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TOXICOLOGY AND TREATMENT: MEDICAL AUTHORITIES AND SNAKE-BITE IN THE MIDDLE AGES

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Abstract

By end of the thirteenth century, surgeons and university-trained physicians in Western Europe had a plethora of authorities from the Greco-Roman and Arabic tradition from which to consult for the treatment of snake-bites. Venomous animals receive the largest share of attention in the literature on biting animals. Nearly all of the sources focus on the idea of the animal biting or puncturing the skin's surface with their mouths and few poisonous animals where the venom is passed on through the skin or hairs are mentioned. Venomous animals frequently appear in discussions on poisons in general, with poisons of animal, mineral or vegetable origin. The bulk of the discourse dealt with venomous snakes and rabid dogs, the latter considered venomous due to its 'poisonous' saliva, and to a lesser extent, scorpions and spiders. In general the bites of non-venomous animals received scant attention. Unlike modern taxonomical categories, medieval categories for animals were usually connected to the movement or the locale of the animal: flying animals, animals in water, land animals (which mainly covered quadrupeds), and crawling animals. It is in the latter category that snakes were located, along with lizards.

1. GRECO-ROMAN AND ARABIC AUTHORITIES ON SNAKE-BITE

Animal bites are covered in Galen's *Megatechne*, his *De theriaca ad Pisonem* and the spurious *De theriaca ad Pamphilianum*. The last two are part of the *theriak* tradition, which dealt with the preparation of theriac, a famed antidote against snake-bite and other conditions. The Great Theriac, usually ascribed to Andromachus (1st c. CE) and highly recommended by Galen even used snake flesh as one of its ingredients and was a major part of the Western pharmaceutical arsenal up to the early modern period.¹ Two influential non-medical sources from the 1st century CE which were used by medieval scholars were Pliny the Elder's *Natural History* (*Historia naturalis*) and Lucan's poem, *Pharsalia*. In Book IX of the latter, Cato the Younger encounters assorted venomous snakes in North Africa, such as the flying *iaculus* and the deadly and petite *dipsas*.² Pharmaceutical texts also covered bites, and their treatment abounds in Dioscorides's *On medical material* (*De materia medica*, 1st c. BCE), the late antique Pseudo-Dioscorides's *On female plants* (*De herbis feminis*), Sextus Placitus's *On medicine made from animals* (*De medicina ex animalibus*) and the widely circulated fifth-century Pseudo-Apuleius, *On plants* (*De herbis*).³ In this last text, snake-bite treatment is discussed in 21 of the 131 entries of plants, and the animals are

the serpent (used as a generic term), the viper and asp. The term viper (*vipera*) in Latin literature usually refers to the *vipera berus* but is often used generically for any venomous snake. The term asp (*aspis*) can refer to any very venomous snake, and often used when describing snakes such as the asp viper (*vipera aspis*). Care should be taken when attempting to identify Greek snake-names with modern taxonomical terms.

The third-century CE treatise *On venomous animals and their remedies (De venenatis animalibus eorumque remediis)* by Philumenus discussed the bites of venomous animals and listed a large variety of venomous snakes and their corresponding symptoms and treatment. The work in translation would play an important role in Arabic medical lore on snake-bite.⁴ Another influential late antique text was the seventh-century *Medical Compendium in Seven Books* of Paul of Aegina, which with Philumenus formed the foundation of Avicenna's extensive coverage of snakes. Paul of Aegina examined prophylactics for venomous animals in general and specialist treatments for particular animals. Of the twenty-one named animals, eleven are venomous snakes. The snakes discussed by Paul of Aegina were the viper, *amphisbaina*, *skytal*, *dryinas*, *haimorroos*, *dipsas*, *kenchrin s*, *kerast s* and asp, water snake, basilisk and sea-serpent.⁵

Many of the Arabic medical treatises that were translated into Latin from the late eleventh to the early fourteenth century discuss snake-bite treatment. Their influence was immense, as they formed a major part of the university curriculum.⁶ The tenth century's *Kitāb al-Malik* of 'Alī ibn al-'Abbās al-Majāsī (known as Haly Abbas in the West) was translated twice, first by Constantine the African in the late eleventh century as the *Pantegni* and in the twelfth century by Stephen of Antioch as the *Liber regalis*.⁷ The *Pantegni* discussed the bite of the *tyro* snake and other snakes, along with bites of other animals, including men and monkeys.⁸ Two treatises by Rhazes (Abū Bakr Muḥammad ibn Zakariyā al-Rāzī, c. 865–925) that included snake-bite treatment were translated as the *Liber continens* (*Kitāb al-Ḥwāf al-Ṭibb*) and the *Liber ad Almansorem* (*Kitāb al-Manṣūr al-Ṭibb*).⁹ Other translated works of interest include Avenzoar's *Al-Taysir*, Albucasis's *On surgery*, Quṣṭ ibn Lūq's *On Physical Ligatures* and Averroes's *De venenis et theriaca*.¹⁰

