HOW TO FIND WATER: THE STATE OF THE ART IN THE EARLY SEVENTEENTH CENTURY, DEDUCED FROM WRITINGS OF MARTINE DE BERTEREAU (1632 and 1640)

MARTINA KÖLBL-EBERT

Jura-Museum Eichstätt, Willibaldsburg, D-85072 Eichstätt, Germany
Koelbl-Ebert@jura-museum.de

Earth Sciences History
Vol. 28, No. 2, 2009
pp. 204–218

ABSTRACT

When Martine de Bertereau (who died around 1643) married the alchemist and mining engineer Jean du Chastelet, Baron de Beausoleil, she had long been occupied with the art of mining "that was hereditary in her house". She wrote two pamphlets on mining addressed to the French king and the Cardinal Duke of Richelieu. In her short publications de Bertereau not only treated mining and mineral deposits in France, she also gave a short introduction to the art of finding water and of assessing its quantity and quality. While divining-rods featured widely, she also gave useful practical advice describing some sensible experiments, which she derived from Vitruvius's book on architecture. Her writings thus allow a unique glimpse into craft-skills, which centuries later developed into what came to be called hydrogeology, but which in the seventeenth century were essentially the same as in Roman times, albeit 'corrupted' by esoteric practices.

1. INTRODUCTION

The Italian artist and savant Leonardo da Vinci (1452–1519) as well as the German astronomer Johannes Kepler (1571–1639) and probably many of their contemporaries compared the movement of groundwater with blood-circulation in living organisms. This idea was already present in ancient Greece, when it was thought that water occupied a network of channels within the body of the Earth, vitalizing and nourishing it (Hölder 1960, pp. 273–279; Hölder 1989, pp. 97–99).

Where this water came from was subject to debate, and since Antiquity several models had been suggested. In the semi-arid climate of the Mediterranean region it was not self-evident that wells and sources derived their water from rain. While the Roman architect and engineer Marcus Vitruvius Pollio (born *ca* 80–70 BC, died after *ca* 15 BC) had a good idea of the water cycle,[1] the Roman philosopher and politician Seneca (*ca* 1–65 AD) claimed from observations in his vineyards that no rain was strong enough to penetrate the soil deeper than ten feet (Hölder 1960, p. 273 ff.).

[1] "Hence the winds, wherever they travel, extract from springs, rivers, marshes, and from the sea, when heated by the sun, condensed vapours, which rise and form clouds. These, borne up by the winds when they come against the sides of mountains, from the shock they sustain, as well as from storms, swell, and, becoming heavy, break and disperse themselves on the earth. . . . A corroboration of this may be seen in a hot bath; for it is absurd to suppose that there can be a spring above its ceiling; and yet that, when warmed by the heated air from the furnace, attracts the moisture from the pavement, whence it is carried up to the vaulting of the ceiling, where it hangs. For hot vapours always ascend, and at first, from their lightness, do not fall down, but as soon as condensed, their gravity prevents buoyancy, and they drop on the heads of the bathers. In the same manner the atmospheric air, when warmed by the sun, raises moisture from all places, and gathers it to [form] the clouds: for the earth acted upon by heat, drives out its moisture, as heat drives out perspiration from the human body" (Vitruvius, Book VIII, Chapter 2). This rain, then, is feeding the rivers, which return the water to the sea.

The Greek philosopher Plato thought that the Earth floated on water, which infiltrated the earth from below (Hölder 1989, p. 97), while Aristotle, who had some idea of the water cycle (see his *Meteorologica*) held that in addition to rainfall, water within the Earth could form by condensation from vapours in its interior (Adams 1938, p. 429).

The Mediaeval tradition referred to the Bible, especially Ecclesiastes 1, 7, in viewing the sea as the ultimate source of rivers[2] (Adams 1938, p. 432). The theologian Albertus Magnus (~1200–1280) assumed some sort of 'water-dome' such that the water in the sea somehow stood higher than the land so that it could flow back to it with a lateral intrusion of seawater into the land (Hölder 1989, p. 97). How it rose within the land towards springs and sources again and in the process lost its salt content could be accounted for in different ways: it might have been caused by the 'virtue' of the heavens or by more naturalistic means of evaporation and condensation (Adams 1938, p. 432 ff.). On the other hand, people like Leonardo da Vinci and the potter and naturalist Bernard Palissy (1514–1589) regarded rain as the source of groundwater.

These days, nobody seriously denies that water reaching daylight in wells and springs once fell upon the Earth as rain or snow, where it percolated underground. However, the poetical—albeit false—image of water vessels within the globe has survived in the imagination of many people and serves as the basis for water-dowsing.

Whereas the use of divining-rods to find ore-deposits seems to be an old idea, dating back at least to Mediaeval times (Knoblauch 1991, pp. 69 ff.) and was described for example by Agricola in 1556 (Agricola 1950, pp. 38–41),[3] it has been said that the first people to claim to find water with the aid of divining rods were Martine de Bertereau and her husband Jean du Chastelet, Baron de Beausoleil et d'Auffenbach (Lancelot 1738, Vol. 1, p. 188; Le Brun 1750, Vol. 2, p. 429; Figuier 1860, Vol. 2, p. 53). These two had made "in various European countries much ado through their astrological and hermetic follies. . . . [They] promised mysterious aids for the investigation of hidden treasures . . . " amongst them "seven metallic and hydraulic rods" (Joecher 1784, entry for 'de Beausoleil').

And indeed, in a publication by Martine de Bertereau, published in 1632[4] (see Figure 1), we may read how this was done:

> Approaching Château-Thierry, and *mounting the mineralogical compass onto the astronomical hinge* [*charniere astronomique*], in order to find out whether there are any mines there, or minerals, I found that there are some springs of mineral water at that place; and thus, having myself transported, then looking therein for the place of that stream, & by chance entering the hostelry, called *the Fleur de Lys*,[5] I found the springs: whereupon having called the officers of the justice, the medical men & the apothecaries of the city, to see the proof of my test[s] & acknowledge the quality of these waters. Setting up the mineralogical compass in its catch [*rechef*] over and near the springs, I let them see with their own eyes (& by definite proof) that

---

2 Ecclesiastes 1, 7: "All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again". This is a piece of Mediaeval 'quote-mining', as the complete text really is about the vanity of all human undertakings, listing numerous metaphors to illustrate this, among them the water example.

