously, I suggest that the marginal note above the first word of the text on page 41v could represent the name of the plant in the picture, and be related to the word Coriander. Drawing on our previous identification of three of the signs, R A and T, in the middle part of the word, we can then provisionally reconstruct the start of the word as KOO or similar, and thereby tentatively read the word as approximately KOORATU?, in the way glossed in row 7 of Figure 9 above. Curiously, if this reading is correct, its closest correlate is arguably the Cretan Linear B Greek version discovered following Ventris' decipherment, i.e. ko-ri-ja-da-na, which is considered to be the earliest of all known versions of the word 'coriander'.

Although tentative, this reading appears therefore to fit the plant identification, and also the previous analysis of the words /arar/ and /taərn/. However, at this stage it too must still be considered speculative, until more evidence is accumulated from other identifications, to which we can now continue.

Centaurea

The next plant to be considered is that on page *f2r*, as can be seen in Figure 10 below. Following the procedure described above, the plant is first identified in Step 1, and then in Step 2 the issue of the possible name in the text is considered.

Step 1 (plant identification): The plant on page 2r of the VM has been identified by Sherwood and others, apparently uncontroversially, as belonging to the genus *Centaurea* (Velinska 2013, Sherwood 2013). Sherwood identifies it more specifically as *Centaurea diffusa*:

> *"Diffuse Knapweed (Centaurea diffusa), is native of Greece and Asia Minor. This weed has a long taproot, and pale-green alternate leaves that are deeply divided into lobes, measuring 1 to 3 inches in length. The single, upright stem produces several spreading branches that end with pink or white thistle-like flowers. During the Middle Ages knapweed had a reputation for curing wounds and was an ingredient in a fourteenth century ointment called 'salve.' This folio could also be represented by spotted knapweed (Centaurea biebersteinii), also native to Eurasia."* (Sherwood 2013 np.)

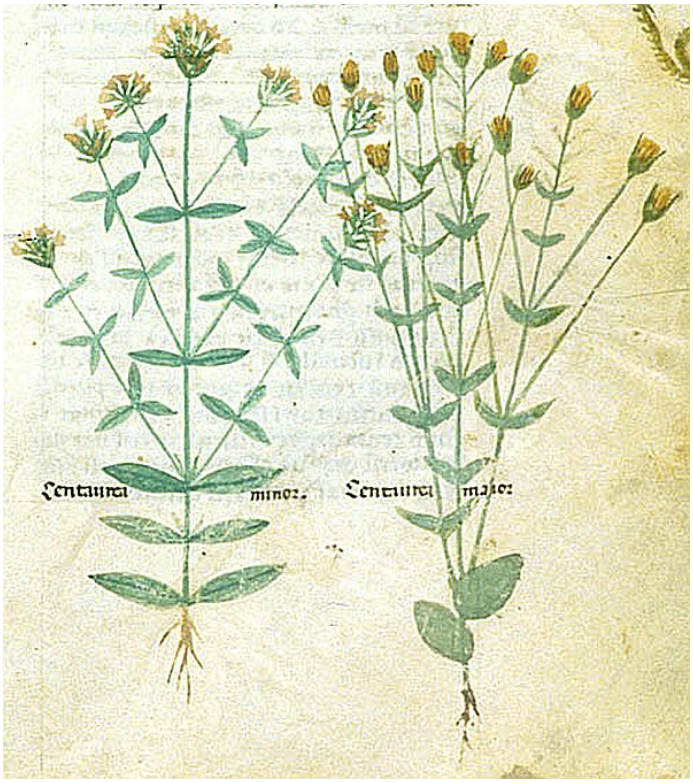
As Sherwood notes, the genus contains a large number of common species in Europe, the Caucasus, Turkey and Iran, including knapweed and cornflower.

Page f2r, with the plant identified as of the genus Centaurea

Detail of page 2r, with the first word of the text

Figure 10: Page f2r

The picture has all the hallmarks of a light coloured species of *Centaurea*, in terms of flower, leaf and root, whether *Centaurea diffusa* or another species. An illustration of two types from the mediaeval *Egerton herbal* is given for comparison in Figure 11, below.



Centaurea minor and major in the *Egerton herbal*: Egerton 747 f21

Figure 11: Centaurea in the Egerton herbal

Step 2 (nomenclature): The genus Centaurea is named after the Centaur Chiron (Greek Χείρων), who was reputed to have discovered its medicinal value.

> *"In the history of the mythologic founders of medicine, [Chiron] was considered the discoverer of the medicinal properties of many herbs, who mastered the 'soft-handed lore of drugs' and passed it on to his pupils. His name became part of the pharmaco-botanical nomenclature; we still have the genus Centaurea. According to Pliny the panacea Centaurion was discovered by Chiron, as was another panacea, Chironium."* (Sigerist 1987:50)

This mythology concerning Chiron was well-known in medieval times, and is mentioned and depicted frequently in herbals. An attractive example can be found in the *Egerton herbal*, seen in Figure 12 below; in the picture on the right a centaur is shown holding a stylized white variety of *Centaurea*.

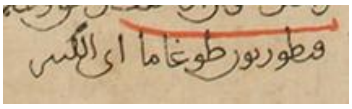
Harley manuscript 1585 showing Chiron the Centaur and Diana F22r

Centauria maior held by a centaur F29r

http://www.bl.uk/manuscripts/FullDisplay.aspx?ref=Harley_MS_1585

Figure 12: Chiron, with Centauria maior on the right

The plant and the name *Centaurea* were widely known with small variations across Europe and also in central Asia in medieval times, as can be seen by its use in the Arabic manuscripts written in Baghdad (*Oxford Dioscorides, dated 1240 CE)* and as far as Samarkand (*Leiden Dioscorides, dated 1082 CE)*.



Leiden Dioscorides in Arabic f. 108b. Naming of "Qanturiyun Tughama ay al-Kabir" Great Centaury – Literally QNTURYUN

Figure 13: Arabic word for Centaury

In both of these the Arabic version of the name is given as *Qnturiyun*, a direct borrowing from the Greek (see Figure 13 above). The same name is given in Arabic in a marginal gloss in the Vienna Dioscorides [9].

[9] http://exhibits.hsl.virginia.edu/hist-images/herbs/kentaureion.jpg

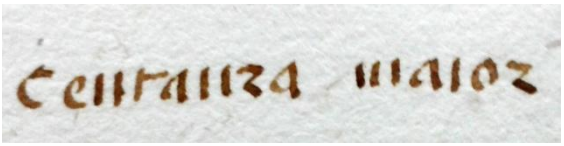
One variety of the plant is still known today in English as Centaury, and in Turkish and Azeri as *Kantaron*.

The first word on the Voynich page can be seen in Figure 10 above, and on the basis of the letters previously identified, I propose that it can be convincingly read as a version of *Centaurea*, resembling the Arabic QNTURYUN and modern Turkish and Azeri KANTARON, as follows:

VM script						
Rough reading	K	N	T	/ə/	IR	N
Gloss and provenance	/k/ as in Coriander gloss above	Assumed from context to be /n/ (c.f. /taərn/ above)	/t/ as in /taərn/ and Coriander	/ə/ or /u/ or /wa/ as in /taərn/ and Coriander	Assumed to parallel Latin /i/ plus variant of /r/	Assumed from content to be /n/ (c.f. /taərn/ above)

Three of these signs have already appeared in the discussion of Coriander and ‘arar’ above, so this reading supports those and is supported by them. It seems highly likely from the context that the second and last signs represent the sound /n/ with or without an implicit vowel.

The fifth sign appears to be a sort of ligatured compound, and is assumed to include at least one vowel and another version of a /r/ sound. (This suggestion will be corroborated when we discuss the Hellebore below, page 33). It closely resembles the common Latin cluster ‘ai’ and could be borrowed from it.



