

DISTURBANCE OF FUNCTION
(*FUNCTIO LAESA*):
THE LEGENDARY FIFTH CARDINAL SIGN
OF INFLAMMATION, ADDED BY GALEN TO
THE FOUR CARDINAL SIGNS OF CELSUS

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*Quid enim stultius quam incerta
certis habere, falsa pro veris.*

—Cicero

FATUOUS it undoubtedly is, as Cicero says, to take the uncertain for the certain and the false for the true. But we are all liable to do so at times. Karl Popper reminded us not long ago, in an essay entitled *On the Sources of Knowledge and Ignorance*, that most of what we know or think we know is of traditional origin, i.e., what we have read or have been told.¹ It is *doxa* not *epistemē*, opinion not knowledge. The distinction is apt to be lost sight of with a readiness that is inversely proportional to our real knowledge of the topic under discussion. The remark applies not only to the layman but to the scientist qua scientist. Those of us, for example, who received our biological or medical education in the 1930's, 1940's, and 1950's had no doubt that the normal diploid number of chromosomes was 48; those who were educated in the 1960's "know," with equal conviction, that the real number is 46. Since we are all in the same boat here I hope that no one will suppose that in the following paragraphs it has been my intent to deride an often much maligned group of purveyors of tradition, the authors of textbooks—specifically, the authors of textbooks of pathology. *Bona venia horum optimorum viro-rum dixerim*—I speak without offense to these best of men—as Cicero also said, more or less. The matter that I am about to present does have its comical aspects, but I hope that the amusement, such as it is, will be shared by those—insofar as they still survive—at whom we may smile.

The fifth cardinal sign of inflammation, added by Galen in the second century A.D. to the Celsian tetrad—*calor, rubor, tumor, and dolor*—of a century and a half earlier, is, as attentive readers of modern

textbooks of pathology know, disturbance of function, *functio laesa*. A few examples drawn from textbooks written in English, German, French, and Italian will suffice to make the point. Lord Florey (1970) tells us that “. . . the doctrine of the four cardinal signs of inflammation, redness, swelling, heat and pain, was enunciated by Celsus . . . and to these Galen . . . added a fifth sign *Functio laesa*.”² Franz Büchner (1966) lists *rubor*, *calor*, *tumor* and *dolor*, and adds, “Galen annexed thereto *functio laesa*, the disturbance of normal function, as a fifth cardinal symptom of inflammation.”³ Pierre Dustin (1966) calls Celsus a “Roman patrician who . . . underlined the four ‘cardinal’ signs: *rubor*, *tumor*, *calor*, *dolor*.” And “Galen was to add to these signs the notion of impaired function (*functio laesa*).”⁴ Emilio Verrati (1938), who quoted directly from Celsus, finds that the “clinical manifestations of inflammation were expressed synthetically by Celsus with the aphoristic comment, ‘*Notae vero inflammationis sunt quatuor: rubor et tumor cum calore et dolore*’; to these four cardinal symptoms Galen then added a fifth: *functio laesa*.”⁵

Occasionally the attentive reader of a textbook of pathology receives a sharp jolt. A footnote to Morton McCutcheon’s chapter on inflammation in Anderson (1966), for example, informs us that “the ‘cardinal signs’ of inflammation are redness (*rubor*), heat (*calor*), swelling (*tumor*), and pain (*dolor*) (Galen), together with altered function (*laesa functio*) (Celsus).”⁶ The same bouleversement may be found in the first edition (1932) of William Boyd’s *Textbook of Pathology*: “It was Galen in the first century A.D. who named the famous ‘cardinal signs’ of inflammation as being *calor*, *rubor*, *tumor* and *dolor* . . . to which a fifth was added by Celsus, *functio laesa* or impaired function.”⁷ Celsus’ feat was to bemuse Boyd’s readers only briefly, for the passage was quickly monitored and yanked. In the second and all succeeding editions of the textbook we read that it was “Celsus in the first century A.D. who . . .” etc. Nothing more is said of Galen or the fifth sign.⁸ Contrary to what might be supposed this version, or rather inversion, of the story did not originate with Boyd, as we shall see.

It is not only the textbook writer who transmits the apocryphal Galenic fifth cardinal sign as verity. Robert H. Ebert, in a multiauthored treatise (1965) on the inflammatory process, lists the four Celsian signs as usual, and notes that to these Galen “added loss of function as the fifth cardinal sign of inflammation.”⁹ In another recent monograph

(1968) by W. G. Spector and D. A. Willoughby, one finds an amusing cartoon depicting five atlantes, each bearing the name of a cardinal sign, engaged in supporting the crumbling entablature of a Greek temple, the roof of which is about to come down on the head of the armless fifth figure entitled "loss of function." "The Greeks had a word for it," the authors wrote. Not surprisingly the word turns out to have been uttered in the Latin language: ". . . calor, rubor, tumor and dolor to which Galen . . . added 'functio laesa'."¹⁰ Medical historians themselves are not exempt from purveying this counterfeit information. J. G. W. Gispén, after concluding that the Egyptian term represented by *nsr* can justifiably be translated as "inflammation," remarks that the entity referred to includes among its manifestations Celsus' heat, swelling, and redness—only pain being missing. But, he adds, here "even the addition of Galenus to the characteristics of inflammation, 'impaired function,' is found."¹¹

Some years ago, after having searched in vain—although not entirely in vain—through Kühn's edition of Galen's works for the so-called Galenic fifth cardinal sign, after examining almost every passage indexed under the heading of *pblegmonē* and *inflammatio*, I came to the conclusion that it did not exist as such, that the story of its addition to the Celsian four was only one of those legends that haunt written history. Since Kühn's edition of Galen comprises 20 fat volumes of Greek, including the accompanying translation into Latin, it might seem hazardous to claim, on the basis of a search that could not pretend to be exhaustive, that nowhere in that forest of words was the expression *functio laesa* and its Greek equivalent applied to the symptomatology of inflammation.¹² But there are additional reasons for believing that the fifth symptom is a myth. First, writers before the 19th century, in particular those who lived in the 15th, 16th, and 17th centuries when the works of Galen were widely known and frequently quoted, do not mention the apocryphal fifth sign, as far as I have been able to ascertain. Second, the earlier writers do mention a number of additional Galenic signs of inflammation. Third, no writer who has accepted *functio laesa* as a fifth Galenic sign has ever, to my knowledge, given any indication where anything like it is to be found in the Galenic corpus. (In contrast, liber 3, cap. 10. of Celsus is often, correctly, cited as the source of *rubor et tumor cum calore et dolore*.) Fourth, the interchange of the contributions of Galen and Celsus to the symptomatology of inflammation, so

common among writers of the 19th and early 20th centuries, and the ascription of the fifth sign now to Galen, now to unnamed "later writers," suggests that something is amiss. Fifth, a diligent perusal of mid-19th century German textbooks and monographs allows one to observe the legend of the fifth symptom take form in the hands of its several authors. Sixth, it is possible to find a passage in Galen that may very well have led someone to call the fifth sign, *functio laesa*, into being, although this passage does not deal with inflammation. Finally, Galen could not have consciously added *functio laesa* to the *calor, rubor, tumor* and *dolor* of Celsus, since neither the tetrad, the name of Celsus nor the expression "cardinal sign," in reference to inflammation, occur in any of his writings that have been preserved.