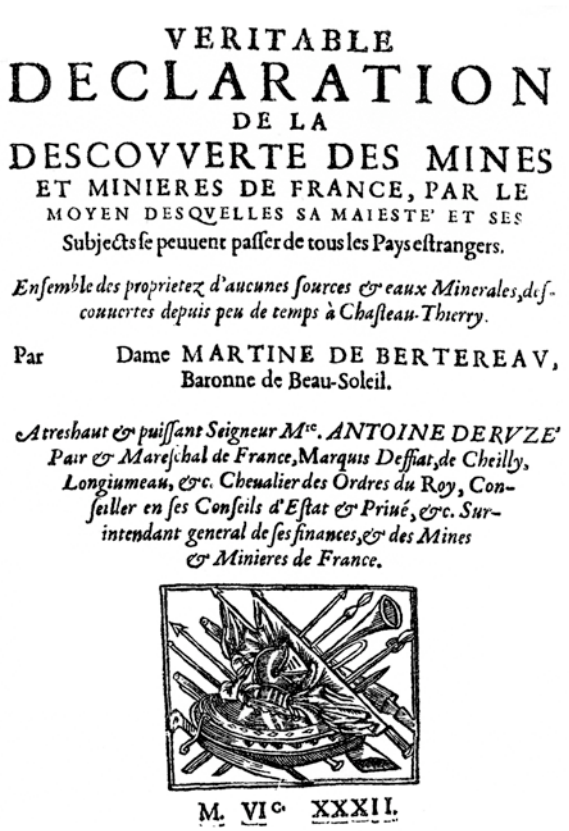
3 Agricola described the use of divining rods, but he himself did not believe that this method worked: "Therefore a miner, since we think he ought to be a good and serious man, should not make use of an enchanted twig, because if he is prudent and skilled in the natural signs, he understands that a forked stick is of no use to him, for as I have said before, there are the natural indications of the veins which he can see for himself without the help of twigs" (Agricola 1950, p. 41).

4 Reprinted in Gobet (1779, pp. 309–320), and available at: http://books.google.com.au/books?id=IzsPAAAAYAAJ&dq=Gobet+Les+anciens+minéralogistes+du+Royaume+de+France&printsec=frontcover&source=bl&ots=dverCqEnUK&sig=jLQ58KFJlQxuF35lE0z5Nxsb3GY&hl=en&ei=qGkDSoC_ApHy6gP-y_DQAQ&sa=X&oi=book_result&ct=result&resnum=3#PRA1-PA355,M1

5 I.e. of the French monarch—an obvious flattery directed towards the King, the intended recipient of de Bertereau's text.

the said fountain & a water that is in Widow Guiot's house, were mineral[ised] & drew their medicinal qualities from passing some mine of silver containing gold & also from some mine of iron, where vitriol is fairly abundant & which is therefore very suitable for relieving obstructions of the liver & spleen, to drive out stones & gravels from the kidneys, to stop dysentery & all flows of the blood, & to alleviate great impairments [of health], &c.

This discovery is a blessing from God, to whom I render thanks, & trust that there is no Frenchman who will not be obliged to do likewise to my name & thank it, for these medicinal waters as well as the other great comforts, discovered by me for the general benefit of France (de Bertereau 1632).[6]


VERITABLE
DECLARATION
DE LA
DESCOVVERTE DES MINES
ET MINIERES DE FRANCE, PAR LE
MOYEN DESQVELLES SA MAIESTE' ET SES
Subjects se peuuent passer de tous les Pays estrangers.

Ensemble des proprietez d'aucunes sources & eaux Minerales, descouuertes depuis peu de temps à Chasteau-Thierry.

Par Dame MARTINE DE BERTEREAV,
Baronne de Beau-Soleil.

A treshaut & puissant Seigneur Mre. ANTOINE DERVZE' Pair & Mareschal de France, Marquis Deffiat, de Cheilly, Longiumeau, &c. Cheualier des Ordres du Roy, Conseiller en ses Conseils d'Estat & Priué, &c. Surintendant general de ses finances, & des Mines & Minieres de France.

M. VIc. XXXII.

Figure 1.
Title page page of de Berterau (1632).

2. MARTINE DE BERTEREAU AND JEAN DU CHASTELET: BIOGRAPHICAL SKETCHES AND THEIR 'GEOLOGICAL' WORK

Jean du Chastelet, Baron de Beausoleil et d'Auffenbach, was born in Brabant in the Spanish Netherlands in 1578. Around 1600, he was called to France by the Superintendent of Mining to serve as mineralogist, alchemist, and mining engineer. Around 1610, he married Martine

[6] Quoted after Gobet (1779, pp. 306–308); translated, as throughout this paper, from the original French by the present author. Nicolas Gobet studied chemistry under Rouelle and was Keeper of Archives to the Comte d'Artois. Interested in history, he compiled a valuable collection of early writings on alchemy, mining, and mineralogy and published a translation of Peter Pallas's work on the origin of mountains and an edition of the works of Bernard Palissy. The fact that de Bertereau's books were anthologised by Gobet suggests that they were regarded as important.

de Bertereau, a woman who had been occupied for a long time with the art of mines, "an art that was hereditary in her house" (Duvergier de Hauranne 1744, Vol. 2, p. 754, Letter 34). The couple had several children, among them the eldest son Hercule, and a daughter Anne born around 1626. [7]

During the sixteen years that followed their marriage (1610–1626), the couple visited ore mines in many parts of Europe, and possibly also in what is today Bolivia. During this time, Jean du Chastelet was employed in leading positions as a mining engineer in Hungary, in the Tyrol, Trentino, and other mining districts belonging to Bavaria and the Vatican respectively.

In 1626, the Beausoleils returned to France upon the wish of a new Superintendent of Mines, accompanied by experienced miners from Germany and Hungary. During the centuries before, the art of mining seems to have been neglected in France. There were mining districts, which had been worked by the Romans, some of which continued to be mined during the Middle Ages. However, everything that was profitable had ceased by the fifteenth century at the latest (Descoqs 1920).

