THE PHENOMENON OF TREMOR IN GALEN

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ABSTRACT: In one of his lectures at la Salpêtrière, Jean Martin Charcot (1825-1893) differentiated action and rest tremors. “The distinction,” he says, “is of the highest importance in the story of chronic diseases of the nervous system accompanied by tremor.”1 Previously, Van Swieten (1700-1772) recognized the two kinds of tremor. According to him, tremor that persists during bedrest results from irritation that intermittently and rhythmically affects the nervous centers. This then would be a convulsive phenomenon—tremor coactus. On the other hand, the tremor presenting during the execution of voluntary movements would indicate a defect of stimulus, itself the result of an insufficiency of the nervous fluid that causes contraction of the muscles under the influence of the will. This, therefore, would be a paralytic tremor—tremor a debilitate.2

This two-fold classification actually dates from long before Van Swieten: Galen had established it, distinguishing very minutely these two kinds of trembling and giving them different names. “For a trembling (τρόμος),” Galen explains, “arises from a weakness of the faculty which moves and carries the body; for nobody trembles who does not endeavor to move his limbs. But palpitating parts (τὰ παλλόμενα) will palpitate although you introduce no motion in them.”3

In this paper I shall examine the phenomenon of tremor and other discordant motions (πλημμελεῖς κινήσεις) in Galen, investigating how he defines them in his book On Tremor, Palpitation, Rigor and Spasm.4 A comparative study of this condition within Galen’s works is a major desideratum, as is a more general investigation of its place in ancient medicine more broadly considered. In this brief study, I shall not pretend to fill either of these gaps. It is hope, however, that this paper will serve as a useful prolegomenon to these important lines of inquiry.

2 Ibid.
4 Galen, De tremore: 7.589-642.
Text and Sources

Galen probably wrote his short work *De tremore (Peri tromou)* between 169 and 180 CE, during his second stay in Rome. To my knowledge, it has been previously translated into English only once, by D. Sider and M. McVaugh (1979); their translation was based not on the text printed by C.G. Kühn, but on an independent collation of manuscripts. Ten manuscripts survive, of which seven are apographs of MS Vaticanus Graecus 1845, 12th century, ff. 171v-197, and this manuscript together with MS Venetus Marcianus Graecus Z. 282, 15th century, ff. 183-189v, has been of most value in establishing the Greek text. *De tremore* was translated into Syriac by Ḥunain ibn Ishaq and then into Arabic by Ḥubaish in the ninth century. No manuscript of the Arabic or Syriac texts has yet been found, but the Arabic version was rendered into Latin in 1282 by the Catalan physician Arnald of Villanova. The text of Arnald’s translation thus represents a very different tradition from that of the surviving Greek manuscripts, and has occasionally proved quite useful in restoring the Galenic original.

Two years before Sider and McVaugh’s translation, M.Z. Konstantinides examined and collated all the Greek manuscripts containing Galen’s treatise *On tremor*, and he established for these codices a stemma, describing their interrelationship. He also critically edited the text of the first five chapters of the treatise. Moreover, in his preface, Konstantinides advised that the full text of the treatise together with the consideration of the Latin translations, as well as a glossary and English translation would be published in the *Corpus Medicorum Graecorum*. This work has not yet been published under the CMG.

In Galen’s survey of his own literature, the last mentioned books were *On Tremor, Palpitation, Rigor and Spasm* and *The Art of Medicine*:

The forth book of my summary covers the remaining five volumes, from the sixteenth to the twentieth. … The argument of the nineteenth concerns the nerves that have their origin in the brain, the sense of smell and source of its faculty of perception, the nerves leading to the eyes. … Distinctions between Diseases and Distinctions between Symptoms; also, following the former of these, one volume

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5 *De tremore, palpitatione, convulsione et rigore* = Περὶ τρόμου καὶ παλμοῦ καὶ ῥίγους καὶ σπασμοῦ; cf. Corpus Medicorum Graecorum: Bibliographies to Galen (Fichtner online version 08/2012).
6 In this study, I refer to this English edition.
Explaining the *Causes of Diseases*; and following the latter, three volumes of the *Causes of Symptoms*, followed in turn by *Affected Places*. Also among those which logically precede my therapeutic works: *Distinctions between Fevers, Mass, Unnatural Lumps*, as well as *Predisposing Causes*, to which may be added *Continuous Causes* and *Tremor, Twitching, Shivering, and Convulsion*, and the work entitled *The Art of Medicine*.\(^{11}\)

However in his citation they also appear in a different order, proof that Galen did not set any importance on exact titles.