Before proceeding with the documentation of these points some general comments are in order. Historians are often guilty of perpetuating mythical or legendary stories. Once established in the literature such fables have the habit of moving from the hands of one writer to another and reproducing themselves from one generation to the next rather in the manner of an inherited disease, *wie eine ewige Krankheit fort*, as Mephistopheles said of the law. Some of the stories are trivial and hardly worth rebutting, others are both important and misleading, still others are almost too good to dispense with even after we have learned that they are false. As G. Kitson Clark recently pointed out, some of them prove to be stories that have merely slipped their historical moorings, i.e., the evidence on which they were based has been lost. From time to time such evidence may turn up again, to confound the sceptic.¹³ From the standpoint of the general historian certain of these legends have been commented on recently by that entertaining and witty writer, Robert Birley, in a little monograph entitled *The Undergrowth of History*.¹⁴ Historians of medicine and science have dealt with the matter also. "Mistrust is the cardinal virtue of the historian," writes Walter Artelt, before presenting a few illustrative cases.¹⁵ One of these is relatively trivial: the fact that while we do not know the *gens* name borne by Galen the one usually ascribed to him, "Claudius," almost certainly stems from a misinterpretation of the honorific "clarissimus," abbreviated "cl." Walter von Brunn wrote in 1937 that the absence of any *gens* name for Galen in the manuscript sources had been noted as far back as 1887, and that in 1902 Karl Kalbfleisch and Karl Sudhoff had agreed with respect to the misunderstood abbreviation. The misunder-

standing did not arise until the 15th century, when printed versions of Galen's works began to appear.¹⁶ A more misleading legend, also mentioned by Artelt, is that of Albrecht von Haller's 12,000 book reviews.¹⁷ Heinrich Rohlf's proved in 1880 that this inherently unbelievable number was a typographical error for 1,200, itself a startling enough figure when one recalls the enormous mass of von Haller's other writings, not to mention his nonliterary activities.¹⁸ That both legends still survive indicates the hardiness of the genus.¹⁹ A third legend mentioned by Artelt is also of a kind that is inherently unbelievable, and it perhaps belongs as well to the category of those too good to forget.²⁰ The story is that Duke Henry I of Bavaria, desiring to test the medical diagnostic skill of the famed Nothker Pfefferkorn, abbot of St. Gall in the 10th century, sent him as his own the urine of a lady's maid. The duke was promptly informed by the abbot of St. Gall that a miracle would soon take place—within a month he would bear a child. And the lady's maid did in fact deliver a child within the month. The modern archivist who brought the story to light took it at face value and concluded that the skill of 10th century physicians was not to be scorned.²¹ Artelt suggested that had the archivist consulted his family physician he might have been spared this lapse.²² To an entirely different category belongs the story of Galileo's experiment at Pisa where, by dropping weights from the Leaning Tower, he is said to have disproved the Aristotelian claim that heavy bodies fall faster than light bodies of the same material and thus demolished Aristotelian physics. This story is false, misleading, and unfounded in almost every conceivable sense, as Alexander Koyré showed in 1937, yet it is one that has been told and retold with various embellishments ever since it was loosed on the world by Viviani.²³ The legend that I am here attempting to overthrow (bearing in mind that such attempts are rarely successful) lies on a scale of importance somewhere between the relatively trivial—such as Galen's apocryphal *gens* name—and the really important—such as the legend of Galileo's experiment at the Leaning Tower.²⁴

We return now to the so-called Galenic fifth cardinal sign of inflammation, disturbed function, or *functio laesa*. The earliest reference to it that I have been able to find does not, significantly enough, assign it to Galen. Uhle and Wagner, in 1864, after mentioning local heat as the prime symptom of inflammation, have this to say: "Celsus himself placed thereafter the other three cardinal attributes, hence in sum four: *calor*,

rubor, tumor, dolor . . . if one takes disturbance of function besides as a fifth symptom”²⁵ The phrasing does not suggest that Uhle and Wagner thought they were saying anything particularly new, and we shall see that this is indeed the case. But they were, as far as I know, the first to put “disturbance of function” directly in the context of Celsus’ four cardinal signs. Noting that neither the name of Galen nor the Latin tag *functio laesa* appears in this version, let us call it α . Version α may also be found in Birch-Hirschfeld (2d. ed., 1882).²⁶ The next version to appear is β : redness, heat, swelling, and pain are ascribed to Galen—not to Celsus—and the fifth symptom remains fatherless. Version β turns up for the first time in Perls (1877): “Since the beginning of our era, and most clearly for the first time in Galen’s writings, which belong in the second century after Christ, we find ‘inflammation’ characterized by four cardinal attributes: calor, rubor, tumor, dolor. . . . We can annex to these symptoms that of decrease of function (‘functio laesa’) in addition.”²⁷ Here, we see, the fifth cardinal sign has been given a kind of legitimacy by rendering it in Latin. Version β may be found also in Ziegler (2d ed., 1882),²⁸ Thoma (1898),²⁹ Stengel (1898),³⁰ Hektoen and Riesman (1901),³¹ and Ribbert (1905).³²

We come now to version γ . Here *calor, rubor, tumor, and dolor* are once again, correctly, assigned to Celsus; *functio laesa* is present but still fatherless. Oddly enough, version γ seems to have made its first appearance in the English translation (1883) of the second edition of Ziegler, itself bearing version β as already noted. In place of Ziegler’s “Since Galen, i.e. since the second century after Christ, recognition was customarily accorded the four cardinal symptoms” etc., we find the following: “From the time of Celsus, i.e. from the first century A.D., four cardinal symptoms of inflammation have been recognized: namely *rubor, tumor, calor, dolor* To these we may generally add a fifth, the *functio laesa*. . . .”³³ But Ziegler himself was not easily moved. In spite of the correction made in the second edition by his translator and editor, Donald McAlister, the offending passage remained in several successive German editions. It was still present in the sixth German edition (1885). I cannot speak for the seventh and eight editions, but by the ninth German edition (1898) the passage had been changed to γ .³⁴ Version γ (which differs from α only in that the Latin tag *functio laesa* is present) made an apparently independent manifestation in the German literature in Stricker (1883).³⁵ Version γ then became the

mode, and is to be found in Martin (1904),³⁶ Adami (1910),³⁷ Hewlett (1912),³⁸ and Karsner (1926).³⁹ Ribbert shifted from β to something approaching γ in the 3d edition of his work (1908).⁴⁰