In France, Baron de Beausoleil was commissioned to make expeditions into the provinces in order to relocate old mining sites, prospect for new mineral deposits, reassess known ones, and give advice on established mining localities. In the execution of this commission, the husband and wife team seem to have acted as equal partners in the prospecting for ores, and she even took the greater part of responsibility and initiative in her writings.

Obviously the Beausoleils expected personal financial advantages from their stay in France, as soon as the newly found deposits went into production. Therefore they invested (out of their own money, as they later claimed) the enormous sum of more than 300,000 *livres* into the work.

But in 1627, an unpleasant event occurred in the city of Morlaix (Brittany). While Jean du Chastelet was away visiting a mine and Martine de Bertereau had travelled to Rennes in order to present the royal letter of commission to the local officials, a provincial bailiff forced his way into their lodgings at Morlaix, claiming that mineral deposits could not be found without the help of magic and witchcraft. The lodgings were searched and all their luggage seized: precious stones, mineral samples, instruments for prospecting and assaying, books on assaying, along with notebooks and papers of all kind.

118 years before the last execution of a witch in France, this was a dangerous situation. Nevertheless, the enlightened magistrate of Rennes dropped the accusation of witchcraft. However, their goods were not returned, and the Beausoleils withdrew to Austria. Emperor Ferdinand II again named the Baron de Beausoleil as Councillor and Commissioner of Mines in Hungary. But having invested so much money in France, the Beausoleils presumably did not want to give up hope of making their fortune in that country. So in 1632, they returned to France with a great number of workers and with a letter of recommendation from the Austrian Emperor. The commissions of the year 1626 were reconfirmed and on 18 August 1634, Jean du Chastelet received a patent as Inspector General of French mines. The Beausoleils again took up their research and discovered numerous mineral deposits (more than 150 they claimed) and demanded the concession to mine them. Thus in 1632, the year of their return to France, Martine de Bertereau wrote an open letter to the king entitled 'Veritable declaration to the king and the gentlemen of his council about the rich and inestimable treasures newly discovered in the kingdom of France' (published, with different title, as de Bertereau [1632]).

[7] For biographical details, see: Gobet (1779, 261ff.), Figuier (1860, 2: 18–58), and Kölbl-Ebert (2003, 2004 and references therein).

In this pamphlet she explained the importance of her discoveries for France, asked for reimbursement of their goods confiscated in Brittany and permission to develop the newly discovered mineral deposits. She also hinted that there had been a number of envious people at the Royal Court. She slightly mocked people who never had entered a mine but imagined they knew perfectly how to prospect for ores because they had read Pliny.

However, the Council of the King remained silent.[8] Therefore in 1640, probably by then in fairly desperate financial circumstances, Martine de Bertereau addressed another petition to the King's court, this time directly to Cardinal Richelieu, entitled:

> The Restoration of Pluto—to His Eminence Cardinal Duke of Richelieu, a work, in which the mines and quarries of France, which are hitherto hidden and retained within the belly of the Earth, are treated in detail, by which means His Majesty's finances will become much greater than those of all Christian Princes and his subjects the happiest of all peoples (de Bertereau 1640).

But the petition did not have the desired effect and in 1642, shortly before his death, Richelieu ordered the Beausoleils, husband and wife together with one of their daughters, to be arrested. They were charged with practising astrology, chiromancy, and casting horoscopes. Jean du Chastelet was imprisoned in the Bastille, where he died in 1645; the two women were brought to the prison of Vincennes, where their traces disappeared. The eldest son, Hercule de Beausoleil, was also arrested when he was bold or naive enough to visit his father. The surviving children, who had been taken in by friends of the family, lost their father's title and took on the name of their mother, Bertereau. The last descendant of the family, who bore the name of Bertereau died late in the twentieth century.[9]

Restitution de Pluton (de Bertereau 1640; Gobet 1779, pp. 339–452[10]) was—among other purposes—meant to be a brief course in the basics of matters relating to mining. Madame de Bertereau gave a long list of the mineral deposits that she and her husband had found: silver, lead, gold, iron, copper, and also mineral pigments, millstones, coal, decorative building stones like marble, and precious stones. A century later, her predictions about part of the ore deposits proved very profitable (see Figuier [1860], Descoqs, [1920]). However, for precious stones, de Bertereau obviously promised more than there really was—diamonds for example.

According to de Bertereau (1640), there are five rules, if one wanted to find ore bodies:[11]

1. Digging, which is the least important [*sic*].
2. Look out for special herbs and plants, which may grow on an ore body. "We notice also that the most important places where mines can be found in this kingdom, are not very fertile, because the earth is occupied in nourishing the metals and minerals rather than the good plants . . . ". [12]

---

8 Maybe there were more urgent problems, for France entered the Thirty Years War in 1635.

9 Christophe Mounier (Paris), pers. comm.

10 Or: http://books.google.com.au/books?id=IzsPAAAAYAAJ&dq=Gobet+Les+anciens+minéralogistes+du+Royaume+de+France&printsec=frontcover&source=bl&ots=dverCqEnUK&sig=jLQ58KFJlQxuF35lE0z5Nxsb3GY&hl=en&ei=qGkDSoC_ApHy6gP-y_DQAQ&sa=X&oi=book_result&ct=result&resnum=3#PRA1-PA355,M1

11 The list is given in Madame de Bertereau's own sequence, though not in her words (cf. Gobet 1779, p. 352).

12 This makes sense, because old spoil heaps are commonly contaminated with heavy metals and are thus extremely infertile.

3. Consider the taste of the water, which emerges from springs in the vicinity of ore deposits.[13]
4. Observe the vapours that are emitted from the mountains and valleys at sunrise.[14]
5. The use of sixteen metallic and hydraulic instruments. [15]

In addition to these rules, there were also seven [divining] rods (corresponding to the seven 'planets' and seven metals and which will be discussed later). "Those minerals grow mostly in the womb of the highest mountains like the Pyrenees, those of Dauphiné, Auvergne. . . .".[16] But for most of the text, Madame de Bertereau seemingly chose to guard her art as a craft secret, covering it in a veil of astrology and other occult practices.

