# EXPLORATION OF UNDERGROUND WATER SPRINGS ACCORDING TO THE ANCIENT HINDUS

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In this paper, the author has examined a scientifically based system of exploring underground springs by the ancient Hindus described concisely in a chapter entitled 'Dakārgalodhyāya' in the celebrated Sanskrit work, *Bṛhatsaṃhitā*, written by Varāhamihira, a famous astronomer, astrologer and mathematician of the sixth century A.D. The technique depends upon a close observation of naturally occurring specific signs in the terrain, comprising the flora, fauna, rocks, soils and minerals, whose state and variation can be logically or empirically linked up with the presence of underground springs in the vicinity. Some of the exploration formulae have been examined and presented. One startling factor emphasized at length is the role of termite knolls as indicators of underground water. Relevant scientific literature examined seems to indicate considerable support for this premise and the author has pointed out that it warrants further investigation by the scientists at a multi- or inter-disciplinary level and that one possible benefit from this approach is the better understanding of ecological relationships in nature.

## Introduction

Exploration methods of underground water can be divided broadly into two classes, the instinctive or the intuitive method, and the scientific method. In the instinctive method, the operator depends upon certain instinctive or intuitive sense he happens to possess and uses certain dowsing aids like a forked green twig, a hand-held pendulum or a balanced needle to sense his involuntary muscular reactions to the presence of underground water. The scientific methods, on the other hand, depend upon certain observable signs, such as the presence of certain kinds of indicator plants; termite hills standing by themselves or in association with certain flora; the behaviour of insects and other fauna; topographical characteristics, variation in the soils and rocks and other factors, which can be logically or empirically connected with the movement of underground springs. It is not widely known that the ancient Hindus had developed a scientific system of water divination which is described concisely in the celebrated Hindu Work, *Bṛhatsaṃhitā* by Varāhamihira, who lived in the sixth century A.D. and is famous as a pioneer in astrology and other celestial sciences. This chapter, entitled *Dakārgalodhyāya*, forms the fifty-third chapter of that work, and contains 125 couplets in Sanskrit. The work, complete with commentaries of Bhaṭṭotpala (tenth century A.D.), is published by the Varanasi Sanskrit Viswavidyalaya in two volumes. This helpful commentary in the chapter gives several parallel quotations from Sāraswata who is apparently regarded as the founder of this school of ground-water exploration included in it, and also some verses of earlier authorities such as Manu, and Bhṛgu relevant to this art, helping considerably in tracing its development from ancient times to the days of Varāhamihira and Bhaṭṭotpala.

The word *Dakārgala* can be resolved into (*u*) *daka* + *argala*, *udaka* standing for water, and *argala* for a small bolt or a lynch pin. The word *argala* can also be thought of as being derived from the root *arj* meaning 'to gain', 'to earn', etc. Hence, the word can be translated as either, Key to Water or 'Winning of Water'. The elision of the initial letter '*u*' in the word *udaka* converts it into '*Dakārgala*' which gives it rather an obscure or esoteric character.

The verses concerned with exploration describe some 70 odd field situations or ecological spectra from which it should be possible to deduce the presence of underground springs. The other verses deal with topics such as digging of wells, their alignment with reference to the prevailing winds, dealing with hard refractory stony strata, sharpening and tempering of stone-breaking chisels and their heat treatment, treating with herbs of water with objectionable taste, smell and other undesirable characters, protection of banks with timbering and stowing and planting with trees, and such other related matters. Some thirty-three verses deal with termite standing alone by themselves, or associated with vegetation, thirty with vegetational factors alone, and the remaining using other factors to help in exploration.

## Importance of Termites as a Clue to Underground Springs

A startling factor that is emphasized at length is the importance of termites as indicators to the presence of underground water springs. There seems to be considerable evidence in the current scientific literature to support this premise, and many leading authorities on termitology with whom the author has had the pleasure of corresponding both in India and abroad agree that the factor might be quite germane to the issue and cannot be ruled out.