The treatise supplements Praxagoras’ work and explicitly adheres to his thought. It was written at about the same time in which *De placitis Hippocratis et Platonis* was finished: in fact in the next to the last book of *De placitis*, as well as in *De tremore*, Galen takes his medical exegesis to Plato’s *Timaeus* into close consideration. In *De placitas* and in *De tremore*, Galen compares the teachings of Hippocrates and Plato with regard to the human body.\(^{12}\)

Before I turn to the very subjects treated in the following work, it will be useful to begin with some general remarks about human motions. Galen says: “When we are healthy, there are two kinds of perceptible motions (αἰσθηταὶ κινήσεις): those due to the impulse (καθ᾽ ὁρμήν), or due to the will (κατὰ προαίρεσιν), acting through the nerves and muscles, which physicians call voluntary actions (προαιρετικαὶ ἐνεργεῖαι); those acting through the arteries and the heart, which they call vital actions (ζωτικαὶ ἐνεργεῖαι). When we are sick, a voluntary action—a motion which acts through the muscles and nerves—is manifest in tremors, spasms, rigors and sometimes with palpitations (ἐν τρόμοις καὶ σπασμοῖς καὶ ῥίγεσι καὶ … παλμοῖς); for all such conditions\(^{13}\) (πάντα γὰρ τὰ τοιαῦτα παθήματα) are discordant motions (πλημμελεῖς κινήσεις) of the same organs through which, when they are healthy, the voluntary actions are accomplished.”\(^{14}\)


\(^{13}\) In this paper, I have opted for “condition” as translation of the Greek words πάθος/πάθημα. In Galen, the distinction between the Greek words πάθος/πάθημα (usually translated as “affection”) and διάθεσις (“condition”) is not clear, although it might be said that the former is a change in progress while the latter is an established change. Cf. Galen, *Method of Medicine*, ed. and trans. Ian Johnston and G. H. R. Horsley (2011), Harvard University Press, xxx-xxxi.

\(^{14}\) Galen, *De tremore*: 7.585.
Tremor

The first condition (πάθημα) investigated is *tremor* (τρόμος). According to Galen, tremor arises from a weakness (ἀρρωστία) of the motive force (δύναμις) that supports and moves the body. The motive force, transmitted from the *arche* (ἀπὸ τῆς ἀρχῆς) through the nerves to the muscles, acts like the motion’s carriage or wings (οἷον ὄχημά τι καὶ πτέρωμα τῆς κινήσεως) for the parts of the body. When the body parts lose this force completely, they are paralyzed, like a bird that has lost its feathers; at this point no motion remains in the parts affected. But those parts of the body that only partially lose this force will necessarily be seen to tremble (ἐν τρόμῳ). If this strength should become weak, everything becomes a burden, even if it is very light. Then motions that are too strong (ὑπέρ τὴν δύναμιν) for weak parts of the body grow violent and involuntary, and hence are tremulous.

In voluntary motions the motive force attempts to lift the members, but due to the weakness it cannot do as much as it wants. The force lifts up a little, but insufficiently, and this leaves the motion incomplete. Again it allows the members to drop. When this happens continually and the motion downward always meets the motion upward, the whole motion becomes double and composite. Therefore, tremor is the name of the condition in which members, falling downward because of their weight, and meet an opposing upward motion produced by the motive force.

The conditioning (διάθεσις) is a weakness of the body’s force, with many possible causes (αἰτία). For example, someone who has lifted a heavy burden and then tries to force himself to walk up a step with it, often trembles in the legs; and if he should try to lift something overly heavy with his hands, they tremble no less. On the other hand, the motive faculty can be suppressed by excess of humors (διὰ πλῆθος ὑγρῶν), or when a chilling (ψῦξις) takes hold. Similarly lack of nourishment (τροφῆς ἀπορία), loss of the natural tone (ζωτικὸς τόνος), fear (φόβος), old age (γῆρας), and sickness (νόσος) also reduce the motivating force and cause tremors.