De Bertereau (1640) also listed the different crafts that a successful mining engineer of her times needed to know:[17]

1. Astrology, for divination, determining when to cut wood, when to build the sixteen instruments, and when to cast horoscopes in order to know people's characters and for medicinal purposes.
2. Architecture, for building the workshops and smelters as well as the machines and pumps.
3. Geometry, for surveying in three dimensions.
4. Arithmetic, for calculating the shares of business partners, for management and administration.
5. '*Perspective*', for bringing light into the mines and offices, and for communication and air conditioning in the mines.
6. Drawing, for plans and reports.
7. Hydraulics, for pumping water out of the deep mines, for acquiring water necessary to wash the ore.
8. Labour and mining legislation.

---

13 This is equally sensible advice.

14 This obviously refers to '*Witterung*', an old German miner's term, meaning vapours, which allegedly rise from rich ore veins. The phenomenon was believed to be real throughout the sixteenth and seventeenth century, and came into disregard only in the second half of the eighteenth century. For a more detailed overview see Adams (1954, pp. 301–305).

15 In Part V of *Restitution de Pluton* (1640), de Bertereau presented seven horoscopes, showing the astrological data of the "hours and minutes of the fabrication of geometric, hydraulic and metallic instruments, as well as the seven metallic and hydraulic rods". Here, she arranged the sixteen instruments into seven groups, corresponding to the seven astrological 'planets' (the Moon, Sun, Mercury, Venus, Mars, Jupiter and Saturn), and to seven metallic and hydraulic [divining] rods. She claims that these groups of instruments could be used to find specific groups of stones and minerals, which are under the influence of a certain 'planet'. The names of these groups of instruments were: '*les grands compas*' (i.e. possibly drawing-compasses)—allegedly used for locating gold (related to the Sun); '*les grand boussoles à sept angles*' (i.e. a compass with seven waxed circles, as described by Georgius Agricola (1556 [1950, p. 142]), for plotting down a succession of seven angles in the darkness of the mines) —used to find silver ores and related to the Moon; '*l'astrolabe mineral*' (an instrument for measuring angular distances)—used to find copper ores and related to Venus; '*le cadran mineral*' (a quadrant, for deducing the length from the measured angle of the line against the horizontal or vertical)—used to help find ores of tin and zinc and related to Jupiter; '*le geotrique mineral*' (not identified)—used to help find ores of lead and antimony and related to Saturn; '*le ratteau metallique*' (i.e. a rake; or some sort of sieve?)—used to find iron ores, and related to Mars; and '*l'hydroyque mineral*' (not identified)—used to help find ores of mercury and related to the planet Mercury (Gobet 1779, pp. 425–426). Thus they appear to have been—at least in part—surveyors' instruments, but the account given seems to have been intended to conceal as much as enlighten. See Agricola (1556 [1950], pp. 128–148) for details of the practical work of a surveyor in the mining industry in the sixteenth century, and still used in the 1600s.

16 Those are regions with crystalline rocks, where outcrops of hydrothermal dykes of Variscan or Alpine age can be expected.

17 Again, the list is given according to Madame de Bertereau's own sequence (cf. Gobet 1779, pp. 388–398).

9. Languages (i.e. Latin, German, English, Italian, Spanish and French), because the workers usually come from all kinds of countries.
10. Medicine, in order to protect oneself from poisonous vapours such arsenic gases.
11. Surgery, to bring quick help to injured workers.
12. Botany, to know the plants that point to the places were metals or water can be found.
13. Pyrotechnics, to determine the correct temperature to melt the different metals.
14. '*Lapidarie*', i.e. petrography, for distinguishing between the different types of ore veins and rocks.
15. Theology, to preach to one's miners who come from very different confessions.
16. Chemistry, to separate the "homogeneous from the heterogeneous", i.e. to separate silver from lead etc., and to know the different types of slags.

The latter was one of the most important 'theories', according to de Bertereau since:

> All those who know about mineral deposits are certain that there is no metal in its matrix without admixture: the heterogeneous always being mixed with the homogeneous: and whoever contradicts this, this person I offer to convince him by demonstration. I assert that it is rare to find lead that does not contain silver and none has ever been found except in Poland in the mine of Kakaray. . . . Also there is never copper that does not contain silver and very often [both] gold and silver . . . , so that those who do not know the principles of metals, their flux and separation in large smelters, lose much and sell the fine gold and silver together with their lead and copper, and other admixed metals, and instead of making a profit they make a loss . . . (de Bertereau 1632, quoted from Gobet, 1779, pp. 300–301).

De Bertereau also advised the French monarch to issue special mining legislation, which should be enforced directly by the central government,[18] because local people like the superstitious bailiff in Brittany could ruin established mines, since continuous working of a mining district was needed to prevent water from flooding the mines (cf. Gobet [1779], pp. 414–415).

We owe civilisation to the miners, de Bertereau reminded Cardinal Richelieu, and it is ignorant and stupid to believe that magicians are needed to find ores. No, she claimed: there is no danger of such devilish things, as long as you employ miners who are recommended by other sovereigns. Thus you can be sure to attract 'religiously safe' craftsmen (cf. Gobet [1779], pp. 416–417).

3. PROSPECTING FOR WATER IN THE EARLY SEVENTEENTH CENTURY

Martine de Bertereau's two publications (de Bertereau 1632, 1640) may be regarded as a kind of hybrid between a 'business report' and a petition. Their purpose was neither scientific nor philosophical, nor were they intended as a detailed miners' manual. Nevertheless, they provide a wealth of information about the state of French mining in the early seventeenth century. Since water was crucial for powering mining machines, for the processing of the ore and also for sustaining a large number of people in the mining area, de Bertereau also gave a short introduction into the art of finding water and assessing its quantity as well as quality:

[18] The idea was probably derived from the situation in the German states. Georgius Agricola (1556) described a 'republic of miners' with an oligarchic structure, controlled by representatives of the Sovereign and managed by mining experts, who were not necessarily shareholders of the mining company. Thus the ultimate control of the management remained with the Sovereign, who expected to receive ample taxes from a well-worked mining district, and was not controlled by the shareholders of the mining company.

> Having (My Lord) treated metals & minerals, precious & common stones, and also the necessities for a Governor of Mines: it seems to me rational to treat the waters & the properties that they may have, according to the natures of the places that they pass & where they have their sources, so that the mineworkers can have good & wholesome [waters] in their houses, , be it for drinking, refreshment, or other uses (de Bertereau 1640, Chapter 4; quoted in Gobet 1779, p. 428).