Termites, often miscalled white ants, are more closely related to cockroaches (blattidae), than to ants, and belong to the insect order Isoptera. At present there are some 1,900 living and fossil species of this faunule described which have been classified into six families and fifteen sub-families, which can be described in lay terms as dry-wood dwellers, damp-wood dwellers, tree dwellers, tree and soil dwellers, ground dwellers, and nest-builders or mound builders. The last variety, the mound builders, are responsible for the impressive epigeous soil structures called the 'Ant-hills' in lay terms, but Termite-knolls, -mounds, -spires, or -prominences by the scientists, which are familiar features of most tropical and subtropical landscape, and the ones that are of interest to us in the technique of exploration of underground springs. These are also referred to as Termitidae or Macrotermes and comprise nearly three-fourths of all known species.[1] Regardless of the species, the termite mounds comprise a complex system of underground tunnels, galleries and rather large vertical shafts, which the faunuies use in foraging for new food resources, or to descend to the underground water table in case of necessity, to obtain supplies of water or moist clayish substances for the construction of certain parts of their nest.[2] Without exception, the water requirements of the insects are generally very high, and they need to protect themselves against fatal dessication by living and working within the climatically sealed environment of their nest or within earth-covered foraging galleries. According to the scientific research literature that the present writer has had the opportunity of examining, the atmosphere within the nest has to be maintained practically saturation moisture level (99–100% relative humidity).[3] It is reported that many incipient colonies perish if exposed to atmospheres as wet as 90–92%. This extreme sensitiveness to dessication is explained by weak chitinization of the body surface. It is a matter of common observation that whenever a termite nest or runway is damaged, the insects immediately rush to the breach and repair it with wet soil brought up from within the nest. It may also be seen that regardless of the season the moisture content of the fresh soil used in the repair is always constant and unvarying, which shows that the insects have, or maintain, access to sources of water at all times, even in the driest of environments. From an over-all consideration of the evidence, it seems to be safe to conclude that, while normally the insects use every readily available source of water close to the ground surface, under conditions of severe environmental or climatic stress, they can and they probably do descend to the water table, no matter how deep it may be.[4] Hence, a well-developed, active, persistent colony of mound-building termites can be taken as an indication of underground springs in the proximity. It would seem that this connection is beginning to be sensed although vaguely by the present-day scientists. According to Grasse and Noriot (1960), the association of Macrotermes and trinervitermes with the water table in the dry Savannahs is clear. In the dry regions of Katanga province (Congo-Kinshasa), the great termitaries of the Macrotermes are seen clearly aligned on the slopes right down to the ooze level.[4] This suggestive alignment of the termite knolls can be observed in many parts of the country, as may be testified to by the present writer who has observed the phenomenon in the dry-jungle uplands of coastal Mysore as well as the Deccan Plateau area. The following verse from *Bṛhatsaṃhitā* suggests that the Ancient Hindus were aware of this tendency on the part of the mound builders:

Valmīkānāṃ paṅktyāṃ yadyeko 'bhyucchritah śirā tadadhaḥ'[5]

'If in a line of termite-mounds one is found to be raised up (taller), water vein is to be found within it' Sāraswata's parallel quotation in Bhaṭṭotpala's commentary says that the depth would be about 4 cubits (6′) but a close examination of the verses show that there is some ambiguity regarding the depth.

In this connection it is interesting to recall a press report that a Soviet Scientist working in the Central Asian desert to the North of Tien Shan ranges has established after several years of research that colonies of the 'Harvester Ant', a desert species of termite, appear only in places having underground water even though it may be over 10 metres deep, and many wells spotted with the help of these hydrogeologists have yielded sweet water. (PTI News item dated May 8, 1971 reported in the Magazine Section of the *Deccan Herald*, May 9, 1971). While this is very interesting, the following exploratory verse in *Bṛhatsaṃhitā* is literally breathtaking.

'Ekasthāḥ pañca yadā valmīkā madhyamo bhavecchvetaḥ
Tasmin śirā pradiṣṭa naraṣaṣṭyāpañcavarjitayā.'[6]

'If a group of five termitaries are found in a place (desert region), and the middle one among them is found white, water should be declared in it at a depth of fifty-five *naras*'.

The unit of depth used by the ancient Hindus is *nara* which is explained in one verse by Sāraswata as comprising 120 *angulas* (digits $= 0{\cdot}75''$). Bhaṭṭotpala amplifies it in his commentary saying that it is the depth covered by an average man standing with his hands extended straight overhead.[7] This would mean that the depth to be declared in this case is $7{\cdot}5 \times 55 = 412\frac{1}{2}$ feet.