When the fatherless fifth sign, *functio laesa*, in β (in which *calor*, *rubor*, *tumor*, and *dolor* are credited to Galen) is assigned to Celsus, we have version δ . We have already met with δ in both the first edition of Boyd (1932) and the latest edition of Anderson (1966). A still earlier instance of δ , which is apparently a contribution of the English-speaking peoples, turns up in Muir (1924), who informs us that "Galen gave, as its *cardinal* signs, *tumor*, *dolor*, *rubor* and *calor* To these Celsus added another of importance, namely *functio laesa*, or impaired function." Anderson has been less fortunate than Boyd in the matter of editorial attention, and his grotesquely incorrect version—which would have Celsus adding a cardinal sign that was never his to the nonexistent four cardinal signs of a man who lived a century and a half later—continues to eke out its existence in a footnote, where it clings to the larger text like some hardy parasite that cannot be dislodged.⁴¹

We come now to the version I shall simply refer to as the "canonical," not necessarily because it is the version with which modern readers of textbooks are most familiar, but because it represents the legend in its most fully developed and palatable form. A few examples of the canonical version were presented in the opening paragraphs of this paper. Celsus, we recall, is in this version credited with the introduction of *calor*, *rubor*, *tumor*, and *dolor*, and to these Galen is said to have added a fifth cardinal sign, *functio laesa*, or disturbed function. When was the canonical version introduced? The earliest exhibit in my collection is that of Tendeloo (1919), who states: "Celsus himself . . . grouped *rubor*, *tumor*, *calor* and *dolor* together . . . Galen annexed as a fifth, *functio laesa*, disturbed activity."⁴² It is possible that a still earlier instance of the canonical version exists somewhere, either within the realm of textbook literature or outside of it, for I cannot claim that my search has been exhaustive.

Marchand, who is the only writer to have given the origin of the fifth symptom any attention, as far as I know, pointed out in 1924 that its parentage was somewhat uncertain.⁴³ Marchand did not differentiate between the introduction of the fifth symptom, as such, and the introduction of the Latin tag *functio laesa*. It is rather more curious that he had nothing to say about the ascription of the fifth sign to Galen. The

omission would seem to be significant, since he was well acquainted with Galen's views on the symptomatology of inflammation (he quotes them at length) and he did not hesitate to point out that Birch-Hirschfeld, Ziegler, and others had wrongly assigned the four cardinal symptoms *calor, rubor, tumor, and dolor* to Galen. On the face of it the omission would suggest that the habit of ascribing *functio laesa* to Galen was not yet widespread at the time Marchand wrote.⁴⁴ What Marchand had to say on the subject is worth careful reading:

To the old four cardinal symptoms disturbance of function ('*Functio laesa*') was later annexed in addition as a fifth, yet in no way with justice, since it is not a phenomenon peculiar to the inflammatory process, but one inseparable from every disease-state, whether or not this is bound up with an inflammatory process. Who first gave *Functio laesa* the meaning of a 'cardinal symptom' has not been precisely established. The old interchange of the general process with inflammatory disease underlies this assumption.⁴⁵

Marchand also called attention to James Macartney who, he wrote, in 1838 mentioned as a "fifth cardinal symptom the alteration or disappearance of normal secretion (thus a *functio laesa*)."⁴⁶ (What Macartney actually wrote was that inflammation is characterized by "*heat, redness, tumour and pain*; to which should be added, an *alteration or suspension of the natural secretions of the part*";⁴⁷ he says nothing of Celsus, Galen, the cardinal signs, or *functio laesa*). Marchand also noted that Virchow had emphasized disturbance of function as an important feature of the inflammatory process. He quoted in support of this claim a sentence that had at its beginning a reference to a paper written by Virchow in 1852 and at its end a reference to one written in 1854; this left the reader to puzzle over the source of the interior, supposedly direct, quotation from Virchow.⁴⁸ As it turns out the quotation from Virchow is a chimera made by grafting the middle of one sentence onto the tail of another written two years later.⁴⁹ As far as Virchow's beliefs were concerned, however, Marchand's point was valid and his reference to Macartney contains another clue to the origin of the fifth cardinal symptom, *functio laesa*.

Virchow's views on inflammation would require our attention if only for the fact that his first paper on the subject appeared in 1843 and his last, 57 years later, in 1900.⁵⁰ In 1854, with reference to the question

of functional disturbances accompanying inflammatory processes, Virchow noted that the attention of physicians had frequently been called to this matter in the past. He mentioned the "four cardinal characteristics of *calor, rubor, tumor and dolor*" described by Celsus, observed in passing that Galen had regarded inflammation as a kind of local fever—*inflammatio veluti febris est membri*—but said nothing of *functio laesa* or disturbed function as a fifth cardinal sign.⁵¹ When dealing with the same subject four years later in his *Cellular Pathology* Virchow, it must be admitted, nods: "In the arrangement of the ancients, as they have been preserved in the dogmatic writings of Galen, heat is known to occupy the dominant position among the four cardinal symptoms (*calor, rubor, tumor, dolor*), for it is the symptom from which the process has received its name."⁵² This reads as if Virchow meant that the four cardinal symptoms, so designated, or some reference to Celsus, were to be found in the Galenic writings, but one may suppose that he knew better.

At this point we shall glance backward into the four or five centuries preceding the 19th, that long period during which Western medicine was steeped in Galenism even when at times opposing it. We already suspect that the chances of finding any traces of a Galenic fifth cardinal symptom designated *functio laesa* are vanishingly small, but the search will be rewarding for other reasons. First, a dictionary definition from a standard mid-18th century medical dictionary: "In particular, by inflammation is understood a swelling, caused by the presence and the stay of blood, accompanied by heat, redness, tension, pain, and often fever."⁵³ The definition is Galenic rather than Celsian and a "fifth" sign, tension, is inserted before "pain." But more informative will be one of those long and scholarly commentaries that Boerhaave's pupils in the 18th century were in the habit of appending to the master's dicta. Gerard van Swieten's elucidation of Boerhaave's Aphorism 370—"An inflammation, which is sometimes called a *phlegmone* or fire, is so denominated from the similitude both of its causes and effects to those of fire"—follows:

General custom has in all languages (as far as I can find) imposed a name to this disorder from that of fire. Thus it is termed *inflammatio* by the Latins and *phlegmon* or *phlogosis* by the Greeks. . . . Thus Galen: "*But this tumor, assuming a pulsation and fiery heat, answers then properly to the ancient title of phlegmon. But*

the ancients do not thus distinguish it; for they called any heat or inflammation a phlegmon, as I have frequently demonstrated. But from the time of Erasistratus it has been customary to term those tumors phlegmons, in which there is not only an inflammatory heat but also a resistance and pulsation; they have also of necessity a redness so-called," etc. (*Comment. 3 in liber Hippocrat. de Fracturis. Charter, vol. XII, p. 236*). And in like manner he in another place (*De tumoribus praeter naturam cap. 2. Charter, vol VII, p. 313*) mentions heat among the diagnostic signs of a phlegmon. And thus Aegineta says, that indeed it was usual to call all hot tumours, accompanied with pain and burning heat, by the name of *phlegmons*: But that even these are said to differ according to their efficient matter: for good blood, of a moderate consistence, flowing plentifully and forcibly into any part, being there impacted by its quantity occasions the phlegmon properly so called; but yellow bile lodging in any part forms an *herpes*; and blood flowing together with yellow bile causes an *erysipelas*: but when the influent blood is very hot and thick it usually produces carbuncles (*Aegineta, liber 4, cap. 17, p. 63. versa*).