Divining rods also featured extensively in the text:

> For conclusion, if you apply the *verge Lunaire* & moreover that of Mercury and if they incline themselves halfway towards the east, west, north, or midday, it is very certain that there is water in the direction [*du costé*] to which they incline themselves & if they go down less than half, it is a sign of but little water (Bertereau 1640, Chapter 6; quoted in Gobet 1779, p. 432).

However, these enigmatic references to dowsing were somewhat half-heartedly slotted in between otherwise quite useful advice and experiments, and thus it becomes clear that dowsing was hardly more than a facade behind which to conceal de Bertereau's 'trade-secrets'. Also throughout her text (and contrary to the way most people using divining rods today) de Bertereau gave the impression that finding water was not the difficult part, though finding potable water in sufficient quantity was not the actual point (Bertereau 1640, Chapter 6).

The true role that divining rods played in de Bertereau's art may be deduced from an incident that occurred in 1629 in the city of Château-Thierry. As mentioned in the introduction (Section 1), de Bertereau claimed to have discovered a spring, identifiable as the *Fontaine de Mont Martel*, by deploying various occult instruments (Bertereau 1632). However, from a memoir by the physician Claude Galien, written about a year later, we are offered a quite different story:

> [S]ome thirteen months ago . . . a virtuous lady, who, tired of the troubles of Court, endeavoured to divert herself in one of her castles, very near the waters of Pougues:[19] however, at that time, upon passing through our city, she was retained therein for fifteen days or a month by the force of a flaming heat in the intestines of her eldest son; and so it happened that during her usual promenades in the middle of our streets, through which this beautiful ornament of nature flows, she admired how the flagstones were much reddened and as if painted with natural paint by the virtue of our waters. She addressed herself to us[20] & after several visits that we paid to look after the condition of the sick [son] . . . , she assured us, that our humid element undoubtedly had the same properties as the waters of Pougues, hidden within the coldness of its substance (Galien 1630, quoted in Gobet 1779, pp. 306–307).

That is, by Galien's account, there was no mention of divining rods or other occult instruments. Instead, he tells us about the simple and quite sensible observation of the deposition of iron oxides from the water.

Thus forewarned, we begin by ignoring any notions about divining rods from de Bertereau's text about water (de Bertereau 1640, Chapter 6); but the following 'practical' advice survives:

> The method is thus that at sunrise the Master who wants to find water, lays himself flat on his belly at a place where he expects to find water, there keeping his chin close to the ground (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, p. 428).

---

[19] Pougues-les-Eaux is a fashionable spa-town in today's Nièvre Department in Central France.

[20] I.e. Galien.

In this manner, 'the Master' had to observe the land around him and watch for vapours rising out of humid meadows and fields, indicating the presence of water.

According to de Bertereau, there are also certain plants indicative of water, e.g., wild willows, reeds, roses, ivy, coltsfoot, and

> other similar kinds of herbs, which can neither thrive nor be nurtured without moisture. But we must always also be careful that they very often thrive along some pool or ditch, receiving the rainwaters & those that flow through the fields, where they stagnate & because of the hollow are retained longer than in other places (de Bertereau 1640, Chapter 6; quoted after Gobet 1779, pp. 430–431).

Thus de Bertereau stressed that we can be more confident, where "those herbs or shrubs live without being sown or planted" (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, p. 431).

In cases where such clear signs were missing, she suggested a number of simple experiments, which not only could point to the existence of underground water but also give an approximate impression of the amount present, and thus whether it would be advisable to dig further or whether it might be preferable to sink the well somewhere else. She suggested that one should:

> make a ditch in the earth, four feet on all sides & six in depth, and in this at sunset, you put a brazen vessel or of lead without admixture, or as well a basin; this vessel you anoint with olive oil on the inside, then turn it with the opening to the ground[. A]fterwards cover the remainder of the ditch with reeds, or leaves; then throw earth on top & leave it like this for the whole night. On the following day go to uncover it: and if you find little droplets of sweat in your vessel you are assured that there is water in that place.
>
> Similarly if you put an unburned clay pot into such a hole, & cover it up as before, when you come to open the hole if there is water under the earth, your pot will be wet or half collapsed because of the liquid.
>
> Additionally, if you throw therein a combed, woollen fleece & on the following day if you see water coming, on wringing it, you can be sure that there is a great abundance of water in that place.
>
> . . .
>
> Moreover: if a lamp, full of oil & lighted, is placed within [the hole], & if, on the following day, it is found hardly turned dryer, also if there is the rest of the wick & oil [still there], or even if it is found to be humid, this will signify that there is water at depth.
>
> Finally, if we make a fire in that place, so that the crust of the earth is burned, & heats itself internally, in such a way that a misty vapour escapes from it, water is certainly there.
>
> . . .
>
> These facts, or at least one of them, & if there are any of the said signs, one should sink a well: but if by chance (as often happens), we encounter a source of water, we must make several other ditches around it, which by means of the trenches all lead [the water] to one place.
>
> All waters must principally be sought for in the mountains & on the northern side where they are opposite the course of the Sun, and are found more pleasant and healthy, & in greater abundance (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, pp. 431–432).

De Bertereau was aware that the lithology of the ground influences the taste and quality of the groundwater, and also the quantity available. However, she did *not* give a geological explanation of this phenomenon:

> Additionally, it is necessary to consider the nature of the land, because there are localities, where it is generated, & others where it is found not at all or very little. . . . Where sand is found underfoot, there it is weak & limp, & again if we encounter it in low-lying places it will be muddy & tasteless. In black soil, one may well find some humours & rare droplets, which

> collect there from the winter's rain & snowfalls, & stagnate at solid places: those are of rather good taste.
> . . .
> In mixed sand, i.e. rough, rude & almost brown & similarly in Arene [sand] & Carboucle [carbuncle?] they are more reliable & durable, [and] even show (which is the most desirable) a very good taste. In red rocks, there is good & plentiful water, provided it does not (on the other hand) escape through the cracks (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, pp. 429–430).