The hugely influential and comprehensive *Canon of Medicine* by Avicenna (ibn Sīnā, c. 980–1037) drew on Paul of Aegina, Philumenus, and other authors when discussing animal bites in ninety-eight chapters.¹¹ The longest chapter was devoted to rabid dogs, but there were general chapters on snakes and specialist chapters devoted to individual snakes such as the basilisk, the multi-coloured asp, viper, “the snake that makes blood come out all pores,” and horned serpent (likely *Cerastes cerastes*). Avicenna's *Canon* became the primer for the scholarly study of animal bites, until it was complemented by Maimonides's *On Poisons and the Protection against Lethal Drugs*. Maimonides (Moshe ben Maimon) composed this work in 1190 at the request of al-Qāḍī al-Faḍl, counsellor and secretary to Saladin. The work, designed for lay readership, discussed general medicines for all bites and specific medicines for certain animals, including snakes, along with simples and compounds and suggested procedures for one who had been poisoned or bitten by a venomous animal. It was translated three times into Latin in the late thirteenth and early fourteenth centuries. The three Latin translations are by Armengaud Blaise, Giovanni da Capua and one termed ‘Anonymous Vatican.’ The French surgeons Henri de Mondeville and Guy de Chauliac used

Giovanni da Capua's translation when citing and re-using this treatise in their works.¹² It became the model for specialist poison treatises, for example, William of Marra's *Papal Garland* (*Sertum Papale*) directly parallels Maimonides's text, and is similarly dedicated to a patron (in this case Pope Urban V, 1362–1370), extorting the readers to take due care and protect themselves from poisons and venomous animals. The snakes covered by William are the basilisk, the *armene*, the asp, the horned snake, the *affadius*, the *tyro*, the dragon and the viper. The fourteenth century saw an upsurge in these specialized poison treatises, such as William Varignana's (1270–1339), *On the bites of venomous creatures* (*De morsibus venenatorum*) and Christopher degli Onesti's (taught in Bologna, 1379–1386) *Problems on poisons* (*Problemata de venenis*).¹³

2. ADAPTING MATERIAL AND DISCUSSING THE TOXICITY OF SNAKE VENOM

The question arises of how Western European scholastic medicine adapted the Greco-Arabic discourse on venomous animals. Due to different environmental realities, many authors would cover only animals that abounded in their broad geographical area, unless an encyclopedic coverage was desired.

Encyclopedic coverage is particularly seen in thirteenth-century mendicant works such as Thomas of Cantimpré (1201–1272) *On the nature of things* (*De natura rerum*) and Vincent de Beauvais's *Speculum naturale*, both of which attempted a universal coverage of animal species as an aid for preachers.¹⁴ In the Dominican scholar Albertus Magnus's monumental commentary on Aristotle's *On Animals*, snakes are discussed throughout the work but the bulk of the material occurs in book XXV of Albertus's *On animals* (*De animalibus*) occurs in book XXV, where sixty-one snakes are discussed, along with a discussion on the nature and action of snake venom. The vast majority of the information on each of the individual snakes comes from Avicenna's *Canon*.¹⁵ For example the entry for the *Armene* snake affirms that like the *regulus* snake it kills by its bite, gaze, and hiss, and that no treatment is possible, citing Avicenna's entry for the same animal.¹⁶ Although Avicenna is the major source for Albertus, Pliny and Lucan are also referenced, as are Isidore of Seville and Thomas of Cantimpré.

In a similar vein, the Paris-trained Franciscan Iohannes Aegidius of Zamora's exhaustive thirteenth-century work *Against poisons and venomous animals* (*Contra venena et animalia venenosa*) lists over fifty-six animals.¹⁷ This work functions in a similar manner to Albertus's *On Animals* more as a compendium of natural history, covering a wide spectrum of knowledge, than as a list of suitable medical treatments.

However, such a complete approach was impractical for the uses of medical practitioners, as the deluge of information on exotic snakes that would never be encountered in practice obscured information on treating snake-bite. Therefore most medical treatises that discussed snake-bite limited their coverage to species endemic to their geographical location, and limited references to 'exotic' snakes or simply did not discuss them at all.