Heat was therefore a common sign of every inflammation among the ancients, who gave the common appellation of phlegmon to all kinds of inflammation; but they afterwards restrained it to that species of inflammation, in which there was a resisting tumour, accompanied with a redness, and a burning heat; but to the other species of inflammation they gave different names. Thus in Celsus (*liber 3, cap. 10, p. 139*) we read, that the signs of inflammation are four; to wit, a redness and a tumour with heat and pain. Whence it appears, that the general name of *inflammation* was, even among the Latins, restrained to only one particular species."⁵⁴

In this passage van Swieten, carefully giving chapter and verse, has informed us that Galen's *phlegmonē* is distinguished by swelling, pulsation, and heat, but that the "ancients," according to Galen, called any hot localized lesion a *phlegmonē*, until Erasistratus (who lived almost five centuries before Galen—as far back from him as Paracelsus is from us) limited the term to those tumors or swellings in which not only heat was present, but resistance, pulsation and, necessarily, redness as well.

(In that hardier time pain was perhaps less regarded; one wonders why our "Roman patrician," Celsus, accorded it such importance.) Commenting on the writings of Paul of Aegina (who lived about five centuries after Galen) van Swieten notes that by then the term *phlegmonē* was applied to all hot tumors with accompanying pain and heat. The various species of inflammation (drawn by "Aigeneta" from Galen) were also referred to at times as phlegmons, although they were more properly designated erysipelas, herpes, and so on. At the close of his note van Swieten refers to the Celsian tetrad and infers that the "Latins" used the general term inflammation for one particular species. (The truth is that the "Latins," by and large, never did use the technical term *inflammatio* mentioned by Celsus as a translation for the Greek *phlegmonē*.⁵⁵) Most important, in all of what van Swieten has to say there is no reference whatsoever to a Galenic fifth sign, *functio laesa*, or disturbance of function.

If it is enumeration we desire we can find the signs and symptoms of inflammation up to the number of seven in the *Universa medicina* of Bartholomew Pardoux (Perdulcis), a 16th century Galenist of Paris. The numbering occurs in the following passage:

Hence many symptoms arise, which distinguish phlegmon from other tumors. Firstly a prominent swelling (*tumor*) which involves not only the skin but also the flesh, and this is not diffuse but gathered and presented in a point; the part only undergoes distension. Secondly heat (*calor*), which is not great right at the start but increases in the process of time, perspiration being checked because of obstruction of the channels, whence it is followed by festering. Thirdly, redness (*rubor*), not only as the companion of heat but also as a sign of the underlying humour. Fourthly, pulsation (*pulsatio*), now from the repressed movement of an artery that is somewhat dilated by the increased use of the pulse, now by the impulse of fervid matter, especially when pus is being formed. Fifthly, tension (*tensio*) which comes about from overfilling. Sixthly, hardness (*durities*) and resistance (*renixus*), for the same reason. Seventhly, pain (*dolor*) if the part is sensitive, because of immoderate heat, tension and tearing (*ex cap. 1, liber 13. Method. et 2. ad Glauco. cap. 2. de Tumorib. et. 5. liber 2. de locis affectis*), in the sharpness of which phlegmons exceed other tumors."⁵⁶

The brevity of Pardoux's references to Galen's writings suggest the familiarity with them that he expected from his readers. We see that neither Celsus nor the Celsian tetrad of cardinal signs, nor even the Celsian term *inflammatio* is mentioned in the passage.

A slightly different ordering of the signs and symptoms may be found in Pardoux's definition of *phlegmonē*, although pain still comes last. He writes: ". . . phlegmon can be defined as a hot prominent and circumscribed tumor, derived from an afflux of blood, with redness, tension, resistance, pulsation and pain joined thereto."⁵⁷ We see that "pulsation" occupies fourth place in the first order of listing and sixth place in the second. A compromise would be to award it fifth place. This is exactly what was done by a recent writer whose name deserves to be honored (unfortunately, it is not certain to whom the honor should go). The passage may be found in the fifth edition (1948) of Beattie, Dickson, and Drennan. After getting off to a very bad start with the claim that the "classical features of inflammation have long been recognized in medical literature as '*calor, dolor, tumor, rubor atque functio laesa*'" (the spurious *atque* and the quotation marks both imply that some real author who wrote in Latin is being cited) they almost succeed in redeeming the whole race of textbook writers with a footnote that, after crediting *rubor, tumor, color, and dolor* to Celsus, adds: "To these cardinal symptoms of inflammation Claudius Galenus (Galen) added a fifth, viz. 'pulsatio'."⁵⁸

It would be possible at this point to show that Fernel⁵⁹ and Brissot⁶⁰ in the early 16th century have nothing to say of Celsus and his four cardinal signs, let alone of the fifth sign, *functio laesa*, supposedly added by Galen, that the same applies to the encyclopedic Guy de Chauliac,⁶¹ who wrote in the 13th century, and that the term *inflammatio* itself did not become a technical medical term in general use until the 16th century.⁶² I strongly suspect that if a search were made of the Arabic and Byzantine medical writers of a still earlier period the results would be the same. Rather than do so, and without further quotation from Galen himself on the symptomatology of inflammation—since we are already sufficiently acquainted with his views—I conclude this paper with a remark that, in view of all that has gone before, may seem paradoxical. There actually is a *functio laesa*, more or less, to be found in Galen.

This *functio laesa*, however, does not apply to *phlegmonē*, i.e., inflammation, whether in its general or specific sense, but to disease itself. To

Galen disease is a disturbance of physiological function. We may recall that Marchand suggested as a possible explanation of the origin of the fifth cardinal sign a confusion of inflammation with disease in general, although he did not follow up his own lead. The close approximation of *functio laesa* to which I refer is to be found in Galen's well-known essay on the medical art (*Technē Iatrikē, Ars Medica*). The same passage also turns out to be the source of Macartney's "alteration or suspension of the natural secretions of the part," which he suggested in 1838 as an addition to heat, redness, swelling, and pain. The context of the passage is as follows. Galen is presenting a wide range of signs and symptoms met with in various diseases. After mentioning dyspnea, cough, pain, and disturbance of phonation as features of diseases of the trachea, he writes: "And in the same way affections of all other parts are diagnosed from swelling, pain, disturbance of functions and difference of excretions. The praeternatural tumors are indeed phlegmons, erysipelas, scirrhi and edemata." He then briefly comments on the kinds of local change that give rise to pain, and adds that "function, however, is injured in a threefold manner, weakened, perverted or not carried out at all."⁶³ The Greek of Galen for the phrase "disturbances of function" is *blabēs energeiōn*, and the translation given in Kühn is *functionum offensione*. The Greek for "function, however, is injured" is *blaptetai de hē energeia*, and the translation *autem functio laeditur*. The conclusion that *functio laesa* is the illegitimate descendant of *functio laeditur* seems irresistible, but the precise circumstances of its birth remain obscure.