Since water can possess quite different qualities it is "necessary to assay them, so that the workers & those who drink from them in the mines are not surprised by unpleasant illnesses like goitre, stones, gout, ulcers, catarrhs & other illnesses, which the waters may carry by their evilness & poison" (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, p. 433). To carry out such assays, she again suggested simple, but ingenious, experiments:

> It is necessary to take the aforementioned water & put it into a bronze vessel, & leave there for twenty-four hours; if it does not cause spots, that signifies that it is very healthy.
> Similarly, if we leave this water in a cauldron to boil very clean & if we observe how it cools down: & then pour it out, and if then there is neither residue at the bottom, nor sediment, nor mud, we may rest assured that it will be very pure.
> . . .
> And also if we put some vegetables, such as peas, beans or similar others on the fire to cook in a pot with this water; if it is cooked quickly, this will be a sign that it is good & healthy.
> Moreover if we see it at its source to be clean & shining like the moon, even in some places where it flows, if we see it is causing neither mosses nor reeds & that its channel is not befouled by any dirt, and also retains a pleasing purity; all these signs indicate that its substance is good & pure (de Bertereau 1640, Chapter 6; quoted after Gobet [1779], p. 433).

In brief, close observation of the landscape and the knowledge of water-loving plants gave the water prospector the first hints as to where to start digging. A whole series of experiments were suggested to save time and labour before attempting to sink a proper well. An experiment using a woollen fleece (see previous page) might even be regarded as a primitive version of what a modern hydrogeologist would call a 'pump trial', designed to give a rough estimation of the amount of water, or the ease with which it could be drawn out of the soil into a proposed well. Although the 1600s are notorious for their lack of hygienic conditions, the water prospectors were conscious of the necessity of having clean and healthy water. The experiments they used were designed to discard water that was too acid or alkaline (i.e. 'aggressive' to metal vessels) or with too much mineral content or substances that were possibly poisonous if used over long periods.

However, all these ingenious methods were not, in fact, innovations of the sixteenth or seventeenth century. Although de Bertereau gave no reference to it, her text was an almost direct borrowing from the first-century (BC) Roman writer, architect and engineer, Marcus Vitruvius Pollio. In his time, he was (it is thought) chief of *Ballista* (or artillerymen) in the Roman army. His only surviving work *De architectura*, which was also mentioned by Pliny the Elder and the Roman water commissioner Sextus Julius Frontinus (?–103/104 AD), contains a section (Book VIII) dealing with water resources. *De architectura* was rediscovered in 1414 by the Florentine humanist Poggio Bracciolini. It became available in a French edition from 1547, and in German in 1543, although de Bertereau might have read the Latin version.[21]

[21] http://en.wikipedia.org/wiki/Vitruvius (accessed 27 March, 2008).

4. COMPARING VITRUVIUS AND DE BERTEREAU

De Bertereau's text was in fact basically drawn directly from Vitruvius, though with certain significant exceptions. Sometimes, the text seems to have been adapted to suit a more northern, Central European climate. Where both Vitruvius and de Bertereau wrote that water-loving plants are an important sign to look for, de Bertereau's list of plants was different and she also stressed that we must be careful not to be misled by plants that have been artificially sown or planted—something that Vitruvius did not mention[22] because in his more arid and hotter Mediterranean climate, such plants cannot survive without proper irrigation, which any water engineer would instantly notice. In Central France, on the other hand, it is (or used to be) sufficient to pour on the odd watering can of water during the summer.

After encountering water, de Bertereau proposed to "make several other ditches around it, which by means of trenches all lead to one place" (de Bertereau 1640, Chapter 6; quoted in Gobet 1779, p. 432), while Vitruvius opted for several other wells to be dug around the first one "and, by means of under-cuttings, connected with it so as to concentrate them" (Vitruvius VIII, 1, 6). By his method Vitruvius used to reach the much deeper groundwater level of his native country and had to move less soil and rock than with de Bertereau's trenches. However, these were more appropriate for a shallow groundwater level.

There are other slight deviations from the Vitruvian text, which may be ascribed to translation or transcription errors. While, for example, de Bertereau's test hole was dug four feet by four feet and six feet deep, Vitruvius only instructed workers to dig a ditch three by three feet wide and five feet deep (Vitruvius VIII, 1, 6).

The most notable difference between the two texts was, however, de Bertereau's additions of divining rods (see Table 1).

Table 1. Illustrative synopses of a small section of de Bertereau (1640) and Vitrivius (VIII), to show the addition of esoteric instruments and the omission of theoretical issues in de Bertereau's text.

De Bertereau (1640, Chapter 6)	**Vitruvius (VIII, 1, 5–6)**
Additionally, if you throw therein a combed, woollen fleece and on the following day if you see water coming, on wringing it, you can be sure that there is a great abundance of water in that place, *especially if the rod of the Moon inclines itself deep down.*[23]	A fleece of wool being placed in the same pit, if, on the following day, water can be expressed from it, the existence of water in the place is indicated, and that in abundance.
Moreover, if a lamp, full of oil & lighted, is placed within [the hole], & if, on the following day, it is found hardly turned dryer, also if there remains the rest of the wick & oil [still there], or even if it is found to be humid, this will signify that there is water at depth.	Also, if a trimmed lamp full of oil be lighted, and placed in the covered pit, and on the following day it be not exhausted, but still retains unconsumed some of the wick and oil, and present a humid appearance, it shows that water will be found there, *inasmuch as heat invariably draws the moisture towards it.*
Finally, if we make a fire in that place, so that the crust of the earth is burned, & heats itself internally, in such a way that a misty vapour escapes from it, water is certainly there. *For conclusion, if you apply the Moon rod & that of Mercury within [the hole] and if they incline themselves halfway towards the east, west, north or midday, it is*	Moreover, if in such place a fire be made on the ground, and the ground, when heated, throws out cloudy vapours, water will be found in it.

22 Vitruvius was only concerned about plants that live around a pond or other type of depression, which might accumulate rainwater instead of indicating a high groundwater level (Vitruvius VIII, 1, 3).

23 The Moon rod was one of seven rods, corresponding to the seven astrological planets, which de Bertereau used as diving rods (see below). The rods were mounted on a support and were assumed to deviate from the horizontal in the presence of a substance corresponding to the rod, in this case water.

certain that there is water close to where they incline themselves & if they go down less than half way, it signifies but little water.	
These facts, or at least one of them & if there are any of the said signs, one should sink a well	These experiments having been made, and the requisite indications being manifest, a well is to be sunk on the spot.