By situating tremor in forces rather than organs, Galen departs from Praxagoras, who said that tremor is a condition of the arteries, and Herophilus, who associated tremor with the nerves. In particular Galen finds fault with Herophilus in attributing to the organs an illness of the motive faculty. To make his point, Galen uses a musical simile: “Lyre-playing is not an activity of the lyre;
lyre-playing is an activity of the musician, and the lyre is the instrument. Sometimes the playing of the lyre turns out badly though the musician’s fault, and sometimes because of damage to the instruments he uses. Similarly, the craftsman and the artificer of voluntary motion in animal life is the faculty or force (δύναμις), while the instruments (ὄργανα, a word as applicable to musical instruments as to organs of the body) are the nerves (νεῦρα) and muscles (μύες). Therefore, lack of motion and faulty motion are due to conditions either of the instruments (ὄργανα) or of the faculty (δύναμις) using them. Hence, palpitations, spasm and paralysis are injuries of the instruments (ὀργάνων βλάβαι), while tremors are conditions of the unwell faculty (δυνάμεως ἄρροστοσθής πάθη).”

Palpitation

Palpitation (παλμός), just like tremor, is an unwanted and involuntary motion (κίνησις … ἄβούλητος and ἀκούσιος), in which the palpitating parts move up and down. Palpitations differ from tremors in site of effect (τόπος), cause (αἰτία), and symptom (σύμπτωμα).

“Tremor never arises in anyone who in no way undertakes to move,” Galen says, “for tremor is a symptom of powerless and weak motion. In a body in which there is absolutely no motion, there can be no weakness or powerlessness in respect to motion.” Palpitation, however, happens even to those who are motionless. For example, the eyebrow, eyelid, and eye are often raised involuntarily together. This has great importance both for an understanding of the nature of palpitation and for differentiating between it and tremor. For, what appear to be risings (ἐπάρσεις) and fallings (θέσεις) in palpitating parts are really expansions (διατάσεις) of the bodies as they fill up, followed by collapses (συνιζήσεις) as they are evacuated in turn. Motions in those who tremble are of an entire limb, when it falls or is raised; nothing, however, is expanded and contracted. Because of this, the entire member trembles whenever we undertake to do something, none of it remaining motionless: muscles, arteries, tendons, veins, bones and skin all move upwards and downwards with the same motion. But not everything palpitates. For a tendon, bone, cartilage or anything else like this, do not palpitate: they do not have a cavity (κοιλία), which by expanding and contracting would allow their parts to be lifted up and collapse whenever it contracts.

Motion is common to both tremor and palpitation: but while tremor is an involuntary and alternating up-and-down motion of the limbs (ἀκούσιος δὲ κίνησις ἄνω τε καὶ κάτω τῶν μερῶν ἐναλλὰξ ϕερομένων ὁ τρόμος), palpitation is an unnatural expansion and collapse (διάστασις μέν τίς ἐστι καὶ συνίζησις παρὰ φύσιν ὁ παλμός). Things moving upward and downward leave their former place

22 Galen, De tremore: 7.593.

and move to a new one; things expanding and contracting keep their initial place, alternately filling and leaving the surrounding space. In order to remark better on the difference between tremors and palpitations, Galen describes the recognizable signs (γνωρίσματα) of these illnesses. Often, when a great muscle or several muscles palpitate violently, the limb is lifted up by their expansions (διαστελλομένοις), and it falls back down when muscles contract (συστελλομένοις). But it is not proper to call tremor “this kind of involuntary rising and falling (τὴν ἀκούσιον ἔπαρσιν τε καὶ θέσιν) of the limb”23. And the motion itself is unlike that of a tremor. For example, when the motions of palpitating muscles keep the whole limb in motion, each of the motions is complete within its possible range of motion. This is not the case with tremors, of which the upward and downward motions are always incomplete. Involuntary upward and downward motions in muscles palpitating violently are defined by discernible limits while upward and downward motions in tremorous muscles are always incomplete.

Next Galen considers the cause of the condition: a thick and vaporous pneuma (πνεῦμα παχὺ and ἀτμῶδες),24 having no outlet. When a member expands, the pneuma has collected in a cavity. A swift emptying or filling, an expansion or contraction, a falling and a rising, or any other motion like these, can be brought about only by pneumata. Hence the cause of palpitations: the substance (οὐσία) is pneuma, and the qualities (ποιότης) of the substance are moisture and thickness (ὕγρότης … παχύτης).