Despite writing a treatise titled *On poisons (De venenis)*, the scholar Pietro d'Abano (d. 1316), professor of Medicine at the University of Padua, would cover only ten animals, and among those, only two entries on snakes, one on vipers and one on non-venomous snakes.¹⁸

In his influential medical compendium, the *Lily of Medicine (Lilium medicinae, c. 1305)*, Bernard de Gordon, who taught medicine at Montpellier, devoted an entire chapter to the treatment of snake bites entitled "On the Bite of Serpents and Other Venomous Beasts" (*De morsu serpentum et aliorum venenosorum*) and two other chapters examined dog and scorpion bites.¹⁹ Bernard began his chapter by stating that snakes bit people due to three reasons: the location, the weather or if threatened. Regarding the first, Bernard explained there were dangerous snakes in warm climates, like the *tyro*, dragon, asp and basilisk (which could kill with its mere sight and touch), but that they did not live in his geographical area as "we do not have such a diversity of snakes" (*nos autem non habemus tales diuersitates serpentum*). Similarly, the French surgeon Henri de Mondeville in his early fourteenth-century *Surgery (Chirurgie)* explained how:

There are types of serpents, over all in hot countries, and they can be found in the medical authors, such as the *tyros* or the vipers, which are the same thing, big and small scorpions, flying or non-flying snakes, dragons, asps, basilisks and many others which we do not find in France and are not of interest. We only have common grass snakes, lizards, stellions (geckos) like the 'moron' or the leopard-lizard. These live in France in the forests, fields, lakes and other places. I have seen them hidden in stables and in villages they hide in burrows until someone pulls them out and puts them in a sack. They are common in houses and do not harm people unless they are attacked or harmed. Their bite is light in comparison with other snake bites. They prick with their tongues and bite with their teeth, when we talk about serpents in this text, we mean grass-snakes.²⁰

Regarding snake venom itself, nearly all medical authors followed Avicenna in claiming that it was 'hot' poison (unlike a scorpion bite, which was 'cold'). Venom's toxicity also depended on the sex of the animal, its age, and the weather.²¹ Bernard de Gordon, quoting Avicenna, noted that some male snakes were more dangerous than the female ones, that snakes in dry places were worse than those in damp areas, hungry snakes worse than those which had just eaten, younger ones were worse than old, and fast-moving ones more dangerous as they could accidentally bite people.²² Albertus Magnus explained that the difference between male and female snakes regarding toxicity was due to males having fewer teeth but more poison. Weather affected toxicity as the 'hot' poison of snakes grew more potent in summer than in colder weather.²³

The appearance of the bite itself could help identify the animal in question. For Mondeville, if the animal itself was not available for the surgeon's inspection, then the bite of the viper or *tyro* could be identified by pain at the site of the bite, which soon spread over the body, an emission of blood and greasy pus from the site of the bite, and the skin of the patient would turn green, or at least the site of the bite itself would go green. The male viper's bite would have two punctures, while the female's would cause many puncture wounds. In contrast, the serpent's bite (an ordinary grass-snake for Mondeville) would involve pain and swelling at the site. The patient's face would go white (as heat retreated from the body's surface),

changing to green, blue or black (as the heat returned to the surface) and the bite site would become very hot, accompanied by vomiting, painful urination and colic.²⁴ Similarly, Bernard de Gordon remarked that at the site of the bite there would be intensive pain and swelling, and it would change color, from white, to green, to black, as the poison moved in the tissues. There would be vomiting, painful urination, and stomach ache, and great heat at the site of the bite due to snake-venom being hot “just as Avicenna says” (*sicut dicit Avicenna*).²⁵

Nearly all medical texts devoted the majority of their discussion to treatment, and Avicenna and Maimonides were the two authorities most followed.

Bernard de Gordon numbered the procedures to be followed, which are the following (in paraphrase):

1. Apply a strong and painful ligature around the site of the bite.
2. Take a rooster, pluck the feathers from its bottom and place it on the site of the bite. If the rooster dies, this is a good sign as it is attracting the venom. Repeat this with more roosters.
3. Take a sponge or wool, dip it in hot water, and place it on the site. Repeat this action several times.
4. Apply a cupping glass, along with scarification if necessary.
5. Cover the bite area with a plaster of theriac.
6. Apply a plaster made of gum resin, plant gum-juice, myrrh, asafoetida, opoponax, pepper and sulphur, all mixed up with wine.
7. Take pomegranate leaves, crush them with figs, and apply as a plaster.
8. Give the patient to drink a potion of pomegranates, pomegranate leaves, coriander, gentian and turbith, all cooked in water.
9. Call a *villein* (*persona uilis*) to come and suck the punctured area. Make sure that their stomach is full of wine, rue, nuts and figs, and that their mouth is rubbed with wine and oil.
10. If there is no other way, and the member is a small one, amputate it.²⁶

We can compare Bernard’s order of action, from applying a ligature to amputation, with a similar list of first procedures in Henri de Mondeville’s *Chirurgie*.

1. Tie a ligature.
2. Apply a plaster of theriac.
3. Get someone to suck the bite; the sucker should rinse his mouth with oil or oil and warm wine and rub oil of violets on his lips, and have a full stomach of garlic and nuts.
4. If no volunteer can be found to suck the wound, pluck feathers from the anus of a rooster or a chicken and place it on the bite until it dies. Then apply more.