On the other hand, in rare instances, de Bertereau treated Vitruvius rather freely, even twisting his meaning to its opposite. While de Bertereau claimed that the newly discovered, healthy mineral waters of Château-Thierry (see Section 1) "drew their medicinal qualities from passing some mine of silver containing gold & from some mine of iron, where also the vitriol is very abundant" which made the water suitable to treat illnesses like kidneys stones, etc. (de Bertereau 1632), Vitruvius warned of using springs in areas, "where gold, silver, iron, brass, lead, and other similar substances, are excavated", because the waters

> when taken inwardly, passing through the intestines,affect the nerves and joints, and produce hard swellings on them. Hence the nerves are contracted by the swelling, in the direction of their length, and thus induce the cramp or the gout, because the vessels become saturated with gross hard particles (Vitruvius VIII, 3, 5).[24]

There was also much omitted from the original Roman text, notably the more theoretical parts, such as the introduction, which stressed the importance of water as one of the elements and it being most vital for life, or Chapter 2, which related theories about the origin of underground water. Bertereau omitted also those parts that dealt with problems which only arose when the actual 'water-searching part' has finally been accomplished, e.g., the levelling and planning of aqueducts, canals, leads and plumbing. Also, Bertereau omitted the chapter that described hot springs, naphtha sources and other special cases of fluids seeping from the ground. Bertereau thus omitted those parts of Vitruvius's text that might have seemed irrelevant to her cause.

Among the omitted parts was Vitruvius's Chapter 5, which nevertheless may have been of some relevance to our argument in the following section. In this chapter, Vitruvius instructed his readers how to convey water to houses and cities:

> for which purpose levelling is necessary. This is performed either with the *dioptra*, the level (*libra aquaria*), or the *chorobates*.[25] The latter instrument is however the best, inasmuch as the *dioptra* and level are often found to be incorrect. The *chorobates* is a *rod* [italics added] about twenty feet in length, having two legs at its extremities of equal length and dimensions, and fastened to the ends of the rod at right angles with it; between the rod and the legs are cross pieces fastened with tenons, whereon vertical lines are correctly marked, through which correspondent plumb lines hang down from the rod. When the rod is set, these will coincide with the lines marked, and show that the instrument stands level.

5. THE DIVINING ROD RECONSIDERED

Judging from her descriptions (see, for example, de Bertereau [1632]), Madame de Bertereau's divining rods were not of the 'forked-twig type', held in the dowser's hand such as was illustrated by Agricola. Hers were mounted on some sort of support, maybe a tripod,

[24] Of course, the purpose of the two texts here was quite different. While Vitruvius was concerned with the medical or toxic qualities of water, de Bertereau tried to convince the citizens of Château-Thierry of the superiority of their water, and water passing gold and silver certainly sounded very noble!

[25] An instrument used in Antiquity to determine the horizontal. It was essentially a grooved rod, with water in the groove. See: http://en.wikipedia.org/wiki/Chorobates.

and were only used after the mineral deposits or water source had already been discovered by some other, more sophisticated, means.

According to Knoblauch (1991), there are few hard facts known about the history of divining rods, either for ore finding, treasure hunting, or water dowsing. Much that has been written was, and is, published by people practising this esoteric business themselves and they seem to be more concerned with providing their 'art' with a noble and ancient pedigree than with actual historical data. However, it seems that the use of divining rods, as there are used today, is not older than the Middle Ages. The first historical sources derive from the German Renaissance, and the international spread of divining rods was due to migrating German miners, especially after the decline of the German mining industry following the Thirty Years War. For a while, the rods became quite fashionable, especially among clerics, at least until in 1701, when the use of divining rods was forbidden by a Papal decree. Contemporary literature sways between positive and negative reactions. There is, however, something possibly older, which might be comparable to divining rods, the so-called rhadomancy or 'rod magic' (Knoblauch 1991, Chapter 4, pp. 69–92). But again, it is difficult to obtain any real facts about the issue. Among many other things, which do not concern our topic, authors (such as Agricola [1950], p. 40) also mention stiff and straight rods or wands, but only rarely mounted on supports such as de Bertereau described.

De Bertereau often referred to a '*verge de Mercure*' or 'Mercury rod'. This should not be equated with a Caduceus, the symbol of the Roman god, because de Bertereau's rod was not connected to the god but to the planet. The Mercury rod was, I suspect, used by de Bertereau for water simply because the metal mercury is, like water, a liquid under normal conditions. Elsewhere (de Bertereau 1640, Chapters 1 and 5; see also Note 13) she tells us that she had '*sept verges métalliques*' (seven metallic rods) in use, which corresponded to the seven astrological planets and to the alchemists' seven metals, which bore the symbols of these planets, and de Bertereau also used the Moon rod in connection with water (see, e.g., Table 1), perhaps because of the tides, which are affected by the Moon.

De Bertereau claimed that the 'Ancients' already used such rods. Vitruvius, however, did not mention them. He only talked of 'rods', mounted on supports, in connection with levelling prior to the construction of aqueducts (see above). His rods were definitely parts of surveyors' instruments such as the *chorobates*, the *groma* or the *dioptra*. De Bertereau, on the other hand, had the habit of passing off her surveying instruments for mines (such as compasses, quadrants, etc.) as occult, astrological devices (cf. Note 13), either to impress the public or to hide her craft secrets.[26] So it may be suspected that the alleged divining rods served the same purpose. This view is strengthened by the fact that de Bertereau herself obviously did not attach much importance to the rods for finding water. And in the incident at Château-Thierry, described above, a 'mineralogical compass' mounted 'onto the astronomical catch' was used, and no rod at all (de Bertereau 1632). In de Bertereau's text on water, rods or other occult instruments were just 'decoration' to the otherwise sound craftsmanship—which, however, was inherited from her Roman predecessor.

6. CONCLUSION

Whereas at first glance, the early seventeenth century, pre-scientific text by Madame de Bertereau has much to say about the use of divining rods, we find behind this façade valuable information on the craft-skill of water prospectors, i.e. on the very beginnings of hydrogeology, which in de Bertereau's time was part of the art of mining.