Palpitations may take place in two sites: it most often arises in the muscles, where there are many small cavities, but also in the skin, where there are no cavities. In the first kind of palpitation, the pneuma fills any cavities the body might have, raising and expanding the surrounding material. In the second kind of palpitation, because the skin has no cavity, the pneuma collects under the skin and separates it from the underlying member, making a new cavity itself.25

Those who are colder are more easily affected by palpitation. Warmth rarefies the pneuma and renders animal bodies fine and soft. Cold, however, thickens and solidifies the pneuma. It is therefore readily retained in cold bodies, unable to dissipate both because of its own thickness and because of the denseness of what surrounds it. In contrast to cold, warmth softens, and relaxes the body, opening its pores and thinning out the pneuma, which it stirs into motion. Because of this, remedies for palpitations end to thin and warm the body, helping the pneuma exit.

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23 Galen, De tremore: 7.595.
24 In ancient physiology the term pneuma (πνεῦμα) had a number of meanings. Particularly with Erasistratus it was used to describe an air- or spirit like material, derived from the inspired air, which traveled in the arteries either alone (Erasistratus) or with blood (Galenus) and was distributed throughout the body. Cf. Galen, Method of Medicine, ed. and trans. Ian Johnston and G. H. R. Horsley (2011), Harvard University Press, XC-CXI.
After tremor and palpitation, Galen distinguishes rigor (ῥῖγος), as follows. 26 “One must first consider what rigor is,” he explains; “this seems to be well known to all, but actually is extremely difficult to define, not only because it is not easy to find the cause (αἰτία) or the disposition of the body (διάθεσις) arising from the cause, but also because men seem mistaken in the very description of the concept.” The idea that rigor is “chills with tremor” (τὸ σὺν τρόμῳ λέγειν κατάψυξιν) is clearly refuted by the fact that not all those who suffer rigor shake, but only those who suffer it violently; and when it does occur, it is not tremor that arises, but something like “shock and agitation” (σεισμοῦ τε καὶ κλόνου). The agitation (κλόνος) associated with violent rigs (σφοδροῖς ῥιγέσιν) attacks the body so implacably that it is impossible to be still (ἀμήχανον), no matter how hard one tries. The motion in those suffering from rigor is entirely involuntary. Moreover, while tremor is a condition of one member, rigor affects all the entire body. 27

Tremor further differs from rigor in that one may tremble with no sensation of cold, while it is impossible to suffer rigor without a chill. Rigor, therefore, cannot be equated with tremor. “Whenever someone is chilled without shock and agitation”, Galen points out, “he does not suffer rigor: rather, if the condition (τὸ πάθος) is truly to be called rigor, it must be accompanied by an uneven and involuntary motion (τὴν ἀνώμαλον τε καὶ ἀπροαίρετον … κίνησιν).” Without this, if not even the skin is moved irregularly, it is called chill (κατάψυξιν). If, however, the skin should be disturbed (ταράττοι), and shake (σείοι), from some attacks (κατὰ τινας ἐμβολάς), the condition is called a shiver (φρίκη), so that shivering is an affection of the skin alone, just as rigor is of the whole body. In the case of healthy patients, suffering rigors means every painful chill. Those physicians defining the unhealthy rigor as a chill seem to be describing merely the rigor found in healthy patients. The unhealthy rigor is a painful chill (κατάψυξις ἀλγεινὴ), with a certain irregular shock (μετά τινας ἀνωμάλου σεισμοῦ) and agitation (κλόνου) of the whole body.” 28

Having defined rigor, Galen moves to the proximate cause of the condition (ποιοῦσα τὸ πάθος αἰτία) and its antecedent causes (τίσι δὲ μάλιστα προηγούμεναι αἰτίαις)? 29 Recognizing what rigor is, what is the proximate cause of the pathos (ποιοῦσα τὸ πάθος αἰτία)? What antecedent causes does it most often follow (τίσι δὲ μάλιστα προηγούμεναι αἰτίαις) ?