The words ‘centaura maior’ in the Wellcome 15th century herbal

Figure 14: 15th century rendering of ‘Centaura major’

In fact, the Voynich manuscript has many examples of what looks like ‘ai’ and ‘aii’. If we consider the lettering in Figure 14, which represents the words *Centaura major* as written in a 15th century herbal in the Wellcome Library close to the age of the VM, we note that single vertical lines in various combinations could rather confusingly be used to form all of the four letters *n*, *u*, *m* and *i*. In particular the

combination ‘a’ plus one vertical line stood for ‘ai’ and with two stood for ‘au’. It seems possible, at least, that the similar Voynich clusters of letters were borrowed from contemporary Latin calligraphy, and likewise represent vowel clusters or diphthongs in the same way. Since this also fits well with the reading of KNT/ə/IRN as Kantaron/Centaurea, we will therefore provisionally read the Voynich ‘ai’ symbol as /əi/ and the aii symbol as /əu/.

To those unfamiliar with Abjad scripts it might seem objectionable that this reading begins with three consonants together (K + N + T) with no intervening vowel. However, this is precisely the way in which Arabic, for example, or other Abjad scripts, would write this word even today. It was noted above that the name of the same plant in the *Leiden Dioscorides* begins with three written Arabic consonants transcribed as QNT, unvowelled in any way, since the reader must supply the vowels. For readers in many languages this is not problematic, and it strongly suggests that the writers of the VM were using a script which in this respect resembled an Abjad, with some vowel omission. We recall that at first this feature of Egyptian hieroglyphs confused Champollion, and it has perhaps hindered decoding of the VM up to now as well.

Three signs for ‘R’

Another curiosity is that we now have three signs which apparently represent the sound /r/, namely:

Voynich sign			
Variant	1	2	3
Possible vowelling	RA?	R?	UR? RO?

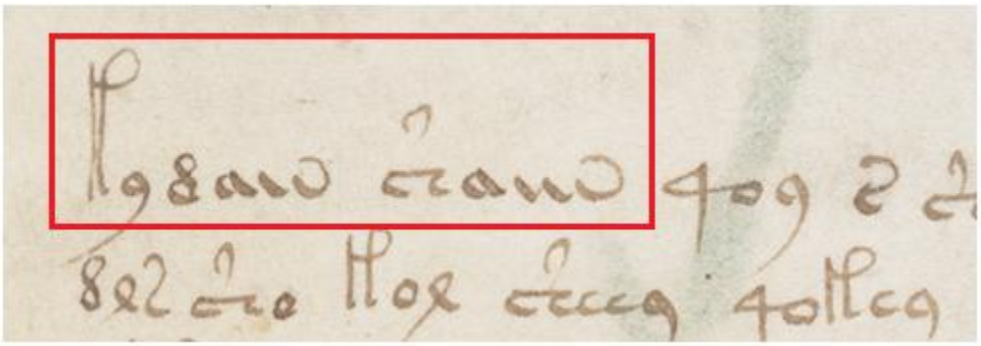
This appears anomalous, but could be explained linguistically in at least three ways. Firstly, the shape of the sign could simply be different depending on the environment (e.g. variant 2 could be used to indicate a sense-ending or a line-ending, and variant 3 could be used following particular letters). Alternatively, each variant could include an extra implicit vowel. In the Amharic and Ge’ez scripts, and in other abugidas (Daniels, Bright 1996) the signs vary in shape depending on the implicit consonant-vowel combination which they include, for example BA is slightly different from BI; in many Indic languages the vowel is simply assumed to be *‘a’* unless another mark indicates differently. It is possible that likewise the Voynich letters could represent RA, R (because it is terminal) and RI or some variant, possible even with a grammatical case implication. This could give readings of ‘a**RA**a**RA**’, and kntui**RO**n respectively, or similar. A third, more technical possibility is that these could be allophones of /r/

occurring in complementary distribution, with different symbols depending on the phonetic realization, even though with the same underlying phoneme[10]. However, this is an element of the script which needs more investigation.

Chiron the Centaur

When I began the analysis of the 'Centaurea page' I was faced with what appeared to be a significant obstacle. The page has two paragraphs and both begin with almost the same word. This was positive in one sense, since a herbal manuscript commonly repeats the plant name, and indeed we might expect the plant name to be repeated at the head of each paragraph. However, the two words were not identical: the word at the start of the second paragraph lacked the final /n/, and if my other analysis was correct should therefore be read KNT/ə/IR. How could this difference be explained? Would it be detrimental to the analysis?

On reflection, and on looking also at the *second* word of the second paragraph – you can see it in Figure 15 below - it occurred to me that it could be the name of the centaur Chiron himself. One reason for this is that the first sign of the second word occurs also as approximately 'CH' in the name for the plant *Nigella Sativa*, to be discussed below on page 41. This analysis would render the first word plausibly as KNT/ə/IR = '*Centaur'* and the whole phrase as roughly KNT/ə/IR CH/ə/UR, perhaps signifying '*The Centaur Chiron'*, on the basis that Greek names commonly dropped their endings when they were borrowed into other languages (e.g. Aristotle is Aristo in Hindi, and Chiron is known as Chiro even in older Western sources such as Lempriere 1843).



The first words of the second paragraph of the 'Centaurea page', F2r. The first two are proposed to read KNT/ə/IR CH/ə/UR, the name of the Centaur Chiron

Figure 15: First words of f2r

If we then look at the page as a whole, this reading is also plausible in terms of the anticipated genre, since it suggests that the function of the first paragraph is to give information about the plant itself, while

[10] I am grateful to Elaine Schmidt for this suggestion.

the function of the second is then to provide what is called the *aetiology*, namely the medicinal, historical background as to how this plant came to be used and why the plant is known to be medicinally effective. In short, in terms of both script and genre this appears to be a satisfactory reading of the two words.

If this is correct, the reading of the second word could be summarized as follows:

VM script			
Possible reading	/kʰ/ or /x/ or / tʃ/ X or CH	/ə/ or /u/	/ur/ UR
Gloss and provenance	Assumed to be aspirated Kʰ, or X (as in the Scottish 'loCH' and Arabic 'KHartoum') or like CH as in 'chess'	/u/ or /ə/ as in /taərn/ and Coriander gloss above	Assumed to parallel Latin /u/ plus variant of /r/

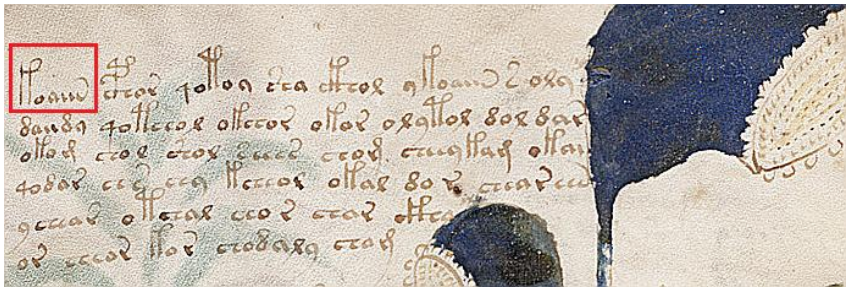
Testing the validity of the analysis

If the analyses above are to be considered valid, they must demonstrably assist us in reading the first words of other VM plant pages convincingly as the names of the plants depicted on those pages. In other words, the test which this analysis must pass, if it is to be convincing, is whether or not we can now use the signs we have so far analysed to identify more Voynich plants with appropriate plant names as the first word of the page. If we can do this, then the signs we have identified will be more credible, and the analysis as a whole is more likely to be accurate.