5. After the above, scarify the area, apply cupping glasses, or leeches.
6. The patient should not be allowed to sleep until they have a strong pulse.
7. Cut open young pigeons and place them on the bite, replacing them as they cool.
8. If all above does not relieve the symptoms, cauterize the area.
9. If even cauterization does not produce any effect, then amputate the limb.
10. If the surgeon has been called in at a very late time, when the venom is already in the tissues, he should apply a ligature, massage the patient's hands and feet and give evacuants (medicines, clysters, and leeches).²⁷

In both accounts, plasters are applied first and surgery is resorted to as a last option. These two sets of prescriptions can be compared with Maimonides's list of actions to take when someone is bitten:

Bind the spot above the bite as tightly as possible and scarify the wound. Someone should suck the bite, first rinsing their mouth with olive oil, or with wine and olive oil, and then suck. He should smear his lips with olive oil and then suck [...]. One should apply simple or compound remedies to the site of the bite. The patient should not be allowed to fall asleep, as the poison might reach the vital organs. The wound should be kept open [...] if the patient has not improved, slaughter a young pigeon, slit its abdomen and put it on the site of the bite. When the heat diminishes, apply another one. If no pigeons are available, apply young chickens, roosters, hens or a weasel. If none of these animals can be found, pour hot vinegar onto the site of the bite or put a poultice with flour boiled in olive oil to relieve the pain.²⁸

These courses of action, which concord with an account of the treatment of an actual patient by a university-trained practitioner, dated between the 1320s and 1340s, can be found in Gentile da Foligno's *Consilium regarding the bite of a deaf asp*, which records current medical practice on treating snake-bite.²⁹ In addition, Foligno, the Professor of Medicine at the University of Perugia, wrote a monumental commentary on Avicenna's *Canon of Medicine*.³⁰ The bulk of his commentary on animal bites is devoted to the bites of rabid dogs, with little commentary on the bites of snakes, spiders and other venomous animals. The snake that is the focus of the *consilium*, the deaf asp, receives no commentary at all, and even the viper received little attention.³¹ However it is likely that Foligno, like Bernard de Gordon and Henri de Mondeville, believed that more attention should be paid to the most common cause of venomous bites, rather than discussing at length rare reptiles. The treatment in this *Consilium* is based on Avicenna and Maimonides's *On Poisons*, which had only recently been translated from Arabic. The treatment is a parallel to the course of action prescribed by Bernard de Gordon and Henri de Mondeville, and is an example of how actual treatment reflected the prescribed course established in treatises.

The case in question involved a young man, who was bitten on his left foot on a mountain near Perugia at the end of July. The fact that it was summer was influential as venom was believed to increase in potency due to heat, and snake-venom was already an extremely 'hot' poison. The hottest days of summer were also associated with Sirius, the dog-star, whose 'dog days' influenced mad dogs and venomous animals. The patient himself attempted self-

treatment and made a ligature above the bite, but without success, and was brought to Gentile da Foligno seven or eight hours after being bitten. Foligno noted how he was motionless, with closed eyelids, and with heart, brain and body failure.

Paralleling Mondeville's exhortation to identify the animal in question, Foligno requested that the snake in question be brought in, so that he could identify it and thus plan the course of treatment.³² He noted that the snake was a cubit in length, with broad head, a body increasing in size, with short tail, and black with grey spots. He identified it as a short deaf asp, which was likely in this case an asp viper (*vipera aspis*). The asp viper (*vipera aspis*) has quite a toxic venom although, while only being a cubit in length, it would have to be a young specimen, as an asp viper's average length is 60 cm. The broad head of this snake fits Foligno's description, as does the coloring. It is unlikely to have been Orsini's viper (*vipera ursinii*), which is smaller than the asp viper but has a round head. Both snakes could be found in the geographical area of Umbria.³³

Foligno immediately went to work. First the Great Theriac of Galen was applied externally over the heart; then a cupping-glass to the wound location, which was then scarified, and the patient was given draughts of stale butter. The usual treatment of sucking the wound (after application of olive or rose oil to the practitioner's mouth) was not done as "no one was found willing to suck the wound with his mouth" on seeing the patient's symptoms. Foligno had made a theriac of ground-up gentian, balsam seed, rue, and anise, which was to be drunk with strong wine.) On the second day, the patient was examined in the morning. The young man still had closed eyes, a heightened pulse and labored breathing, with a 'foul' face. Although the patient had difficulty in swallowing, he was given emerald powder was given along with citrus seeds infused in wine. Maimonides cited the beneficiary power of emerald powder and citrus seeds, and Foligno would use these two ingredients throughout the treatment.³⁴ The patient had great difficulty swallowing remedies. Later the same day the patient had not improved and his urine was livid. Foligno sent him to his associates for a second opinion and when he returned gave him the theriac of Haly Abbas made of castor oil, cassia wood, round aristolochia, anise seed and pepper, and given with wine. It caused the patient to speak for the first time, and by that evening the patient was conscious and had recognized the doctors. Foligno prescribed emerald powder, citrus seeds and two doses of the Haly Abbas theriac for the night, along with massage and for the patient to be kept awake.