[26] This would be in accordance with a miners' code of 1612, which I found displayed in the *Erzgebirgsmuseum* in Annaberg (Germany) and which stated that: "Members of the mines and foundries are requested to keep their science secret and never to bring strangers into the foundry".

Close observation of the landscape and the knowledge of water-loving plants gave the water prospector a first hint as to where to start digging. A series of experiments was in use to save time and labour before attempting to sink a well. Also, the water prospectors were conscious about the necessity of pure and wholesome water, and they used various tests to ensure that the water was suitable for human consumption. But so far as de Bertereau was concerned these methods were derived from Vitruvius's book on architecture.

Martine de Bertereau's writings thus allow a glimpse into the craft-skills that centuries later developed into what we call hydrogeology, but which in the seventeenth century were essentially the same as in the Roman Antiquity, unhelpfully supplemented by esoteric practices.

At present, it is impossible to judge, whether the use of 'rod magic' was a direct corruption of Roman surveying instruments, or whether it served to hide craft secrets or simply was used to impress the credulous public.

ACKNOWLEDGEMENTS

I like to thank Hugh Torrens (Keele) for improvement of the English of an earlier draft of this paper. Patrick Wyse Jackson (Dublin) and David Oldroyd (Sydney) helped with the present version. Many thanks to them, as well as to John Mather (London), whose constructive critique greatly improved this paper. Thanks also to M. Christophe Mounier, a direct descendent of Martine de Bertereau and Jean du Chastelet, whom I was fortunate to meet in Paris in 2002.

REFERENCES

Adams, F. D. 1938. *The Birth and Development of the Geological Sciences*. Philadephia: Williams & Wilkins.

Agricola, G. 1556 [English translation by Herbert Hoover, 1950]. *De re metallica*. New York: Dover.

Bertereau, M. de. 1632. *Veritable declaration de la descouverte des mines et minieres de France. Par le moyen desquelles sa Maiesté & ses subjects se peuvent passer de tous les Payes estrangers. Ensemble des proprietez d'aucunes sources & eaux minerales, descouvertes depuis peu de temps à Casteau Thierry.* (See Figure 1.)

Bertereau, M. de. 1640. *La restitution de Pluton à M^gr^ l'éminentissime cardinal duc de Richelieu des mines et minières de France, cachées, et detenues jusqu'à present au ventre de la Terre, par le moyen desquelles les Finances de Sa Majesté seront beaucoup plus grandes, que celles de tous les Princes Chrestiens, et ses sujects plus heureux de tous les Peuples*. Paris: H. du Mesnil. In Gobet (1779), pp. 339–452.

Descoqs, A. 1920. La Bretagne minière et les prospections du B^on^ et de la B^ne^ de Beausoleil. *Bulletin de la Société géologique & minéralogique de Bretagne* 1: 227–239.

Duvergier de Hauranne, J. 1744. *Lettres chrétiennes et spirituelles de Messire Jean Duvergier de Hauranne, abbé de S. Cyran. Qui n'ont point encore été imprimées jusqu'à présent*. 2 vols.

Figuier, L. 1860. *Histoire du merveilleux dans les temps modernes*. 2nd edn. 2 vols. Paris: Hachette.

Galien, C. 1630. *La descouverte des eaus minerales de Chasteau-Thierry & de leur proprietez*. Paris: Cardin Besogne.

Gobet, N. 1779. *Les anciens minéralogistes du Royaume de France; avec des notes*. Vol. 1. Paris: Ruault.
Available at:
http://books.google.com.au/books?id=IzsPAAAAYAAJ&dq=Gobet+Les+anciens+minéralogistes+du+Royaume+de+France&printsec=frontcover&source=bl&ots=dverCqEnUK&sig=jLQ58KFJlQxuF35lE0z5Nxsb3GY&hl=en&ei=qGkDSoC_ApHy6gP-y_DQAQ&sa=X&oi=book_result&ct=result&resnum=3#PRA1-PA355,M1.

Joecher, Ch. G. 1784 *Allgemeines Gelehrten-Lexicon, darinnen die Gelehrten aller Stände sowohl maenn- als weiblichen Geschlechts, welche vom Anfange der Welt bis auf ietzige Zeit gelebt, und sich der gelehrten Welt bekannt gemacht, nach ihrer Geburt, Leben, merckwuerdigen*

Geschichten, Absterben und Schrifften aus den glaubwuerdigsten Scribenten in alphabetischer Ordnung beschrieben werden. Vol. 1. Leipzig: Johann Friedrich Gleditschens Buchhandlung.

Hölder, H. 1960. *Geologie und Paläontologie in Texten und ihrer Geschichte*. Freiburg and München: Verlag Karl Alber.

Hölder, H. 1989. *Kurze Geschichte der Geologie und Paläontologie—Ein Lesebuch*. Berlin: Springer-Verlag.

Knoblauch, H. 1991. *Die Welt der Wünschelrutengänger und Pendler—Erkundungen einer verborgenen Wirklichkeit*. Frankfurt: Campus.

Kölbl-Ebert, M. 2003. Life, work and historical reception of alchemist and mining engineer Martine de Bertereau († *ca* 1643). In: *Proceedings of the 26th Symposium of the International Commission on the History of Geological Sciences "INHIGEO Meeting—Portugal 2001—Geological Resources and History"; Aveiro and Lisbon, Portugal, 24th, June—1st, July/2001*, edited by Manuel Serrano Pinto, 235–250. Aveiro: Centro de História e Filosofia da Ciência e da Técnica, Universidade de Aveiro, Portugal.

Kölbl-Ebert, M. 2004. Biographie einer Biographie: die denkwürdige posthume Karriere der Martine de Bertereau. *Geohistorische Blätter* 7: 93–102.

Lancelot, [C.] 1738. *Mémoires touchant la vie de M. de S. Cyran, pour servir d'éclaircissement à l'histoire de Port Royal*. 2 vols, Cologne (publisher not stated).

Le Brun, P. 1750. *Histoire critique des pratiques superstitieuses, qui ont séduit les peuples, & embarassé les savans. Avec la méthode et les principes pour discernier les effets naturels d'avex ceux qui ne le sont pas*. 2 vols. Paris : G. Desprez & P. G. Cavalier Libraires.

Vitruvius Pollio, M. *De architectura*. Book VIII. http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Vitruvius/8*.html (accessed 27 March 2008).