The moral of the whole story is perhaps too obvious to need emphasis. I shall close with some words borrowed from Alexander Koyré's essay on Galileo and the experiment at Pisa: *Quant à sa morale . . . nous en voudra-t-on de laisser aux lecteurs le soin de la tirer eux-mêmes?*⁶⁴

NOTES AND REFERENCES

1. Popper, K.: On the Sources of Knowledge and Ignorance. In: *Conjectures and Refutations*, 2d ed. New York, 1965, pp. 3-30.
2. *General Pathology*, 4th ed. Lord Florey, ed. London, 1970, p. 22. Another instance occurs in Walter and Israel: "The cardinal signs of inflammation—*calor, rubor, dolor and tumor*,—have been known since the original description by Celsus in the first century A.D.: to these Galen a century later, added a fifth, *functio laesa* or loss of function: Walter, J. B. and Israel, M. S., *General Pathology*, 2d ed. London, 1965, pp. 97, 98.
3. Büchner, F.: *Allgemeine Pathologie*, 5th ed. Munich, 1966, "Galen fügte als.

5. Kardinalsymptom der Entzündung die Functio laesa, die Störung der normalen Funktion, hinzu," p. 398.
4. Dustin, P.: *Léçons d'anatomie pathologique générale*, Brussels 1966, p. 293: "Celsius [sic], patricien roman qui . . . soulignait les quatres signes 'cardinaux': *rubor, tumor, dolor, calor*. Galen . . . devait ajouter à ces signes la notion de trouble fonctionnel (*functio laesa*)."
5. Verrati, E.: *Pathologia Generale*, 3d ed. Milan, 1938, p. 400: "le manifestazioni cliniche dell' infiammazione acuto furono espresse sinteticamente da Celso col noto aforismo, '*Notae vero inflammationis sunt quatuor: rubor et tumor cum calore et dolore*'; a questo quattro sintomi cardinali Galeno ne aggiunse poi un quinto: *la functio laesa*."
6. *Pathology*, 5th ed. Anderson, W. A. D., ed. St. Louis, 1966, vol. 1, p. 13. Cf. #41 for other editions of Anderson.
7. Boyd, W. *A Textbook of Pathology*. Philadelphia, 1932, p. 28.
8. *Ibid.*, 2d ed. Philadelphia, 1934, p. 96.
9. *The Inflammatory Process*. Zweifach, B.W., Grant, L. and McCluskey, R. J., eds. New York, 1965, p. 5.
10. Spector, W. G. and Willoughby, D. A.: *The Pharmacology of Inflammation*. New York, 1968, p. 1.
11. Gispén, J. G. W.: Is the Origin of our Concept of Inflammation to be Found in the Ancient Egyptian Medical Texts? In: *Verhandlungen des XX. Internationalen Kongresses für Geschichte der Medizin*. Hildesheim 1968, p. 229.
12. *Claudii Galeni Opera Omnia*. Kühn, C. G., ed. Leipzig, 1821-1833, 20 vols.
13. Clark, G. K.: *The Critical Historian*. London, 1967, pp. 49-53.
14. Birley, R.: *The Undergrowth of History*. General Series G. 30. London, Historical Association, 1955.
15. Artelt, W.: *Einführung in die Medizin-historik*. Stuttgart, 1949, p. 129.
16. Brunn, W.: Darf man Galenos 'Claudius' nennen? *Ciba Zeitschrift* 4/43: 1505, March 1937.
17. Artelt, op. cit., p. 128.
18. Rohlfs, H.: Eine literarische Legende. *Deutsches Arch. f. Gesch. d. med. u. med. Geographie* 3:270-274, 1880. The typographical error is said by Rohlfs to have appeared in Blumenbach's *Biographie* of von Haller in 1785. One year later Blumenbach wrote that von Haller was the author of 1,200 reviews. Rohlfs adduces other evidence in support of his claim.
19. Garrison, F. H.: *An Introduction to the History of Medicine*, 4th ed. Philadelphia, 1929, reprinted 1963, pp. 317-318. Garrison writes that von Haller's "fame as poet and botanist soon drew him away from his native city to the newly established university at Göttingen, where he remained for seventeen years, teaching all branches of medicine, establishing botanic gardens and churches, writing some 13,000 scientific papers, and incidentally achieving his best experimental work." One wonders whether Garrison's 13,000 scientific papers owe something to the typographer's "12,000 book reviews."
20. Artelt, op. cit., p. 128.
21. Kletler, P.: *Handbuch der Kulturgeschichte*, Kindemann, H., ed. 1. Abtlg., 1934-1939 (Bd. 2), pp. 77, 78.
22. Artelt. *ibid.*
23. Koyré, A.: *Galilée et l'expérience de Pise. A propos d'une légende, in Études d'histoire de la pensée scientifique*. Paris, 1966, pp. 192-201. The essay first appeared in 1937. Viviani's account made its appearance 60 years after the experiment supposedly took place and is the sole historical source, according to Koyré (op. cit., pp. 196, 198). E. B. Krumbhaar, in his history of pathology, is also guilty of spreading the story. He calls *functio laesa* "a dynamic concept that had been announced by Galen but later forgotten" and remarks that the four cardinal signs of Celsus, "with the *Functio laesa* added by Galen," nicely summarize the gross changes of inflammation (*Pathology*, New York, 1937, pp. 101, 124).
24. I call the instance of "Claudius" Galen relatively trivial because no important conclusions have been drawn from it (and perhaps also because I have been guilty of it myself). But if there had arisen a story to the effect that Galen received the cognomen of Claudius because he stammered or was lame, or