This is difficult, as many of the Voynich signs are still unknown. Furthermore the plant names could well be in an obscure non-European language, given the fact that we already have one name possibly borrowed from Arabic/Hebrew (Arar for Juniper), and another also apparently in Abjad and non-European form (KNT/ə/RON for Centaurea); in addition, if the marginal addition to the 'Coriander' page (f41v) does represent the more European version of 'coriander' as suggested above, this implies that the undeciphered first word of that same page might be a very different, possibly obscure name for the same plant. This combination of unknown letters and still obscure underlying language means that the task is still a difficult one.

Hellebore

However, it is still feasible to test the signs we have so far identified. With this in mind we can turn to consider page *f3v*, which can be seen below (Figure 16). Following the usual procedure I consider first the identification of the plant, and then discuss the first word on that page.



Voynich manuscript *f3v*, 'Hellebore page', in full and with detail of the first line and first word

Figure 16: 'Hellebore'

Step 1 (plant identification): Sherwood identifies this plant as Dungwort or Bear's foot (*Helleborus foetidus*), referring to its "thick, succulent stem; palmately compound leaves; drooping green, cup-shaped flowers; and short rhyzomes for roots" (Sherwood 2013). Whilst her specific identification of *Helleborus foetidus* may be overconfident, it does seem plausible that it is a species of the genus *Helleborus.*

Two sorts of hellebore were commonly identified in antiquity for medicinal purposes, called black and white respectively on account of their roots. Dioscorides recommended the black hellebore as a cure for melancholia, and as a purge, while white Hellebore was used as an emetic (Leyel 2007:223) and also used as a sneezing agent. Although the white hellebore is now considered a different genus and species altogether (*Veratrum album*) the visual resemblance of the two is still plain to see. However, given that the black hellebore was far more prominent in ancient herbal remedies and mediaeval herbal manuscripts, the VM picture could well represent *Helleborus niger*.

The VM drawing has prominent roots, as befits a hellebore, and distinctive leaves which resemble the 'bear's foot' shape which gave it one of its common English names. The leaves can be compared with those in the modern photograph below of *Helleborus foetidus* (Figure 17) and also with the images of black hellebore from the *Harley herbal 3736* and the earlier *Egerton herbal* (Figure 18, page 35), both of which show slightly jagged leaf shapes, not identical with the VM version but reminiscent of it. A much earlier Greek herbal, the 6th-7th century *Naples Dioscorides* depicts the black hellebore with similarly distinctive jagged leaves and a reddish flower, as can be seen in Figure 19.

A photo of *Helleborus foetidus*
(Sherwood 2013, 'from Wikipedia')
Figure 17: Helleborus foetidus

Elleboro nigro (Black hellebore), *Harley herbal 3736*, f35r, 16th century

Egerton herbal between c. 1280 and c. 1310 f. 36 'Elebor nigru'(Black Hellebore)

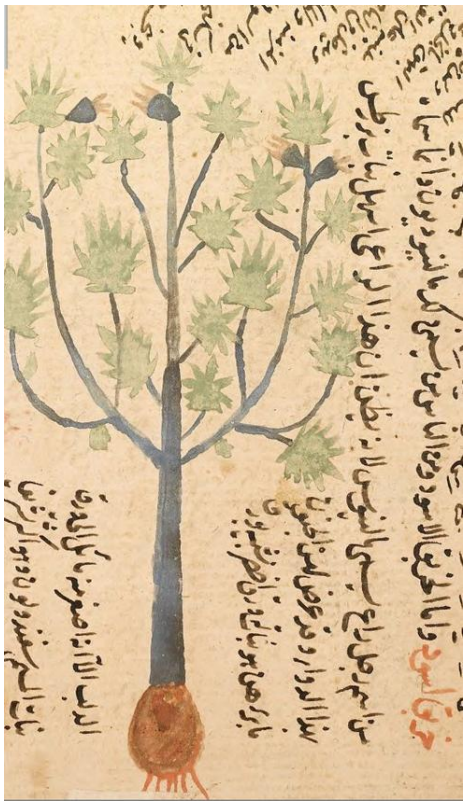
Figure 18: Images of Hellebore

Black Hellebore from the Naples Dioscorides

http://www.wdl.org/en/item/10690/

Figure 19: Black hellebore

In mediaeval Arabic herbal manuscripts the hellebore is called *Kharbaq*, with both white and black varieties commonly cited and discussed. To my mind an illustration which, although stylized, has several features similar to those of the VM picture, is that in the *Princeton Arabic herbal* (see Figure 20). In this image we see not only clear purple flowers/pods just as in the VM, but also oddly jagged leaves themselves resembling bears' feet. Another Arabic version, also with similarly purple-blue flowers and jagged leaves, is found in the Leiden Dioscorides, and can also be seen in Figure 20. These might suggest a possible Arabic influence on the VM illustration, although in other respects the Arabic versions are highly stylized, while the VM version is approaching the three dimensional.



Kharbaq aswad (Black Hellebore)
15th century
http://pudl.princeton.edu/viewer.php?obj=2801pg40q#page/89/mode/2up

Kharbaq aswad (Black Hellebore)
Leiden Dioscorides f176b
11th century
https://socrates.leidenuniv.nl

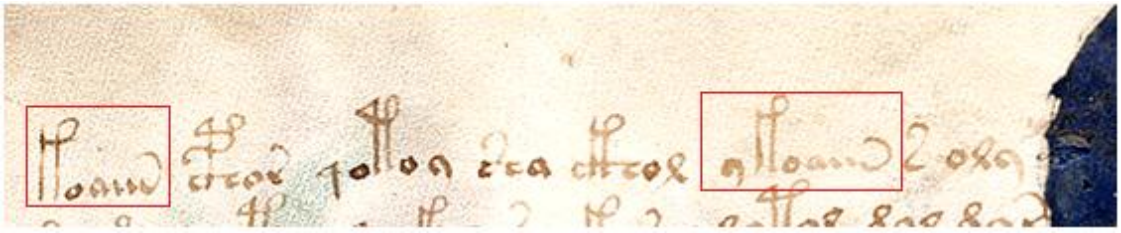
Figure 20: Mediaeval Arabic depictions of black hellebore (kharbaq aswad)

Although the VM plant depicted on f3v is therefore still odd in some respects, it can nonetheless be considered with some confidence to represent a species of the genus *Helleborus*, most probably black

hellebore owing to the resemblances with the depiction of black hellebore in other mediaeval herbal manuscripts, including Arabic herbals, but perhaps another species such as *Helleborus orientalis*.

Step 2 (nomenclature): The first line of the page is reproduced below, in Figure 21, in which it can be seen that the first word of the page appears to be repeated again near the end of the same line, apparently with a prefix. Both are highlighted in the Figure. (Incidentally, this increases the likelihood of it being the name of the plant in the picture, and also decreases the likelihood of the page being the result of a hoax created using a stochastic process).

If we adopted a European perspective and anticipated some form of the word 'hellebore', we would be disappointed, since the first word on page *f3v* in the Voynich manuscript looks nothing like any known version of the Greek word.