The next morning, on the third day, Gentile received a message that the patient looked worse but had taken hardly any of the medicines and had slept. Foligno ascribed both of these as causes of the patient's current condition and insisted that all three medicines be forcibly administered. A few hours later, Foligno visited the patient and found him much improved. A diet of chicken fat and chicken soup (with emerald powder and citrus seeds sprinkled on top) was prescribed, and theriac was administered that evening, along with ensuring that the patient did not sleep and applying cupping glasses again to the site of the bite.

By the fourth day, Foligno found the patient with an improved urine despite a complaint of stomach and kidney pains. Foligno prescribed a clyster of milk and decoction of mallow. The patient was then to be washed with a decoction of *aristolochia rotunda* and Haly Abbas

theriac was administered again. By the fifth day, the patient had much improved and the prescription of Haly Abbas theriac was stopped and a diet of good food and wine was prescribed, with a suggestion to eat something sour in two days time due to the hot poison causing ‘derangement,’ as that species of snake’s venom affected the brain and nerves. Foligno finished his account by noting that most people bitten by the deaf asp do not open their eyelids for months, citing Avicenna.³⁵

In surgical treatises which deal with animal bites, surgery was not offered as a first option and if done at all, only in combination with a wide variety of pharmaceutical treatment. This was exemplified in Guy de Chauliac’s fourteenth-century *Chirurgia Magna* which exhorted the surgeon to consult “*Avicenna, Rasis, Raby Moyses* [Maimonides], *et Henricus* [Henri de Mondeville]” and to remember that “Physic is better than surgery” (*Physicum enim magis est quam cyrurgicum*) when treating snake bites.³⁶ This was observed in the two courses of action, when first presented with the patient, by Bernard de Gordon and Henri de Mondeville, in which both followed a very similar pattern, from ligatures and plasters and surgery, in particular, to amputation as a last resort.

Lanfranc of Milan (d. 1306) was a Milanese surgeon who moved to Lyon and Paris, and hugely influenced surgical knowledge, through his book (*On Surgery*) and his pupils (including Henri de Mondeville).³⁷ When treating the bites of venomous creatures, Lanfranc suggested first applying simples or compounds to extract the venom. These simples included crushed garlic, salted fish, ashes of burnt wine lees, opoponax, gourd leaves, fenugreek roots, fish-gills and crushed ants. The compounds included the urine of a young man mixed with nitre and plasters of calf’s fat and butter, along with the Great Theriac. The wound was to be left open for at least forty days and the patient should not be bled at the beginning (to prevent the poison from moving around the body), nor should laxatives be administered, so that the venom would not move to the intestines. The patient would be fed a good diet and his head would be bathed with a decoction of the head and feet of a ram. For the next month, the patient should take either simples or compounds. In the case of a viper’s bite, he additionally suggested cupping the bite site extensively, to draw out as much blood as possible, and packing crushed broom (*planta genesta*) around the bite, keeping the wound open. Lanfranc’s list of simples are a noted contrast to the ones recommended by his pupil de Mondeville, who relied on Maimonides on this subject.

One of Lanfranc’s students and Henri de Mondeville’s contemporary was Jehan Yperman (1260?–1330?), who wrote the first surgical treatise in Flemish.³⁸ He recommended the application of myrobalans (*Terminalia chebula*) and cupping glasses. If the puncture-marks were hot, it was a sign of a very venomous beast. Recommended compounds included the Great Theriac of Galen, along with Mithridatium, another complex compound medicine from antiquity that was famed as a remedy against snake-bite. In addition, Yperman suggested simples such as tansy, tormentil, asafoetida, mint, gentian, lily, honey, rue and salt along with compounds such as Esdra and Ierologodon [i.e. Hierologodion] of Galen.³⁹ The recipes for these complex compounds of multiple ingredients were to be found in the standard pharmaceutical text known as the *Antidotarium Nicholai*. The *Antidotarium Nicholai* (c. 12th c.) was a condensed version of the *Antidotarium magnum*, a large

alphabetical miscellany of pharmaceutical recipes, composed in Southern Italy in the late 11th century.⁴⁰

The most extensive coverage of snake-bites occurs in French surgeon Henri de Mondeville's *Chirurgie*, whose major sources were Maimonides and Avicenna. Mondeville repeated Maimonides's dictum that medicinal quantities had to be adjusted according to the patient's age.⁴¹ His first procedures for treating a bite have already been examined.