- that Claudius was an appropriate name for him because he did so (as in the case of the Emperor Claudius) the mistake would not be trivial.
25. Uhle, P. and Wagner, E.: *Handbuch der allgemeinen Pathologie*. Leipzig, 1864, p. 441.
 26. Birch-Hirschfeld, F. V.: *Lehrbuch der pathologischen Anatomie*, 1ster Bd., allg. Th., 2nd ed., Leipzig, 1882, p. 54: ". . . der alten Cardinalsymptome des Galen's: *Calor, Rubor, Tumor, Dolor*, denen der Begriff der Funktionsstörung hinzugefügt wurde." I have not seen the 1st ed. (1877).
 27. Perls, M.: *Lehrbuch der allgemeinen pathologischen Anatomie and Pathogenese*. Stuttgart, 1877, pp. 56, 57. The passage is still present in the 3rd ed., Neelsen, F., ed. Stuttgart, 1894.
 28. Ziegler, E.: *Lehrbuch der allgemeinen und speciellen pathologischen Anatomie und Pathogenese*, 2d. ed. Jena, 1882, p. 140: "Seit Galen, d.h. seit dem zweiten Jahrhundert nach Christus, pflegt man der Entzündung 4 Cardinalsymptome zuzuerkenne, nämlich die Röthung (*Rubor*), die Schwellung (*Tumor*), den Schmerz (*Dolor*) und die erhöhte Temperatur (*Calor*). Dazu kommt meist noch ein fünftes Symptom, nämlich die Herabsetzung oder Hemmung der Function des betreffenden Theiles, die *Functio laesa*." I have not seen the 1st ed.
 29. Thoma, R.: *Lehrbuch der pathologischen Anatomie*. 1ster Th. Stuttgart, 1894, p. 614. After naming both Celsus and Galen. Thoma writes: "Die Entzündung beginnt nach Galen mit der Erhitzung, *Calor*; diese hat sodann ein Zuströmen der Körpersäfte (*Affluxus*, *Rheuma*, *ρευμα* zur Folge, welche sich als *rubor* und *tumor* aussert, und den Schmerz, *dolor*, erzeugt. In späterer Zeit kam als fünfte Cardinalsymptom die *functio laesa*, die durch die Entzündung bewirkte Funktionsstörung hinzu." This represents a Procrustean effort at tailoring Galen to Celsian measure. The origin of *functio laesa* is then assigned rather vaguely to a later time.
 30. Stengel, A.: *A Textbook of Pathology*. Philadelphia, 1898, p. 98: "Galen and his followers defined it by giving the cardinal symptoms: heat (*calor*), redness (*rubor*), pain (*dolor*) and swelling (*tumor*). To these may be added altered function (*functio laesa*)." The passage remained unchanged down to and including the 8th ed. (1927).
 31. Hektoen, L. and Riesman, D.: *An American Textbook of Pathology*. Philadelphia, 1901, p. 150: "The external manifestations of acute inflammation are commonly redness, swelling, heat and pain (*rubor, tumor, calor, dolor*). These are the so-called Galenic signs of acute inflammation . . . inflammation may exist without any of these gross signs, so great has the significance of the term inflammation changed since its introduction by Celsus. To the four original cardinal signs mentioned has been added a fifth, the loss or disturbance of function (*functio laesa*)." The history implied in this passage is myth.
 32. Ribbert, H.: *Allgemeine Pathologie und allgemeine pathologische Anatomie*, 2d. ed. Leipzig, 1905, p. 335: "Man nennt sie gewöhnlich die vier *Kardinalsymptome*. Sie wurden bereits von Galen aufgestellt und als *Rubor, Tumor, Calor und Dolor* bezeichnet. Die neuere Zeit hat dann entsprechend der Erfahrung, dass entzündete Teile weniger funktionsfähig sind als vorher, als fünftes Symptom die *Functio laesa* hinzugefügt." The fatherless fifth, it now seems, was born of later "experience."
 33. Ziegler, E.: *A Textbook of Pathological Anatomy and Pathogenesis*. Translated from the 2d. ed. McAlister, D., ed. London, 1883, p. 135.
 34. Ziegler, op. cit., 9th German ed. Jena, 1898, p. 323: ". . . es sind der *Rubor*, der *Tumor*, der *Calor* und der *Dolor* schon zu Beginn unserer Zeitrechnung von Celsus als Cardinalsymptome der Entzündung bezeichnet worden. Den vier wurden alsdann als ein weiteres Symptom noch die *Functio laesa*, die Störung der Function des entzündeten Gewebes hinzugefügt."
 35. Stricker, S.: *Vorlesungen über allgemeinen und experimentelle Pathologie*. Vienna, 1883, p. 225: "Die Cardinal-

- Symptome (nach Celsus) lauten Rubor, Calor, Tumor, and Dolor. Das Merkmal Functio laesa ist später hinzugefügt worden."
36. Martin, S.: *General Pathology*. Philadelphia, 1904, pp. 1, 2: The phenomena of inflammation in vertebrates are well expressed in the four words rubor (redness), tumor (swelling), dolor (pain), calor (heat) (Celsus). To these . . . must be added *functio laesa* or diminished function." (The peremptory "must" is unique.)
 37. Adami, J.: *Principles of Pathology*. Philadelphia, 1910, vol. 1 p. 413: Celsus defined inflammation as a "condition characterized by 'rubor, tumor, calor, dolor'—redness swelling, heat and pain, —to which definition later writers added a fifth cardinal symptom, that of 'functio laesa'." A slight variation is offered by Bruce D. Fallis: "The cardinal signs of inflammation are, therefore, rubor, calor (skin only), tumor and dolor, as described by Celsus. . . . Often a fifth sign, *functio laesa*, or improper function of the inflamed part, is added (*Textbook of Pathology*. New York, 1964, p. 65).
 38. Hewlett, R. T.: *Pathology, General and Special*. London, 1912, p. 88: "From the times of Celsus . . . four cardinal signs and symptoms have been recognized . . . to which a fifth was later added, viz. the disturbance of function (*functio laesa*) in the injured part."
 39. Karsner, H. T.: *Human Pathology*. Philadelphia, 1926, p. 156: ". . . Celsus, who pointed out four cardinal signs of the condition, redness, heat, swelling and pain (rubor, calor, tumor, dolor). As a result of later studies, a fifth cardinal sign, disturbance of function (*functio laesa*) was added." The phrase "later studies," which has its amusing side, may owe something to Ribbert.
 40. Ribbert, op. cit., 3d. ed. Leipzig, 1908, p. 168: "Sie wurden bereits von Galen aufgestellt" was somewhat grudgingly altered to "Sie wurden bereits von Celsus und Galen aufgestellt." The fifth sign was then ascribed to a "spätere Zeit" (as in Thoma) instead of a "neuere Zeit."
 41. Muir, R.: *Textbook of Pathology*. Philadelphia, 1925, p. 88. The first printing of the 4th ed. (1961) of Anderson's *Pathology* carried version δ . The 'canonical' version appears in the second printing of the 4th ed. (1961). The 5th ed. (1966) reverts to δ . The five versions do not exhaust actuality. Another possibility that has not been overlooked is to assign all five signs to Celsus, as Erich Letterer seems to have done: ". . . mit den historischen Entzündungszeichen des Celsus: *Rubor, Calor, Tumor*, sowie mit dem *Dolor* und der *Functio laesa* hinreichend charakterisiert" (*Allgemeine Pathologie*, Stuttgart 1959, p. 677), although the phrasing is ambiguous. The five signs may be listed without mentioning either Celsus or Galen: "*Clinically acute inflammations . . . are characterized by the five cardinal signs: calor, rubor, tumor, dolor and functio laesa*" (Sir Roy Cameron in Robbins' *Pathology*, 3d. ed. Philadelphia, 1967, p. 33). The same occurs in Delafeld and Prudden: "The concept of inflammation was originally a clinical one in which the process was marked by special symptoms—redness, heat, swelling and pain, and impaired function" (*A Textbook of Pathology*, 10th ed. New York, 1934, p. 81). Certain other writers mention both men but do not distribute credits (the 3rd ed. of Ribbert, op. cit., really belongs in this category): ". . . die vier *Celsus-Galenschen Kardinalsymptome* wahrnehmbar sind; dazu kommt *Functio laesa*" (Gotthold Herxheimer's *Grundlagen der pathologischen Anatomie*, Munich, 1921, p. 52), and Horst Oertel's "from the time of Celsus and Galenus, the most prominent and evident vascular phenomena, the reddening—the swelling, the heat and the pain (rubor, tumor, calor, dolor) were the cardinal symptoms of inflammation, and to these was later added impaired function (*functio laesa*)" (*Outlines of Pathology*, Montreal 1927, p. 236; Oertel adds in a footnote that neither Celsus nor Galen originated the cardinal signs and cites Marchand's *Handbuch* article, referred to later in this paper). Some writers mention only the four