The first line of text on the 'Hellebore' page, with two words highlighted

Figure 21: First line of 'Hellebore' page, f3v

VM script				
Reading	K /k/	A /a/	/ə/	UR /ur/

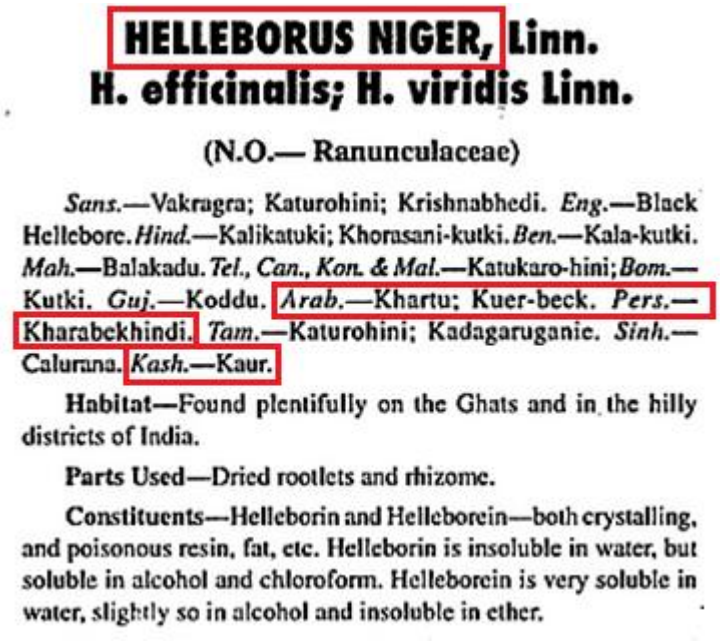
Figure 22: Possible reading of first word of f3v

On this occasion I decided to test of the analysis as a whole. To this end, instead of searching widely for possible plant names which might fit, as I did with previous examples, I directly translated the word according to my scheme so far, and read it as KA/ə/UR (see Figure 22), a word unfamiliar to me. In order to test out whether this reading could possibly be correct I simply typed '*Kaur Hellebore'* into the Google search engine[11]. To my surprise and gratification, this immediately offered a possible solution, since it returned numerous references to the name 'Kaur' as an name for the black hellebore, many in Indian

[11] Other search engines are available

herbal guides. When I did this in July 2012, the first result which Google produced was the book by Panda on Indian medicinal herbs (Panda 2000:311) a page of which is reproduced below (

Figure 23) with my highlighting.



HELLEBORUS NIGER, Linn.
H. officinalis; H. viridis Linn.

(N.O.— Ranunculaceae)

Sans.—Vakragra; Katurohini; Krishnabhedi. *Eng.*—Black Hellebore. *Hind.*—Kalikatuki; Khorasani-kutki. *Ben.*—Kala-kutki. *Mah.*—Balakadu. *Tel., Can., Kon. & Mal.*—Katukaro-hini; *Bom.*—Kutki. *Guj.*—Koddu. *Arab.*—Khartu; Kuer-beck. *Pers.*—Kharabekhindi. *Tam.*—Katurohini; Kadagaruganie. *Sinh.*—Calurana. *Kash.*—Kaur.

Habitat—Found plentifully on the Ghats and in the hilly districts of India.

Parts Used—Dried rootlets and rhizome.

Constituents—Helleborin and Helleborein—both crystalling, and poisonous resin, fat, etc. Helleborin is insoluble in water, but soluble in alcohol and chloroform. Helleborein is very soluble in water, slightly so in alcohol and insoluble in ether.

Page from Panda (2000:311)
(Highlighting added)

Figure 23: Hellebore in an Indian herbal

This shows clearly that the word *Kaur* is used for Hellebore in Kashmir, and that cognate names are also used in a variety of other languages, many including the pattern *K + vowels + R*, or the possibly cognate *K + vowel + L*, and *KH (/x/) + vowel + R/L*. Salient among these in Panda's spelling are: *Khartu*[12] *and Kuer-Beck* in Arabic, *Kharabekhindi* in Persian/Farsi, ***Khor****asani-kuti* in Hindi and so on. Other works on Indian plants report similar nomenclatures, most frequently *Kaur* in the Punjab.

This gives immediate and graphic support to the possibility that the first word on the VM page f3v is indeed some form of the name *KAUR*, meaning hellebore, as my analysis predicted. This in turn supports the larger analysis above regarding other plants and names, and lends further support to the method as a whole.

At first glance it might also seem to imply that the word *Kaur* could be of Indian origin. However, more systematic investigation into the etymology produced a more complex and nuanced picture, which can now be explored.

[12] Panda's reference to an Arabic word *Khartu* for hellebore may be in error. No corroboration can be found for it in Arabic sources.

Etymology of the pattern 'K + vowels + R' meaning black hellebore

The earliest available instance of the pattern '*K + vowels + R'* meaning hellebore appears to be the Sumerian KUR.KUR (Campbell Thompson 1949:151). In his earlier research Campbell Thomson took this form definitively to refer to black hellebore, saying that "…KUR.KUR thus coincides very closely in almost every way with the ancient black hellebore", though he added the caveat that "even in Assyrian times it is possible that white and black were confused." (Campbell Thomson 1924:671). In his later authoritative *Dictionary of Assyrian Botany*, he was less sure, associating the name rather with White hellebore (*Veratrum Alba L.)*, linking it also with the delightfully onomatopoeic synonym *a-ti-šu* referring to white hellebore's use as a sneezing powder.

In the same discussion Campbell Thomson cites the Akkadian "*qarbuhu*" which can be seen also to contain a variant of the pattern '*K + vowel + R'*, this time with the guttural semitic consonant transcribed as Q. He compares this with the Arabic *ḫarbaq* (or *kharbaq*) and the Syriac *ḫurbakhnâ* (both beginning with the sound /x/ like the last sound of the Scottish word 'loch'). The Arabic form *kharbaq* was the standard mediaeval Arabic base word for hellebore, with the adjectives 'white and 'black' added to distinguish the two; for example, the Princeton Arabic herbal, seen already in Figure 20 above, shows the plant called *kharbaq aswad*, black hellebore, and the Arabic word can be seen in red to the right of the first picture.

The second part of the Arabic word, i.e. "-baq" would appear to derive from the Persian word *beḵḫ* meaning 'root', indicating again that the first part, 'khar', is a separable lexeme for the plant itself. This analysis is supported, curiously, by two Georgian loanwords for hellebore, namely *ḫarbaqi* and *ḫarisjira*, both beginning with the /x/ or 'kh' sound. The first of these is cognate with the Arabic and Persian *'kharbaq'*, while the second literally means root (*jira*) of the *ḫar*, (Apridonidze et al. 2006). This once again supports the analysis that the '*K + vowels + R'* pattern is a separate lexeme indicating one variety or other of the plant hellebore, in this case with the KH variant: *KHAR*.

From this trail of evidence, then, the appearance of the pattern *K + vowel + R* in modern Indian herbals can be explained not necessarily as a native Indian form, but as a probable early borrowing from Sumerian and Akkadian, transmitted eastwards perhaps via Arabic and/or Persian, in some cases retaining the pronunciation *kaur* with the harder /k/ sound (as in Punjabi *kaur*) in preference to the Arabic/Persian *khar* with /x/ (kh).

Subsequently it appears to have been associated with, or confused with, a native Indian plant whose formal species name even today retains the *K + vowel + R* pattern: Picrorhiza ***kurr***ooa. This plant has

some of the features of *Helleborus niger,* but is not identical. Baden-Powell offers an insightful account of how the process of transmission and re-identification probably occurred, referring to a number of drugs which, in his analysis, *"…..were introduced by the Mahomedan hakims who had studied from the Arabian school of medicine who, themselves, derived their knowledge from the Greeks."* (Baden-Powell 1868:318). He then attributes to these 'hakims' (wise men) the credit for introducing numerous Greek drugs to India, and refers by way of example specifically to the black hellebore, calling it 'Kaur':

> *"To these [hakims], without doubt, are owing the use of a few drugs which are not native to India, such as Hellebore…… It is now certain, that, in the Punjab at least, most of these medicines, although resembling somewhat the drugs used by the Greek physicians in appearance, are widely different in nature, and are generally derived from plants which are really natives of India. Thus it will be shown that the specimens called "kálí kútkí" which in most books of Indian medicine is [sic] termed Helleborus niger, is in reality exactly similar to "kaur," the produce of the Picrorhiza [kurrooa]."* (Baden-Powell 1868:318 Emphasis in original).