In examining rigor’s causation, Galen insists on the theory of four qualities (hot and cold, wet and dry), which are the four elements of the universe (fire, water, air and earth), and to the four “humors” of the body (blood, phlegm, yellow

26 Galen, De tremore: 7.611-638.
27 Galen, De tremore: 7.608.
29 For “cause” (αἰτία), one must determine whether Galen means this in the sense of “agent” or “explanation.” In this passage (7.614), Galen distinguishes the proximate cause (ἡ ποιοῦσα τὸ πάθος αἰτία) from “the antecedent causes (προηγούμεναι αἰτίαις),” while in other passages from On tremor, as in others of his works, Galen generally does not make this distinction. Cf. Johnston, I. (2006): Galen On Diseases and Symptoms, Cambridge University Press, 31-32.

bile, and black bile). According to this doctrine, an animal is healthy whenever its qualities and humors remain balanced. If, however, one should predominate over the other, the animal must sicken with an illness similar to the nature of excessive quality or humor. Hence phlegmons (φλεγμονάι), erysipelas (ἔρυσιπέλατα), herpes (ἕρπητες), carbuncles (ἄνθρακες), burning fevers (τὰ καυσώδη), redness (φλογώδη) and all feverish conditions (πυρετώδη πάθη), occur whenever the quality of heat predominates. Spasms (σπασμοί), tetanus (τέτανοι), palpitations (παλμοί), stupor (νάρκαι), paralysis (παραλύσεις), epilepsy (ἐπιληψίαι), and paraplegia (παραπληγίαι) occur when cold is dominant. Then to what dispositions does rigor supervene? Rigor is a condition that affects the natural heat of the body (πάθος τοῦ κατὰ φύσιν θερμοῦ).

In regard to the origin of the condition, in rigor there occurs a sudden and violent chill of the innate heat. It is necessary for the heat to be chilled “suddenly and violently”; that is, the heat itself remains strong, weakened neither in substance nor in tonos, but affected by an external cause. At this point, Galen employs the simile of “flames” (φλόγα) to describe the external causes that could affect the innate heat:

rigor occurs when the innate heat, although strong and able to sustain itself, is suddenly checked in the same way that a flame is quenched by water. Confusion results in the body, a double motion occurring as in the tremulous, but for a different reason. The mixed motion of tremor arises due to a weakness of the motive faculty. In the case of rigors, the natural motion of the heat is forcibly checked. With a violent motion, the heat tries to push them aside and to clear the way for itself, but is checked in its motion, and the whole body shakes at the resultant impact. The heat, having become vaporous, collides with what opposes it, rebounds back, suffers something like a stroke, and returns to its source; set in motion again, it pushes outward more violently and again rebounds with this impact; this cycle repeats, as long as the distressing causes remain.

Because of these repeated impacts that distress the body, the condition is painful and the cyclical, opposed motions move the animal irregularly.

Furthermore, the body, heated beyond its natural state, produces sweat, for whenever the heat after many impacts has escaped and can now breathe freely, the body must be heated. In rigor, therefore, it is painful not to warm up after being chilled.

Next, Galen addresses whenever rigor is due to a cold or warm cause. That the condition is cold is manifest (ψυχρὸν τὸ πάθος); but whether the agent causing it (τὸ δρῶν) is also cold seems worthy of investigation. First, rigor is a sign (γνώρισμα) of the tertian fever (τριταίου ἀκριβοῦς), and “not even a madman would say that such a fever is created from a cold humor”. Secondly, rigor supervenes on the bilious, remittent fever and marks its crisis. Finally, “a bitter and warm drug applied to a wound will cause first pain; then it brings about a

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30 Singer, P. N. (1997): X.
33 Galen, De tremore: 7.627.
shivering and then rigor on top of the shivering. Phlegmon (φλεγμονή) on the point of abscess is associated too with rigors and shivers (ῥῖγος τε καὶ φρίκη).³⁴

So Galen acknowledges that rigor arises from bitter and warm humor, as yellow bile, no less than from cold and congealing humor.³⁵ But how could a cold condition arise from a bitter, warm humor? Galen puts on the question: “To deny what is evident would be like agreeing that we do not see, simply because we do not know how we see”. Galen, therefore, cannot explain how a bitter and warm humor can produce rigor, but because this evidently happens, he is able to establish that “all it takes to bring on rigor is for the cold or the bitter to be in excess.”

Galen then discusses other factors producing rigor. He has already mentioned that rigor may follow the application of hot drugs and that it happens in burning and tertian fevers, when the yellow bile (ξάνθη χολή) moves through the flesh rather than in the hollows of the veins. This rigor arises either by increased production of this humor in the flesh or by its natural purgation through the flesh. Those suffering indigestion, or who are filled with bad humors, or who come into the summer sun or the bath, or those who exercise at once begin to shiver, and some of them suffer rigor too. Both kinds of causes, hot and cold (ψυχρὰ καὶ θερμὰ), produce painful motion in the body.