Simple medicines were to be ingested promptly by the patient. A variety of substances were suggested, including lemon-pips, crushed emerald powder, spikenard, garlic, mandrake, iris roots, cumin, rue seed. In addition, like Yperman, he also recommended tormentil and declared that the roots (chewed and eaten) was a common remedy in France, and that hunters would feed it to their dogs if they were bitten by snakes. Three theriacs were the recommended compound medicines: the Great Theriac "just as Rabbi Moses and Averroes in his *Theriaka* say," a Theriac of Four from the *Antidotarium Nicholai* and a theriac of asafoetida.⁴²

There were also topical drugs to be applied to the wound. The simple ones were water-mint, basil, droppings of pigeons (or ducks or goats), sulphur, asafoetida, bdellium, salt, garlic, ox-bile or citron pips (crushed and powdered). Compound topical drugs included crushed pigeon-droppings with garlic and salt, crushed marshmallow seeds with vinegar and oil, wild mint boiled in vinegar, ground pomegranate and fig leaves and a plaster of one of the theriacs applied on the wound itself. All of the simples and compounds were quoted directly from Maimonides.⁴³

Mondeville also added some surgical notes, instructing the surgeon to enlarge the punctures on the wound itself, and open them if closed, before applying cauteries. If the patient could not bear a cauter, then a strip of cloth soaked in a caustic ointment should be inserted into the wound. Topical medicines were then to be applied on this area.⁴⁴

CONCLUSION

This paper has presented an overview of snake-bite treatment by medical authorities in Western Europe c. 1200–1400. After a foray into the major texts in translation available to Western European physicians and surgeons, this paper has emphasised the huge predominance of Avicenna (translated in the late twelfth century) and Maimonides (available from the early fourteenth-century) in the discussions on toxicology and treatment. A wide variety of medical treatments were available, including plasters, assorted theriacs, special diets, ligatures, cupping, and use of cautery. Animal bites of all kinds were believed to contain noxious poisons that needed swift attention, and thus were clearly distinguished from wounds caused by other means, such as sharp blades or clubs. In addition, in order to direct the correct specialist treatment, surgeons would have to identify the animal in question. Similarly, they would have to recognize particular symptoms in the patient, which varied depending on which particular snake had bitten the patient.

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4. Wellmann, M., editor. *Corpus medicorum graecorum*. Leipzig and Berlin; 1908. *De venenatis animalibus eorumque remediis*. x,1,1 The list of snakes was likely translated into Arabic from a pseudo-Galenic work on poisons based on Philumenus. Ullman, Manfred. *Islamic Medicine*. Edinburgh University Press; Edinburgh: 1978. p. 25 discusses the Arabic translator's efforts to translate accurately the Greek terminology of snake names, as there were considerably more names for different snakes in Greek than in Arabic, added to the problem of trying to translate the names of snakes which were not endemic. In the end the translator transliterated and Arabized the Greek names. Also see idem. *Die Medizin im Islam*. Brill; Leiden: 1970. p. 334-341. For an example of the list in Arabic medicine, see the multitude of snakes in Avicenna, *Liber canonis medicinae*, Strassburg, 1473 (Book IV, Fen 6, Treatise 3), to be now cited as Avicenna, *Canon*, 4.6.3 with the relevant chapter number.
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6. As an example of Avicenna and other Arabic translations in the medical curriculum, see Park, Katharine. *Doctors and Medicine in Early Renaissance Florence*. Princeton University Press; Princeton, NJ: 1985. Appendix II: Medical Curriculum at the University of Bologna (1405)
7. There are no modern editions for the Latin translations of these texts and early sixteenth-century editions have to be consulted. The *Pantegni* is printed in *Omnia Opera Ysaac* (Lyons, 1515) and the *Liber regalis* in Haly filius Abbas *Liber totius medicine necessaria continens* (Lyons 1523). For more on translation issues, see the articles in Burnett, C.; Jacquart, D., editors. *Constantine the African and 'Al ibn al-'Abbās al-Maṣī: the Pantegni and related texts*. Leiden: Brill: 1994.
8. Rubin, Jonathan. The Use of the 'Jericho Tyros' in the Theriac: A Case Study in the History of the Exchanges of Medical Knowledge between Western Europe and the Realm of Islam in the Middle Ages. under review. This paper discusses the use of the *tyro* snake in the preparation of theriac and argues that the first use of the term *tyro* occurs in the *Pantegni* and might be a creation of Constantine himself. Many thanks to the author for letting me read this unpublished paper.
9. *Continens Rasis*. Venice: 1529. and *Liber nonus ad Almansorem*. Venice: 1497.
10. Avenzoar. *Liber Teiser*. Venice: 1490. Albucasis. *Cirurgia*. Venice: 1500. Riddle JM, Wilcox J. Qusta ibn Luqa: Physical ligatures and the recognition of the placebo effect. *Medieval Encounters*. 1995; 1:1–48. Averroes. *De venenis et theriaca*. Bologna: 1497. For a general overview of the