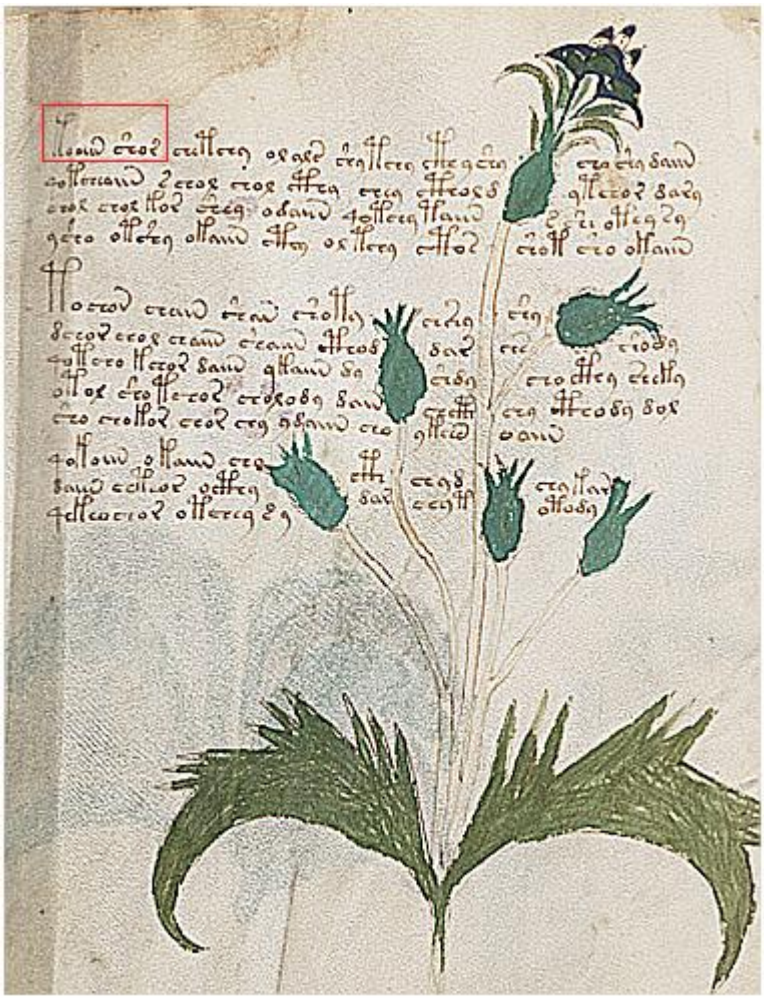
A final irony is that, as we saw in Panda's list above, one current Farsi/Persian word for black hellebore is *Kharabekhindi*, literally 'Indian Khar-root'. This implies a *re*transmission of the plant and its name back westwards to Persia, but now with new Indian 'branding'.

In summary, there is therefore strong evidence for the idea that the pattern '*K + vowel + R'* represents an even older word for hellebore than the Greek version, and was known in one form or another for centuries across a wide area as the name of that plant. The name appears in the Caucasus (with the two forms seen above in Georgian, and also a form of *kharbaq* in Armenian, according to Kouyoumdjian 1981), across the Middle East and into India, with slight variations in the realization of the first consonant and the vowelling, in a manner which is normal across such a wide geographical and historical range. It sometimes also has the suffix 'baq' or similar, meaning 'root'. For example, we noted its appearance in mediaeval Arabic herbals as *kharbaq* for black hellebore, with illustrations.

I suggest for these reasons that the reading of *KA/ə/UR* as the name of the Voynich plant on *fv3* is highly plausible, indeed likely, and that Sherwood is correct to interpret the plant illustrated as a species of the genus *Helleborus*, though perhaps not the more European *Helleborus foetidus*, but possibly *Helleborus niger* or *orientalis*. The analysis of the name in this way is, in addition, supported by and in turn supports the reading of other plant names above. I suggest that it therefore renders the analytical procedure used in this paper, and the resulting decoding as a whole, the more plausible.

Nigella Sativa

Continuing the attempt to examine the first word of plant pages and matching them with the plants depicted, let us consider the case of page f29v (Figure 24):



Folio 29v

Figure 24: f29v, 'Nigella Sativa' with first words highlighted

Nigella (Katzer 2013)

Figure 25: Images of Nigella

Step 1 (plant identification): This plant can be identified with relative confidence as *Nigella sativa*, largely because of the distinctive seed pods and leaves, which can be seen in images from Katzer's website reproduced above (Figure 25). Both Velinska (Velinska 2013) and Sherwood agree on the identification, the latter offering also the following description:

> *Roman coriander (Nigella sativa), is an annual plant in the ranunculus family, native to Southern Europe, North Africa, and Southwest Asia. It has finely divided, linear leaves and pale blue or white flowers with 5 to 10 petals. The fruit is a balloon-like capsule containing numerous seeds. The seeds are frequently referred to as black cumin…* (Sherwood 2013)

As seen from the name, which derives from the Latin *niger* (black) the defining feature of this plant has always, and across different cultures, been the black colour of the seeds, which have a long history of use in cookery and medicine, being found even in the tomb of Tutankhamen (Peter 2004). However, they have frequently been confused with the seeds of other plants such as *Bunium bulbocastanum* (see Figure 26) and also Caroway (*Carum carvi*), all of which have been called 'black cumin'.

Images of two plants used to make 'Black Cumin': Bunium Bulbocastanum and Nigella Sativa (Wikipedia: Black Cumin)

Figure 26: Black Cumin

Step 2 (nomenclature): As can be seen in Figure 27, the first word on that page is the same as the word already analysed as KA/ə/UR, for hellebore. This at first appears anomalous, but when read with the second word it can be interpreted as KA/ə/UR CHAR, as set out in Figure 28.

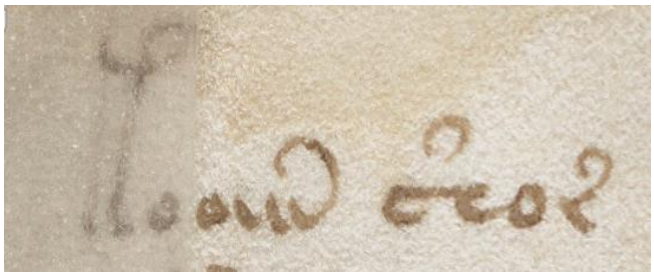


Figure 27: The first words on f29v

VM script								
Possible reading	K /k/	A /a/	/ə/	UR /ur/		CH / X /tʃ/ or /x/	A /a/	/r/ R

First word of 'Nigella Sativa' page f29v, with possible interpretation

Figure 28: Interpretation of the first words of f29v

The first sign of the second word has already been analysed as possibly the first sound in the name Chiron (see page 31 above), which would give it a possible reading of /tʃ/ (CH) or /x/ (KH). This is cognate with

words in dozens of languages in Asia and the Near East, suggesting the possible meaning of the colour 'black'. The list in the Appendix below (page 58), taken from the Omniglot website'[13], lists over 30 languages, mainly in Asia, which use some form of the same pattern to mean 'black', resembling variants on 'kara' (Ch/K/KhK + vowel + R/L + vowel). They range from Turkic languages (such as Turkish 'kara' and Mongolian 'xar') to Indian languages (Hindi kālā, Gujarati, kaaro), to probable borrowings into Japanese (kuro). Slavic languages also use a similar pattern, but with a suffixed /n/, e.g. Russian чёрный = čornyj – with a /ʧ/ as first consonant.