## Association of Termites and Vegetation

It is a matter of common observation that many times termitaries are met with in close association with trees, and many trees and plants in flourishing state are found to arise right from the middle of termitaries being none the worse for contact with these faunules, notoriously destructive to wood. There is considerable scientific evidence to say that the mound builders, particularly, will not attack living wood if dry-rot, attacked wood is available. Esenther *et al.* (1961) noted that runways of certain species on trees tended to go straight to decaying parts of the wood.[8] It is significant that the family termitidae among which are to be found the mound builders do not possess the symbiotic protozoa in their guts which in others seem to be responsible for the digestion of the cellulose directly from wood.[9] It is also suggestive that only the mound builders maintain fungus gardens in comb-like structures constructed out of wood pulp and saliva or faeces of these faunules. There seems to be some controversy among certain scientific circles as to whether the constituents of these combs is all faeces or all saliva, but the point seems to make no difference to this particular aspect of association of healthy trees and plants with the termite prominences. It is quite a common sight to see termite mounds inhabited by these insects completely covered over with grass or vegetation, and very close observation is often necessary to detect the termitary at all although it is of considerable dimensions. The ancient Hindus have exploited this association quite extensively in the exploration of underground springs. The following verses may be considered[10]:—

Jambustrivṛitā maurvī śiśumārī sārivā śivā śyāmā
Vīrudhayo vārāhī jyotiṣmatī garuḍavegā ca = 87 =
Sūkarikamāṣaparṇivyāghrapādaśceti yadyahernilaye
Valmīkāduttaratastribhiḥ karaistripuruṣe toyam = 88 =
Etadanūpe vācyam jaṅgalabhūmau tu pañcabhiḥ puruṣaiḥ
Etaireva nimittairmarudeśe saptabhiḥ kathayet = 89 =

In these three verses Varāhamihira attempts to cover a wide variety of indicator plants found on termitaries which spell water underground at a depth of 3 *naras* in low-lying well-watered valley regions, 5 *naras* in dry jungle uplands, and 7 *naras* in regions of desert wilderness. Since *nara* is $7\frac{1}{2}$ feet the depths indicated come to $22\frac{1}{2}'$, $37\frac{1}{2}'$ and $52\frac{1}{2}'$ respectively. It must also be noted that some of the names of the plants do not mean just one plant but a whole class of plants. This seemingly introduces an element of considerable uncertainty, but experienced dowsers say that this difficulty is not very real since they consider the whole class of plants as being admissible. From this one might suspect that the real indicators are the termitaries, but the plants somehow modify or emphasize the presence of the spring. It is usual among dowsers to correlate the number of the indicator plants found on the termitaries with the size and quality of the underground spring. Although the ancient Hindus correlated the presence of underground springs there is no evidence to say that they had real understanding of the relationship between the underground springs and the termitaries, but accepted it most probably purely on an empirica basis. The names of the flora mentioned are given below with their botanic names.

*Jambuu* (*Eugenia Jambos, Eugenia Jambolana*); *Trivṛta* (*Ipomea turpethum*); *Maurvī* (*Sanserviera roxburgiana*); *Śiśumārī* (?); *Śārivā* (*Hemidesmus indicus*); *Śivā* (several plants: *Cucumis utilissimus, Terminalia chebula, Emblica officinalis, Flacourtia cataphracta, cynodon dactylon*); *Śyāmā* (several plants with black or dark foliage, or stems and petioles, etc.: *Ichnocarpus fructens* —black creeper, *Kṛṣṇa sārivā*; *Datura metel*; *Agalaia roxburgiana*; *Panicum italicum*; *Panicum frumentaceum, Panicum coloncum, Amarylis zeylanica,* *Balasamodendron mukul*— = *B. alagocha*; *Hibiscus abelmoschus*; *Piper longum*; *Oldenlandia biflora, Cocculus cordifolia*; *Cyperus rotundus*; *Cyperus pertenuis*; *Ipomea turpethum* black variety; *Cynodon dactylon* black variety; *Indigo tinctorea*; *Boerhavia diffusa*; *Dalbergia sissoo*; *Ocimum sanctum*); *Sūkarika* (*Lycopodium imbricatum, I. clavatum*); *Māśaparṇī* (*Glycine debilis, G. Labialis*).[11]

Consider the following verses which lay down the association of certain other trees and shrubs with termitaries[12]:—

Tilakāmrātakavaruṇakavilvatindukāṅgolāḥ
Piṇḍāraśirīṣāñjanaparūṣakā vañjulātibalā = 50 =
Ete yadi susnigdhāḥ valmīkaiḥ parivṛtāstatastoyam
Hastaistribhiruttarataścaturbhirardhena ca nareṇa = 51 =

If the following trees are found well-developed verdant foliage glistening as if anointed and are surrounded by termitaries, water should be declared at a depth of 4½ *naras* below a spot 3 cubits to their north. The names of the trees together with the botanical names are given below.[13]

*Tilaka* (*Cinnamonum iners, Cinnamonum malabaricum*); *Āmrātaka* (*Spondias mangifera*—Indian Hog-plum; *Varuṇaka* (*Crativa religiosa*—three-leaved caper); *Bhallātaka* (*Semecarpus anacardium*—Marking nut tree); *Vilva* (*Aegle marmelos*); *Tinduka* (*Diospyros embryopteris*); *Angola* (*Alangium hexapetalum*); *Piṇḍāra* (*Trewia nudifora, Flacourtia sapida*); *Sirīṣa* (*Acacia speciosa, Acacia sirissa, Mimosa amara*); *Añjana* (*Memecylon edule*—Iron wood tree); *Vañjula* (*Dalbergia ougeinensis, Calamus rotang, Saraca indica*); *Atibalā* (*Sida rhombifolia*).