authors and texts mentioned, see Pormann, Peter. *Medieval Islamic Medicine*. Edinburgh University Press; Edinburgh: 2007. and Jacquart, Danielle; Micheau, Françoise. *La médecine arabe et l'Occident médiéval*. Maisonneuve et Larose; Paris: 1990. Only Arabic texts translated into Latin have been considered for this analysis, although there are many other Arabic texts dealing with venom, such as the late 9th century Ibn Wahshyah's *Book on Poisons*, in Levey, Martin, editor. *Medieval Arabic Toxicology: the Book on poisons of Ibn Wahshiya and its relation to early Indian and Greek texts*. American Philosophical Society; Philadelphia: 1966.

11. Avicenna, *Canon* (cit. n. 4), Book 4, Fen 6, Treatise 3.
12. Maimonides. *On Poisons and the Protection Against Lethal Drugs*. Brigham Young University Press; Provo, UT: 2009. ed., trans. and comment. G. Bos (Arabic-Latin translation) and M.R. McVaugh (Latin editions) *Idem*, pp. xv and xli-xlii.
13. Sertum papale. Bibliotheca Apostolica Vatican, Ms Barbarini Lat. 306:1–157. Another copy of this text: Metz, Bibliothèque Municipale, Ms. 282. *De morsibus venenatorum*. Vol. 5315. National-Bibliothek, Handschriften; Vienna: p. 111r-127v. and *Problemata de venenis*. Vol. 3659. British Library Harley Ms; London: p. 16r-68v. These texts will be examined in detail in further publications.
14. *De natura rerum*. Walter de Gruyter; Berlin: 1973. Book Eight (on snakes), and *Speculi maioris Vincenti Burgundi Praesulis Belvacensis. Ordinis praedicatorum, theologi ac doctoris eximii*. Venice: p. 1591 *Speculum naturale*. Books xviii–xxii
15. Kitchell, KF., Jr.; Resnick, IM., editors. *Albertus Magnus, on Animals: A medieval summa zoologica*. Johns Hopkins University Press; Baltimore: 1999. p. 1708-1738. two volumes. Chapter 25 is in vol. II Stadler, H., editor. *Albertus Magnus: De Animalibus libri XXVI; nach der Cölnher Urschrift. Beiträge zur Geschichte der Philosophie des Mittelalters, Bd. 15, 16, Münster i. W., Aschendorff; 1916 and 1921*
16. Kitchell; Resnick. *Albertus Magnus, on Animals*. p. 1717 cit. n. 15 and based on Avicenna, *Canon* (cit. n. 4), 4.6.3.23
17. Hernández, Cándida Ferrero. *Liber contra venena et animalia venenosa. Estudio preliminar, edición crítica y traducción*; presented for a doctoral degree at the Universitat Autònoma de Barcelona; Departament de Ciències de l'Antiguitat i de l'Edat Mitjana. 2002;
18. d'Abano, Pietro. *Conciliator differentiarum philosophorum... tractatus de Venenis nouissime...* Vol. 1520. Venice: p. 256v-263r. *idem, Il trattato De venenis*, comment. and illustr. Benedicenti, A., editor. Biblioteca della Rivista di storia delle scienze mediche e naturali. Vol. 2. Olschki; Florence: 1949.
19. de Gordon, Bernard. *Lilium medicinae*. Venice: 1496. p. 18r-18v. Book I, Ch. XIV Demaitre, Luke E. *Doctor Bernard de Gordon: Professor and Practitioner*. Pontifical Institute of Mediaeval Studies; Toronto: 1980.
20. Nicaise, E., translator. *Chirurgie de Maitre Henri de Mondeville*. Félix Alcan; Paris: 1893. p. 436-457. Treatise II, Second doctrine, Chapter II The Latin text is in Pagel, JL., editor. *Die Chirurgie des Heinrich von Mondeville*. A. Hirschwald; Berlin: 1892. p. 17-18. The passage cited here is Nicaise, *idem*
21. Kitchell; Resnick. *Albertus Magnus, on Animals*. p. 1715-1716. cit. n. 15 Avicenna, *Canon* (cit. n. 4), 4.6.3.21
22. de Gordon, Bernard. *Lilium medicinae*. (cit. n. 19), f. 18r. Avicenna, *Canon* (cit. n. 4), 4.6.3.21
23. Kitchell; Resnick. *Albertus Magnus, on Animals*. p. 1715 cit. n. 15
24. Nicaise. *Chirurgie*. p. 440 cit. n. 20
25. de Gordon, Bernard. *Lilium medicinae*. (cit. n. 19), f. 18r. Cf. Avicenna, *Canon* (cit. n. 4), 4.6.3.21
26. de Gordon, Bernard. *Lilium medicinae*. p. 18r-v. cit. n. 19
27. Nicaise. *Chirurgie*. p. 12-13. cit. n. 20
28. Maimonides. *On Poisons*. p. 166-168. p. 8-12. cit. n. 12 (paraphrase of a section of Giovanni da Capua's translation). Also see Arabic text with English translation
29. The consilium is printed and translated in Thorndike, Lynn. *A Case of Snake-Bite from the Consilia of Gentile da Foligno*. *Medical History*. 1961; 5:90–95. [PubMed: 13776700] There are two versions of the text, one short and one long. Thorndike transcribed the long version from Munich, Bayerische Staats-Bibliothek. Ms Lat. Monacensis 77 f. 79v-80r and noted that the short