This strengthens the possibility that the second word on page f29v of the Voynich manuscript should be read 'CHAR' or 'KHAR' or similar, possibly to mean black, so as to fit with the main perceived characteristic of the *Nigella* seeds. However, it is also possible that the first word, which we read as 'Kaur' could equally be related etymologically to the word 'black'. In the previous section we noted that in the sense of 'hellebore', it appears traceable back to the Sumerian KUR.KUR, but it could at the same time also be related to the Sanskrit root 'kāla' or 'Kṛṣṇa' meaning black (cf. Sanskrit: karsnya meaning blackness)[14], on account of the plant's black roots.

For this reason it is not clear whether, in the construction K A /ə/ UR CH/X A R the origin of both words derives from the idea of blackness, through different routes, or whether the second means 'seed', related to the Persian 'zireh', which was also adapted eastwards with /j/ and /ʧ/ as the first consonant (Katzer 2013) as shown in Figure 29.

VM	**K A /ə/ UR**	**CH/X A R**
Hindi	kala	jeera
	kalo-	jira
Tamil	karum	cheerakam
Sanskrit	krsna	jira[15]
Persian		zireh
English	***black***	***cumin***

Figure 29: Terms for Black Cumin

Furthermore, since the seed was also commonly confused with Caraway, we cannot rule out a link between the Voynich words and the Latin *Carum Carvi* (Caroway), or Sanskrit *karavi*, and other variants, as set out in Figure 30.

[13] http://www.omniglot.com/language/colours/multilingual.htm
[14] Related both to Krishna in Hinduism and also to the goddess Kālī,.
[15] http://spokensanskrit.de/

VM	**K A /ə/ UR**	**CH/X A R**
Latin	Caru - m	carvi
Arabic	Kara - waya	
Sansrkit	Kara - vi	
Greek	karo	
English	***Caro - way***	

Figure 30: Terms for Caroway

To summarise, the precise meaning of each part of the first two words of f29v, which is taken to name the plant Nigella Sativa pictured alongside, is not entirely clear; it would seem to read either 'Kaur black' or 'Black Seed'. However, the important point for this paper is that both interpretations allow a plausible link between the words and the illustration, and both support the overall analysis of the sounds and letters in this paper. In short, further analysis will help to elucidate precisely what those words signify, but in either case the argument for the sound-letter analysis presented so far is strengthened.

Other possible plant names

It has been suggested above that the approach adopted in this paper, of examining the pictures closely, identifying the plants, then examining the first words on the plant pages, could arguably allow us to identify more sound-letter correspondences through the same process of comparison, and so allow us to decode the script in full. This could then allow more progress to be made on the second phase of decipherment, which might entail identification of the underlying language, or might require the language to be reconstructed.

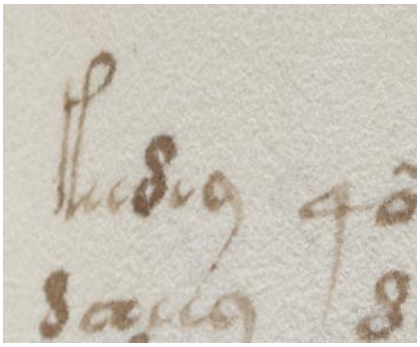
However, as also noted above, I do not underestimate the difficulty of the next steps. Many of the first words on the plant pages contain what are known as 'Gallows' characters, with elaborate decorative swirls. It is not clear whether these are letters identical in sound to other non-decorative letters, or different letters entirely, or merely ornamentation. Some of them overlay, and overlap with, other signs in a manner also obscure. Many of the plant illustrations are odd and insubstantial. For these reasons I anticipate that the path towards full decipherment will still be a long and painstaking one.

However, a few of the first words on the plant pages do seem more amenable to explication, so before moving to a final discussion of the manuscript, I propose briefly to examine two of these. These concern the plants on pages f31r and f27r respectively. Unlike the plants discussed above, it has not been possible to research these in detail as yet, and – as will be apparent – their identification and naming still require verification.

Cotton

Below, in Figure 31, can be seen the first word on page f31r, and in Figure 32 is a proposed decoding based on the signs discussed previously. It will be seen that, drawing on signs which we have seen before, the word can arguably be read as 'KOOTON', and it is tempting to see this as indicating 'cotton'. The word cotton came into English from the Old French coton (12c.), and ultimately (via Provençal, Italian, or Old Spanish) from Arabic ***qutn***, and is perhaps ultimately of Egyptian origin[16]. The name for this plant with the basic structure 'K/Q + T + N', which we still have in English, was known from Western Europe (thanks to the Arabic influence in Spain) through into many parts of Asia well before the date of the VM.

The plant pictured on f31r



The first word on page f31r, provisionally read as 'K OO T O N'

Figure 31: f31r – 'Cotton'

VM script					
Possible reading	K	OO	T	O	N
Gloss and provenance	/k/ as in Coriander And Centaurea	As in Coriander	/t/ as in /taərn/ and Coriander	As in Coriander	As in Centaurea

Figure 32: proposed possible analysis of the first word in f31r

[16] (http://www.etymonline.com/)

However, it is not clear that the plant depicted on this page of the VM is in any way similar to known cotton plants. In the first place it is unusual to have cotton in a mediaeval herbal manuscript. Secondly, it would be curious if anyone wishing to depict cotton neglected to show the crucially important white cotton buds themselves, which do not appear in the VM illustration. Even so, this might not in itself rule out the identification with cotton, since plant illustrators have been known to depict cotton with scant reference to the cotton bud itself. To take one example, Figure 33 shows an illustration of Levant cotton, or Wild cotton, an Asian and Indian variety, in which the cotton bud is not apparent, but of course the leaf shape of this variety is very different from the VM plant. It is also possible, of course, that the VM authors were illustrating a plant they had never seen.

In short, notwithstanding the reading of the first word as *KOOTON*, it is not certain whether this page depicts cotton or not, so the analysis will require more corroboration before it can be accepted.

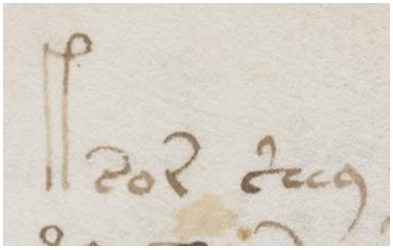
Gossypium herbaceum
http://www.illustratedgarden.org/,
from(Roxburgh et al. 1795-1819

Figure 33: Gossypium herbaceum

Indian crocus

Likewise, the main plant in f27r, (illustrated in Figure 34 below), is difficult to identify with any certainty. However, the first word of the page appears, on the basis of the analysis above, potentially to read K ? A R.

f27r Indian crocus = Kesar?



First word of p f27r

VM script				
Possible reading	K /k/	/s/	A /a/	R /r/

Figure 34: f27r, with a possible reading of the first word

There is no supporting evidence as yet for identifying the unknown sign, but if it were read speculatively as indicating the sound /s/, on the basis of its shape, a reading could be KSAR, which is reminiscent of a common Indian name for the Crocus (i.e. *kesar*), from which saffron is obtained. However – as is typical of the obstacles involved in analysing the Voynich plants – the leaves of the VM plant in the picture are unlike the grassy leaves of *Crocus sativus*, the most common variety, and the source of saffron itself. For this reason it is tempting to identify the VM plant with another variety, such as *Colchicum Autumnale*, often also called *Kesar*, which could be a closer match. Figure 35 shows an illustration of this plant, showing the larger leaves, and also the dessicated seed pod (bottom left), which vaguely resembles the pods in the VM illustration.

http://en.wikipedia.org/wiki/File:Illustration_Colchicum_autumnale0.jpg

Figure 35: Colchicum Autumnale

Even so, as with cotton, it seems odd that an illustrator who has seen the crocus would illustrate it without showing its best known features, namely the flowers or stamen. For this reason this identification, as in the case of *cotton*, must remain speculative on the evidence available.