Celsian cardinal signs, e.g., Boyd, in all editions since the unlucky 1st. A late 19th century example of that formula may be found in Joseph Frank Payne, a Galen scholar: "Numerous definitions have been given. That of Celsus was at one time familiar to all medical students, but in the present day may have to be quoted: 'The marks of inflammation are four; redness and swelling with heat and pain'" (*A Manual of General Pathology*. Philadelphia, 1888, p. 80).

Ludwig Heilmeyer and Hans Joachim Kahler combine an evasive manoeuvre with some bad history; after stating that redness and heat were the outstanding symptoms of inflammation for the "Hippocratic physicians," they continue: "Later physicians, as Celsus (31 B.C.) Galen (129-201 A.D.) and John Hunter (1794) annexed to *rubor and calor*, the already named features of inflammation, as further cardinal symptoms, *tumor, dolor, and functio laesa*, in addition." (*Die Entzündung und ihre Steuerung*. Basel and Stuttgart, 1962, p. 7.)

Authors sabotaged by the type-setter deserve a category of their own. Roussey's "Note vero inflammationis . . ." etc. (Roussey, G. Leroux, R. and Oberling, C.: *Précis d'anatomie pathologique*, 3d ed. Paris, 1950, p. 72) is pedestrian, but Domenico Campanacci's "*rubor, tumor, calor, dolor et functio laesa*" (note also the spurious 'et') shows imagination (*Inflammation*. Proceedings of an International Symposium, Int. Congress series No. 163. New York, Excerpta Medica, 1968, p. vii.). McFarland's "*dolor, color, rubor cum tumor*": misplaces the "cum" and scorns the ablative ending but the typographical error gives it a nice ring. (*A Textbook of Pathology*. Philadelphia, 1904, p. 308); Morehead's "*functio lessa*" (*Human Pathology. An Introduction to Medicine*. New York, 1965, p. 101) is rather apt.

42. Tendeloo, N. Ph.: *Allgemeine Pathologie*. Berlin, 1919, p. 334. Where Uhle and Wagner (1864) wrote "Schon Celsus stellte noch. . ." etc., Tendeloo put "Schon Celsus . . . stellte zusam-

men," which suggests that he was copying (I have translated the troublesome 'schon' as 'himself'). More copying suggests itself when Stricker (1883), Ribbert (1905, 1908), and Tendeloo all use the verb *hinzufügen* (annex). The same verb was used by Büchner in 1966 (cf. No. 3). It will turn up again in Bier; cf. No. 47.

43. *Handbuch der allgemeinen Pathologie*, Krehl, L. and Marchand, F., eds. Leipzig, 1924, 4ter Bd., 1ste Abt., pp. 78-469 (contributed by Marchand on the topic of inflammation and containing an historical account of the concept, pp. 89-106).
44. Ibid, p. 90. Marchand names Schmaus and Schade among those who have wrongly ascribed the four cardinal signs, *calor, rubor, tumor, and dolor* to Galen and states that the name of Celsus is nowhere to be found in the corpus of Galen's writings. Marchand cites Tendeloo's *Allgemeine Pathologie* on p. 102. He either overlooked what Tendeloo had done or had reason for not mentioning it.
45. Ibid, p. 104.
46. Ibid.
47. Macartney, J.: *A Treatise of Inflammation*. London, 1838, p. 10. Another variation on the theme of the fifth symptom was played by Augustus Bier not long ago. After citing several Galenic definitions of inflammation and mentioning the four cardinal signs of Celsus, Bier promises that he will have something to say later of the "fifth cardinal symptom of *functio laesa* that was later annexed in addition." (He does not ascribe the fifth sign to Galen.) The only further reference to *functio laesa* that I have been able to find in his long paper is the conclusion that "the acutely inflamed bodily part accomplishes not less but rather more than the normal, and that one should therefore really not speak of a *functio laesa*, but of a *functio mutata* of the inflamed bodily part" (*Die Entzündung, Arch. f. Klin. Chirurgie 176: 407-549, 1933; cf. pp. 417, 456, 506*). Still another is the following: "For centuries, inflammation was known as the condition characterized by the presence