version appears in two editions of Gentile's work (Pavia, 1488, and Venice, 1497). However the long version is also printed (with minor variants from the Munich manuscript) in Gentile da Foligno, *Questiones et tractatus extravagantes clarissimi domini Gentilis de Fulgineo*, Venice, 1520, ff. 95r-v. Cf. French, Roger. *Canonical Medicine: Gentile da Foligno and Scholasticism*. Brill; Leiden: 2001. p. 239-243. who discusses this case as an excellent example of scholastic medicine in practice.

30. The commentary is da Foligno, Gentile. *Tabula dubiorum ac capitulorum Gentilis Fulgi. super quarto et quinto Canonis Avicenne*. Venice: 1520. Animals' bites (Avicenna, *Canon* (cit. n. 4), Book IV, Fen 6, Treatises 3, 4, and 5) are in ff 175r-185v.
31. *Aspis surda* is translated as "mute asp" in Kitchell, Resnick. Albertus Magnus, on Animals. : 1714.cit. n. 15 as one of the characteristics of these snakes is their silent approach. I have translated it as a "deaf asp" bearing in mind the Vulgate, Psalms 57:5, where "furor eorum sicut furor serpentis sicut reguli surdi obturantis aurem suam" (their fury is like the fury of a serpent, like a deaf *regulus* stopping its ear).
32. This is still the current advice in White, Julian; Meier, Jurg. *Handbook of Clinical Toxicology of Animal Venoms and Poisons*. CRC Press; Boca Raton: 1995.
33. See Kwet, Axel. *New Holland European Reptile and Amphibian Guide*. London, New Holland: 2009. p. 236-239.
34. Maimonides. *On Poisons*. p. 16-18.p. 171-172.cit. n. 12
35. Avicenna. *Canon*. (cit. n. 4), 4.6.3.25
36. de Chauliac, Guy. *Inventarium sive Chirurgia Magna*. McVaugh, MR., editor. Vol. I. Brill; Leiden: p. 163 The section on bites (*de vulnere morsivo et venenoso*) is on pp. 163-164, at the end of the second chapter.
37. Rosenman, LD., translator. *The Surgery of Lanfranchi of Milan*. 1894. from Lanfrank's "Science of Chirurgie," written in 1295, trans. from Latin into two Middle-English mss of 1380, and edited in *Early English Text Society, London Exlibris*, 2003. The section of interest is Chapter 7 ("Bites by mad dogs or other venomous creatures") in *Treatise I, Division III*, and pp. 54-55. *Cyurgia. et Cyurgia Guidonis de Cauliaco Bruni, Teodorici, Rolandi, Lanfranci* [et al.]. Vol. 1519. Venice: 2003. p. 171v
38. van Leersum, EC., editor. *De "Cyurgie" van Meester Jan Yperman: Naar de handschriften van Brussel, Cambridge, Gent en Londen*. A.W. Sijthoff; Leiden: 1912.
39. Rosenman, LD., translator. *The surgery of Master Jehan Yperman*. Xlibris; 2002. p. 222p. 224Book VII, Part III, Ch. 14 ("Snake bites")and Ch. 18 ("Remedies for Poisons")
40. A Middle Dutch translation and part of the Latin text is in van den Berg, WS., editor. *Eene Middelnederlandsche Vertaling van het Antidotarium Nicolai, Ms. 15624-15641, Kon. Bibl. te Brussel, met den Latijnschen tekst der eerste gedrukte uitg. van het Antidotarium Nicolai*. Brill; Leiden: 1917.
41. Maimonides. *On Poisons*. p. 23p. 174-175.cit. n. 12
42. Nicaise. *Chirurgie*. p. 444cit. n. 20
43. Maimonides. *On Poisons*. p. 13-14.p. 169cit. n. 12
44. Nicaise. *Chirurgie*. p. 446-447.cit. n. 20