Discussion

We can now turn to more general discussion, summarising the findings so far and considering the implications for the language of the Voynich manuscript, and its possible provenance and authorship. My

aim is not to offer an overarching 'big theory' of the kind discussed on page 8 above, since in my view the evidence for any such theory is still too sketchy and contradictory, and can lead to false interpretation of the evidence. Nonetheless, the evidence in this paper does allow a few comments which might move the argument forward.

Evaluation

Although the reading of some of the proper names proposed in this paper might be erroneous, I suggest that the weight of corroboratory evidence from the group of names together, with each of their shared signs supporting and supported by the readings of each other, is evidence of a degree of successful decoding. This means that for the first time we can claim with some confidence to have successfully read a number of words in this mysterious document. In particular, the naming of the constellation Taurus, the plant Centaury, the centaur Chiron and the plant 'Kaur' for hellebore, seem to me to be most persuasive.

Purpose and function of the Voynich manuscript

These strands of evidence allow us to reach a number of broad though tentative conclusions about the Voynich manuscript, as follows:

a) **The Voynich manuscript is not a hoax**. It is a meaningful text, encoded in an unknown script.
b) **The script is not an elaborate cipher**, but resembles normal human scripts, with more or less regular sign-sound correspondences.
c) **The content of the manuscript, at least on the plant pages, seems to be completely in accordance with its outward appearance**, namely information about the plants and perhaps their medicinal and other uses. If we look back at the earlier description of typical features of mediaeval herbals (page 11 above), every one of them is evidenced in the analysis in this paper. In other words, the manuscript is probably not a trick document disguising secrets behind a different genre.
d) If the plant pages are representative of the document as a whole, **the Voynich manuscript is probably an explanatory treatise** setting out descriptions of the natural world, with analysis and possible prescriptions for action.
e) Since the language appears to borrow from a variety of cultures, **the manuscript appears to act as a type of manual for interpreting and transmitting information across cultures**.

This would seem largely to rule out more arcane or conspiracy theories, although it is still not entirely certain whether the script is designed for concealment or communication.

Script features of the Voynich manuscript

As noted above, it is important to distinguish between the *script* itself and the underlying *language*, so they will be considered separately. In terms specifically of the script, we can deduce the following:

f) ***Vowels***: the Voynich script shares some features with 'Abjad' languages in its omission of some vowels, perhaps those in unstressed position. However, other vowels are indicated in the script, possibly when long or in a stressed position;

g) ***Varying forms***: some consonants (e.g. /r/) appear to vary in shape according to their position in a sentence, and also their position in a word. This might indicate that they have a different inherent vowel, in the manner of some Abugida scripts, either before the consonant (e.g. /er/) or after it (/re/), which may be indicated by the varied shapes.

The underlying language

It is also possible to draw some general inferences about the underlying language of the manuscript. On the evidence of this paper there is no reason to believe that the script encodes more than one language. As regards which language it might be, this is still unknown.

h) ***Europe***: Besides the long-recognised European pictorial elements in the VM, such as the 'castles'[17], and the archer in the 'Sagittarius' page[18], as well as the 'European appearance' of many of the human figures, it is possible that some of the linguistic elements analysed in this paper also have a European origin. In terms of the script, examples included the possible /t/ sign with the Greek theta, the sign read as /k/ with the Greek 'K'. However, a complication is that although the consonants seem to correspond with the Greek equivalents, the vowels are more ambiguous. In terms of content, the fact that the language seems to include references to both Taurus (though perhaps in non-European form) and also to Chiron the centaur, suggest a European flavor. On balance, then, **the analysis in this paper confirms a European element to the manuscript**. However, with regard to the linguistic elements and plant names considered in this paper, e.g. 'Kaur' for hellebore, **the underlying language is probably not European**.

i) ***Near and Middle East***: A number of plant names seem be borrowed from Near/Middle Eastern sources, for example 'arar' for juniper (from Arabic/Hebrew), the form resembling the Arabic QNTURYUN and modern Turkish KANTARON for Centaurea, and the word 'Kaur' for

[17] http://www.voynich.nu/illustr.html
[18] http://www.voynich.nu/origin.html

hellebore. Echoes of illustrated Arabic herbal manuscripts also suggest a possible element of interaction with Arabic cultural traditions. However, at this stage it is not possible to identify the underlying language as a whole with any known Near East language, and indeed these words could be simply borrowings. Several of the plants discussed also appear to have a Near Eastern connection. If the 'arar' plant is indeed *Juniperus oxycedrus*, then the distribution of that plant extends across the Mediterranean, the Caucasus, and as far east as Iran. The hellebore identified on page f3v also has an eastern appearance, and is unlike European varieties. Taken with the linguistic aspects, this suggests that a possible Near/Middle Eastern influence, and possibly language.

j) ***Caucasus***: Not only do several countries in the Caucasus have early herbal and script traditions, including Georgia and Armenia, along with Christian links which would fit elements of the manuscript, but some of the local languages also show evidence of the words discussed in this paper – Georgian for example uses the words *arari* for juniper seeds, *Harbaqi* for hellebore, and *kentavri* for centaur. In addition, a number of the plants discussed, such as hellebore, *Juniperus oxycedrus* and *Centaurea* are found in the region, all of which could suggest a Caucasian influence.

k) ***Indian subcontinent***: Some of the plant names discussed in this paper appear to have an Indian subcontinent resonance, the most salient being 'kaur', still used in the Punjab for hellebore, but also names for *Nigella sativa* such as the Hindi *kalajeera*. Any argument for an Indian provenance to the manuscript would, however, need to explain the apparent European elements in the manuscript. In any case it may be simply that many Indian languages have preserved Indo-European linguistic forms which could once have existed in other Indo-European languages such as Farsi/Persian as well as many European languages such as Greek. In other words, it is important not to be seduced by apparent resemblances between words in the VM and the host of possible Indian equivalents, without good evidence. However, some influence from the Indian subcontinent cannot be ruled out, including linguistic influences.

l) ***Turkic cultures***: One of the largest language families to be considered as possibly influencing the VM is the Turkic, which includes languages as diverse as Turkish, Azeri, and Mongol. Although the evidence for Turkic influence in this paper is slender, the form of the word *Kantaron* for Centaury appears on Turkish and Azeri, as does the form 'kara' for 'black'. Although the agglutinative nature of Turkic languages seems not to resemble the VM word patterns, a Turkic influence cannot be ruled out.

In summary, the language of the Voynich manuscript is probably not European, but is more likely to be Near Eastern, Caucasian or Asian. We need further evidence to see whether it is of Indo-European, Semitic, Turkic, Kartvelian (e.g. related to Georgian) or from another language family.

Who wrote the manuscript? Where?

It is of course not possible on the evidence discussed in this paper to offer any definitive view as to the authorship or provenance of the Voynich manuscript. However, given that it appears to encode a meaningful language, and to constitute, in essence, a treatise concerning the natural world, perhaps to be communicated to a particular culture, it is possible to speculate.

It is feasible that the script is a deliberately constructed cipher designed to hide information of some sort. However, given the fact that the plant pages seem in practice to concern the plants depicted, presumably offering knowledge which was available to others already, it is more likely that the script is not aimed at concealment, but was instead constructed simply to write a language which had not previously been written down. To put it another way, if the underlying language already had a script (such as Georgian, or Arabic, or Greek), it seems highly unlikely that anyone would invent a whole new one merely to encode information about plants and nature which was already known.