There are a number of nuances of ecological spectra dealt with in Dakārgalādhyāya which are too numerous to be covered in the ambit of a short paper like this. The author of this paper has prepared a translation of this chapter which runs to 100 pages. Apart from termites and the flora, there are other signs also considered. Consider the following[14]:

'Nadati mahī gambhīraṃ yasminścaraṇāhatā jalaṃ tasmin
Sārdhaistribhirmanuṣyaiḥ kauberi tatra ca śirā syāt = 54

'Where the ground emits a melodious drum-like sound when stamped upon, water or treasure trove is to be indicated below that spot at a depth of 3½ naras. The spring will be a northerly one.'

Precise directions for spotting and depth are characteristic of the exploration formulae in Dakārgalādhyāya to distinguish it from other systems of divination.

Although exploration formulae take up bulk of the chapter, there are other topics also dealt with relating to the exploitation of underground springs. For example what should be done if there is hard rocky strata impeding the installation of a well. Varāhamihira describes four alternative methods. We shall however deal with only one.[15]

'Bhedaṃ yadā naiti śilā tadānīṃ palāśakāṣṭaiḥ saha tindukānām.
Prajvālayitvānalamagnivarṇā sudhāmbu siktā pravidārameti' = 112 =

'When a stony layer is refractory to ordinary digging and quarrying methods, a fire should be built upon it using faggots of *palāśa* (*Butea frondosa*) and *tinduka* (*Diospyros glutinosa*), and the stones heated till the stones assume the colour of fire. Then, on sprinkling a mixture of milk (?) and water the stone will shatter.'

The above is a very practical method using locally available materials; using well-known scientific principles. In the other methods the same principle is used but the composition of the chilling fluid vary. Some mixtures are quite complicated using gruel and certain other ingredients fermented for a week. Apparently the mixtures exercise some chemical catalytic action on the heated stones in order to speed up their disintegration.

## Conclusion

In conclusion it may be said that the technique of water divination embodied in *Dakārgalodhyāya* of *Bṛhatsaṃhitā* represents perhaps the first recorded complete system of exploitation of underground springs which is based on logical considerations. As such it is worth more than a superficial notice by the scientists. In this presentation one premise of the technique, namely the termite prominences can serve as useful indicators of underground springs, has been examined at length in the light of the present-day knowledge on the behaviour of termites, and it is found there is considerable evidence to say that the premise of the ancient Hindus is not totally unjustified. It is highly probable that the ancient Hindus, however, did not understand the relationship they had taken for granted most probably on an entirely empiric basis. The very word they used for the termite hill, namely *valmīkā*, means an ant-hill and the other words adopted as synonyms, namely *ahinilaya*, *bhujaṅganilaya*, etc., mean abode of snakes which also is scientifically erroneous. The present-day scientists are better equipped to study these relationships than were the ancient Hindus, and it is recommended that the study of this art should be taken up seriously. One possible result of this study is probably a better understanding of the ecological relationships in nature.

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[1] Biology of Termites, Vol. I, pp. 3, 4.
[2] ——— *op. cit.*, Vol. II, p. 96.
[3] ——— *op. cit.*, Vol. I, 10, p. 354.
[4] ——— *op. cit.*, Vol. II, p. 190.
[5] Bṛhatsaṃhitā, Vol. II, Verse 95, p. 646.
[6] ——— *op. cit.*, verse 82, p. 642.
[7] ——— *op. cit.*, Bhaṭṭotpala's comments and Sāraswata's verse, line 3.
[8] Biology of Termites, Vol. I, p. 499.
[9] ——— *op. cit.*, Vol. I, p. 4.
[10] Bṛhatsaṃhitā, Vol. II, verses 87, 88, 89.
[11] The botanical names of the plants have been fixed with reference to Sir Monier Williams' Sanskrit-English Dictionary, and Dr. Nadkarni's Indian Materia Medica. *See* the list of references at the end of the paper.
[12] Bṛhatsaṃhitā, Vol. II, p. 651.
[13] *See* footnote No. 11.
[14] Bṛhatsaṃhitā, Vol. II, verse 54, p. 636.
[15] ——— *op. cit.*, verse 112, p. 651.

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