- of redness, swelling, heat and pain. . . . Later on, two others were added—*tenderness and impaired function.*" (Green, T. H.: *Pathology and Morbid Anatomy*, 10th American ed. Revised and enlarged by Bosanquet, W. C. Philadelphia, 1905, p. 158.)
48. Marchand, loc. cit., p. 104.
49. The words attributed to Virchow by Marchand are: "die Degeneration als vermehrte Verbrennung und Zersetzung mit Temperatursteigerung eines der wichtigste und wesentlichsten Symptome der Entzündung." In Virchow's essay of 1852 on parenchymatous inflammation the following sentence occurs: "Nicht die Hyperämie und nicht das Exsudat, weder Röthe, noch Geschwulst, noch Schmerz stelle ich in den Vordergrund . . . sondern [die Degeneration, welche als vermehrte Verbrennung und Zersetzung [sic] mit Temperatursteigerung] in geradem Verhältniss zu der Störung der Funktion des Theils sich ausbildet" (*Ueber parenchymatöse Entzündung, Virchows Archiv*. 4:261-324, 1852; cf. p. 324). In his article of 1854 on inflammation Virchow wrote: "Allein mit Recht hat man schon vielfach darauf aufmerksam gemacht, dass die nutritive Störung die funktionelle nicht nur nicht ausschliesst, sondern dass im Gegentheil die Funktionsstörung gerade [eines der wichtigsten und wesentlichsten Entzündungssymptome] bildet" (*Handbuch der speciellen Pathologie und Therapie*, Virchow, R., ed. Bd. 1, Erlangen 1854, p. 72). I have bracketed the parts of Virchow's two sentences that yield something very close to the words attributed to him by Marchand. It seems likely that an error in transcription or type-setting produced a syncope sentence.
50. Rather, L. J.: *Virchow und die Entwicklung der Entzündungsfrage in neunzehnten Jahrhundert*, in Verhandlungen des XX. Internationalen Kongresses, op. cit., 161-177.
51. Virchow, R.: *Handbuch*, op. cit., pp. 46, 47.
52. Virchow, R.: *Die Cellularpathologie*, Berlin 1858, p. 345.
53. de Vilars, E. Col: *Dictionnaire fran-*
- cois-latin des termes de médecine, et de chirurgie* . . . Paris 1759, p. 194: "En particulier, on entend par inflammation, une tumeur causée par la presence et le séjour du sang, accompagnée de chaleur, de rougeur, de tension, de douleur et souvent de fièvre."
54. van Swieten, Baron G.: *Commentaries on Boerhaave's Aphorisms Concerning the Knowledge and Cure of Diseases*. Translated (anon.) from the Latin. Edinburgh 1776, vol. 3, pp. 245-47. I have modernized the capitalization and spelling.
55. van Swieten's reference here to the "Latins" is not entirely clear. Celsus was a compiler and medical dilettante who relied on Greek sources and was himself "never mentioned by ancient physicians", as Erwin Ackerknecht says (*A Short History of Medicine*. New York, 1965, p. 66). In the opinion of Heinrich Haeser the medical writings of Celsus were not highly regarded either by his contemporaries or by later antiquity, and in the entire period between the eighth and the 14th centuries his name was mentioned only four times. Celsus was unknown to the Arabic physicians as well. (*Lehrbuch der Geschichte der Medizin*, 3d. ed. Jena, 1875, vol. 1, p. 294.) The 'Aurelius' frequently mentioned during the medieval period refers, according to Haeser (op. cit., pp. 294, 295) to an extract of Caelius Aurelianus, himself a fifth century translator and transcriber of the works of the Greek physician, Soranus. Since Celsus is sometimes called 'Aurelius Cornelius Celsus' (an impossible and unfounded name, according to Haeser, op. cit., p. 276) the way is open for further confusion—possibly accounting for George Montgomery's entry: the "cardinal signs of inflammation as expounded by Celsus in the sixth century" were *calor, rubor, tumor, and dolor* (*Textbook of Pathology*. Baltimore, 1965, vol. 1, p. 18). See also note 62 of this paper.
56. Perdulcis, B.: *Universa medicina*, 2d. ed. Paris, 1641, pp. 842, 843.
57. *Ibid.*, p. 843.
58. Beattie, J. M. and Dickson, W. E.,

- with the collaboration of Drennan, A. M.: *A Textbook of Pathology*, 5th ed. New York, 1948, p. 17. The 1st. (1908), 2d. (1921), and 3d. (1926) editions do not mention the cardinal signs at all. I have not seen the 4th edition.
59. Fernel, J.: *Universa medicina*, 6th ed. Frankfurt, 1607. Fernel uses the term "phlegmonē" to signify, specifically, a hot, red, praeternatural tumor. It is true that the word *inflammatio* turns up in his text—"calor quoque ex inflammatione vehemens quasi pars uratur"—but it is not used as a technical term and is not listed in the index.
60. Brissot, P. *Apologetica disceptatio*, Paris 1622. Like Fernel, Brissot uses the technical term "phlegmonē" instead of "inflammatio." He writes (p. 65): "The disease with which we are concerned is phlegmon, the essence of which is made up by the following: an overabundance of hot blood in a particular part, from this hot blood its intemperature and swelling, then a solution of continuity due to the excessively swelling and pressing tumor, but from the heat and the solution of continuity pain, unless the part is wholly inaccessible to sense."
61. De Chauliac, G.: *Chirurgia magna Gvidonis de Gavliaco*. Lyon, 1585. In this connection Guy refers to Avicenna, Haly Abbas, Peter of Abano and Galen, among others (never to Celsus). He uses the technical term "apostema" instead of "phlegmonē" as the name of the genus: "Apostema est tumor praeter naturam . . . Apostematum multae sunt species" (p. 50).
62. Celsus states that when blood arrives in vessels that are meant for the transmission of "spirit" it arouses "inflammationem quam Graeci phlegmonēn nominant" (*De Medicina*. Spencer, W. G., transl. London, Loeb Classical Library, 1948, pp. 10, 11). For the next fifteen hundred years, however, the technical medical use of "inflammatio" or "inflammare" was uncommon. Neither Du Cange nor Niemeyer, to name the two chief dictionaries of medieval Latin, gives the technical meaning. It is not to be found in Alexander Souter's *Glossary of Later Latin to 600 A.D.* (Oxford, 1949) or in Wagner's *Lexicon Latinum* (Bruges, 1878). The 13th century lexicon of medical terms composed by Jean de Saint-Amand lists *apostema* and *flegmon* for aspects of what we now call "inflammation" (*Die Concordanciae des Johannes de Sancto Amando*. Pagel, J. L., ed. Berlin, 1894). Although the verb "inflammo" occurs in the text (cf. p. 178, op. cit.), it is not used as a technical term. Among the early printed Latin dictionaries neither the first edition of (Robert) Stephanus (Paris 1531) nor Cooper (London, 1580) lists the technical meaning. Henricus Stephanus (son of the above Stephanus), who compiled a dictionary of medical terms, gives citations from Galen, Aegina, and Actuarius in connection with the term *phlegmonē* and writes that "nostri inflammationes, Graeci phlegmonas appellare consuevit" (*Dictionarium medicum*, 1564). A later edition of Robert Stephanus' Latin dictionary (Lyons, 1573) does give the technical medical meaning of "inflammatio," with citations from both Celsus and Pliny.
63. *Claudii Galeni Opera Omnia*, op. cit., vol. 1, p. 357. The Greek version reads (in transliteration) as follows: "analogon de kapi tōn allōn moriōn hapantōn eks onkou, kai ondynēs, kai labēs energeiōn, eti te tēs tōn ekkrinomenōn diaphoras hai diagnōscis esontai, onkous men dē tous para physin en phlegmonais, kai erysipelasi, kai skirrhois, kai oidēmasin eksetasteon . . . blaptetai de hē energeia trichōs, e arrhōstōs, e plemelōs, e med' holōs gignomenē." The early 17th century translation by Chartier reads: "Eadem ratione aliarum omnium partium affectus ex tumore, dolore, functionum offensione et excrementorum differentia diagnoscentur. Tumores quidem praeter naturam sunt inflammationes, scirrhi et oedemata . . . trifariam autem functio laeditur. Aut enim imbecilliter, aut depravate, aut omnino non editur." (In the Latin version "erysipelasi" has fallen out.) A straightforward definition of disease as abnormal diathesis with disturbance of function, and of health as normal dia-

thesis with effective function may be found in Galen, op. cit. vol. VI, p. 21: ". . . ut sit nimirum sanitas affectus secundum naturam actionem perficiens, contra morbus affectio praeter naturam actionem laedens." The Greek reads:

". . . hōs einai tēn hygieian diathesin kata poiētikēn energieias, tēn de noson diathesin para physin energieias blaptikēn."

64. Koyré, op. cit., p. 201.