The example of the Glagolitic Slavic alphabet, mentioned above (page 12 et seq.) is illuminating. It was invented by a small group of people, possibly two brothers, to write down a Slavic dialect which had no writing system up to that point (Sussex, Cubberley 2006, Auty 1968). In terms of influences, the inventors took signs from a variety of sources, perhaps Greek, Hebrew, Coptic, Armenian and Samaritan, so as to represent the sounds of the particular dialect, though the results "bore little resemblance to any other alphabet" (Fine 1991:136). In terms of purpose, it is possible that they were seeking to promote Christianity. As mentioned earlier, the most famous document in this invented script, the Kiev Missal, was probably written in Bohemia in the 10th century but was then found in the 19th century as far away as Jerusalem (Vlasto 1970). The Glagolitic script survived for many centuries, but if, for example, the small community had been extinguished early, the script could have suffered the same fate as the Voynich script.

Cultural extinction theory

This precedent suggests that the Voynich script could have been created by a small group wishing to encode a previously unwritten language or dialect. This could be done, as in the case of Glagolitic, by borrowing and adapting signs from other scripts and devising others as needed. This group could then have attempted to use that script to write down a body of knowledge about plants, the stars and so on

drawing on classical and other authorities, in what we now know as the Voynich manuscript, only then for the culture to die out or disappear. Given that the 15th century was a time of upheaval, in Europe in the Balkans, in the Near East with Timurid expansion as far as Turkey and the Black Sea, and also with the fall of Constantinople to the Ottomans in 1453, it is plausible to consider this 'cultural extinction' to be a possibility, with the group in question developing a script and literacy, only for it to be extinguished. Other examples of script which have been devised, only for those who can read it to die out include the interesting *Rongorongo* script from Easter Island[19], which again attests to the viability of the theory. This does not mean that the language itself was extinguished of course; it is possible that related dialects are still in existence.

Conclusion

This paper avoids an overarching 'big theory' analysis, but follows a more small-scale, cautious and systematic 'bottom-up' approach, following precedents such as that of Ventris with Linear B and Young and Champollion with Egyptian hieroglyphs. Through this approach I hope to have contributed to the debate in at least two ways, namely in the areas of decoding, and of methodology.

Decoding

Through analysis of a number of illustrations in the manuscript, including one constellation (Taurus) and seven plants, then drawing on European and Middle Eastern mediaeval manuscripts and contemporary nomenclature, I have proposed the systematic identification of a set of proper names in the Voynich text, giving a total of *ten words* made up of *fourteen* of the Voynich symbols and clusters. The full scheme is set out in Appendix 1 (page 56) below. In my view some of the identifications are relatively strong – I would single out the readings of Taurus, Centaurea, and 'kaur' in particular. In fact, my belief that the analysis was on the right track was most strongly reinforced when, seeking to test my proposed reading of the word 'KAUR' as a reading for the plant hellebore, a word I had never seen before, I tested it in an internet search engine and immediately found a perfect matching term, which seemed to me to be beyond all possibility of coincidence. Of course, corroboration of this reading then took some ten months of library research, with the results set out above.

Methodology, and the future

Secondly, I hope that I have contributed to the field by proposing and demonstrating a potentially successful method for the continued investigation of the Voynich manuscript, namely via proper names and careful plant identification, so that we can gradually seek to build up a full scheme of sound-letter

[19] http://en.wikipedia.org/wiki/Rongorongo

correspondences. This might then allow the identification of the underlying language, or a reconstruction of it.

It is important not to underestimate the difficulties which lie ahead; this paper offers an analysis which is explicitly both *provisional* and *partial*. Indeed I suspect it will take many months, if not years, to test out, corroborate, and amend the analyses I have set out above, and perhaps several more to come to a full understanding of the document as a whole. In short, this mysterious manuscript still retains most of its mystery. Although we may have laid a rope on the 'white whale of the code-breaking world', it is still swimming free, perhaps to intrigue and baffle us for a long time to come.

Appendix 1: Summary of proposed sign-sound relationships

Figure 36: Summary of proposed consonants

VM script									
EVA transcription		*k*	*y*	*d*	*r*	*m*	*n*	*sh*	*s*
Proposed approximate sound		/k/	/n/	/t/ or /d/ or /θ/ or /ð/	/r/ or /r/ plus vowel	/r/ in sense-final or isolate position	/r/ or /r/ plus vowel	/k^h/ or /x/ or / tʃ/	/s/
Gloss and provenance		From position in Coriander and Centaurea Shape derived from the Greek/Latin letter 'K'?	From position in Centaurea (twice)	From Taurus, Coriander and Centaurea Shape derived from Greek theta?	From Juniper, Taurus and Coriander	From OROM on page 16r (speculative)	From position in Centaurea and Kaur (hellebore)	Assumed to be aspirated K^h, or X (as in the Scottish 'loCH' and Arabic 'KHartoum') or like CH as in 'chess'	From the word 'Kesar' = crocus (speculative)
Proper names	Juniper, 'arar' - see page 13				R	R?			
	Taurus – see page 19			T	R				
	Coriander - see page 22	K		T					
	Centaurea - see page 25	K	N (twice)	T					
	Chiron – see page 31							CH or X	
	Hellebore – 'Kaur' see page 33	K							
	Nigella Sativa – see page 41	K			R		(vowel +?) R	CH or X	
	'Kesar' – see page 45	K					(vowel +?) R		S
	Cotton – see page 45	K	N	T					

Figure 37: Summary of proposed vowels and clusters

VM script							
EVA transcription		*o*	*a*	*in*	*iin*	*e*	*e e*
Proposed approximate sound		/a/	/ə/ or /u/ or /wa/	/ir/	/ur/	/o/	Long version of /o/
Gloss and provenance		Shape derived from Latin?	Shape derived from Latin? Could be /wa/ by its position in /taər/ and analogy with Proto-Indo-European *tawros, *teh₂wros. If so, it could be like Arabic Waw, a consonant and a vowel	Shape derived in part from Latin?	Shape derived in part from Latin?		
Proper names	'Arar' = Juniper: see page 13	A (twice)					
	Taurus – see page 19	A	/ə/				
	Coriander (f41v): see page 22	A					OO
	Centaurea - see page 25		/ə/	IR	UR		
	Chiron – see page 31		/ə/				
	Hellebore – 'kaur' see page 33	A	/ə/		UR		
	Nigella Sativa – see page 41	A (twice)	/ə/		UR		
	Cotton – see page 46					O	OO
	'Kesar' – see page 46	A					

Appendix 2: Words for 'black' in different languages

Words for 'black' of the pattern K + vowel + R/L + vowel in different European and Asian languages

1.	Assamese	কলিয়া,koliya
2.	Aymara	čʾiyara
3.	Azeribaijani	qara
4.	Bashkir	кара,(qara)
5.	Bengali	কালো,(kālō)
6.	Chuvash	xura
7.	Croatian	crna
8.	Evenki	karā
9.	Gujarati	કાળો,(kaaro)
10.	Hindi	काला,(kālā)
11.	Japanese	黒,(kuro)
12.	Karakalpak	қара,(ḳara)
13.	Kharia	karhaini
14.	Konkani	काळे,(kāle)
15.	Kumyk	къара,(ḳara)
16.	Kuwi	କଆରିନି,(kāṛini)
17.	Malayalam	കറപ്പു,(karappu)
18.	Maldivian	ކަލު,(kalu)
19.	Mongolian	хар,(xar)
20.	Nogai	кара,(kara)
21.	Oriya	କଳା (kaḷā)
22.	Punjabi	ਕਾਲਾ,(kaḷā)
23.	Roma(ni)	kalo
24.	Salar	ɣara
25.	Sinhala	කළු,(kalu)
26.	Slovenian	črna
27.	Tamil	கருப்பு,(karuppu)
28.	Tatar	кара,(kara)
29.	Tofa	қара,[qara]
30.	Turkish	kara *or* siyah
31.	Urdu	ﮐﺎﻟﮯ,(kâlâ)
32.	Uzbek	қора,(qora)
33.	Yakut	хара

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