Rigor, therefore, is likely to arise not only from yellow or black bile (the black bile is cold while the yellow is warm), but from very cold phlegm, as well. Such rigor is not vigorous, even though it sometimes persists for several days.

Finally, in the last paragraph of this section,³⁶ Galen points out “a new and strange rigor called anekthermantos (ἀνεκθέρμαντος: not warmed), owing to lifestyle changes”. Indolent patients, who bathed after meals would suffer in this way: a sensation of tension or weight would arise in the right hypochondrium where the liver lies, because the veins there were blocked by the grossness of the humors. Just as the patients have a feeling of weight and tension in the bowels, they perceive a rigor too.

### Spasm

Galen concludes his work discussing briefly spasms (σπασμός).³⁷ As in the introduction, Galen explains that all the voluntary motions are accomplished through the muscles, whenever the muscles draw with themselves each of the parts to which they are attached.³⁸ When a condition arises producing tension (εἰς τάσιν) in the muscles, a motion that appears natural (ὁμοῖα τῇ κατὰ φύσιν) but is actually involuntary (ἀβούλητος), follows: this condition is called spasm (σπασμός). The muscle is stretched and drawn (τὸ … τείνεσθαι τε καὶ σπᾶσθαι)

³⁴ Galen, De tremore: 7.627.
³⁵ Cf. Plato, Timaeus 85; Hippocrates, Aphorismi 4.58.
³⁶ Galen, De tremore: 7.637-638.
³⁷ Galen, De tremore: 7.639-642.

towards its own source, just as the limb to which the muscle is attached is drawn
toward the muscle. This is common to both the healthy and to the spastic (τοῖς
σπωμένοις) but is involuntary only in the spastic.

Why does this condition arise? In animal bodies excess moisture distends the
nerves (τὰ νεῦρα) and the tendons (τοὺς τένοντας), while drying causes contract
them. In both cases, the nerves and the tendons enter a great tension similar to
what, in the healthy body, produces voluntary motions. It is also possible for a
member, severely affected by phlegmon or similar causes, to draw the attached
nerves along with itself. The origin of the spasm can be found in all these
dispositions.

Spasms arise because phlegmons of the neural parts (αἱ φλεγμοναὶ τῶν
νευρωδῶν μορίων) stretch and pull the contiguous sinews. If the sinews are
stretched, swollen by an imbalance of humors, a condition arises similar to that in
which the chords of an instrument are stretched because of atmospheric moisture.
The opposite occurs in ardent fevers and severe frenzies; as thongs drying close to
a fire are drawn together and tightened, so too spasms arise from an excessive
dryness of the sinews caused by disease.

Whenever the members are stretched forward, the spasm is called
“emprosthotonos” (ἐμπροσθότονος: forward-pulling); whenever backwards,
“opisthotonos” (ὀπισθότονος: backward-pulling); with equal force in both
directions, tetanus (τέτανος: convulsive tension). Spasms caused by dryness
cannot be healed, for these victims will die before a doctor can develop a
treatment for them. Spasms arising from imbalance of the humors or from
phlegmon may be cured by draining the dominant humor or by treating the
phlegmon with its proper remedies.

Conclusion

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In conclusion, when we are sick, involuntary motions appears as tremors, palpitations, rigors, and spasms. All these conditions are discordant motions arising either from dysfunctions either of the organs through which voluntary actions are carried out when healthy (palpitations, rigors, and spasms) or of the faculty that supports and moves the body (tremors). Each condition has its own characteristic: cause (αἰτία), site (τόπος), symptom / disposition (σύμπτωμα / διάθεσις), and signs (γνωρίσματα).

According to Galen, tremor is an involuntary, alternating motion of the limbs resulting from weakness of the motive force that supports and moves the body. It arises from many different reasons (lack of nourishment, loss of tonos, etc.), and in many sites. Palpitation is an unnatural expansion and collapse of the muscles caused by thick and vaporous pneumata trapped by the cold. Palpitations arise in the muscles and in the skin.

Rigor is a painful chill with irregular shocks and agitation, arising when the innate heat, although strong, is suddenly affected by either a hot or a cold cause. Lastly, spasm is an involuntary motion following tension in the muscles which are stretched and pulled by sinews with excess moisture (e.g. in phlegmons) or dryness. Like palpitations and rigors, spasms are a condition of the organs that carry out the voluntary motions.