

THE SEEDS OF DISEASE: AN EXPLANATION OF CONTAGION AND INFECTION FROM THE GREEKS TO THE RENAISSANCE

by

VIVIAN NUTTON*

“AN interesting problem, to which I hope to return.” Thus, in 1915, Karl Sudhoff ended a brief note on Galen’s views on “seeds of plague”, but the hope was never fulfilled, and, despite citation in bibliographies, Sudhoff’s little article, buried deep in the wartime pages of the *Mitteilungen zur Geschichte der Medizin*, excited no scholarly attention whatsoever.¹ This was hardly surprising, for Sudhoff himself appeared to distrust his own conclusion that Galen had in fact prefigured Fracastoro’s celebrated theory of seeds of diseases and was prepared to countenance, at least briefly, the idea that some diseases were specific entities which propagated by means of their seeds. But Galenic scholarship has moved on, albeit slowly, since Sudhoff’s day, and the modern picture of Galen is of a doctor far less logical, systematic and consistent than he once appeared, and more ready to accept for his own immediate purposes ideas and examples from others that did not always fit with his overall schema of humoral medicine. Thus, while supporting Sudhoff’s observations, I shall also show in this paper how Galen’s (and, indeed, the Hippocratics’) general philosophical views militated against the further development of any ontological theory of disease. Galen wrote of seeds of disease in a context of contagion and communicable diseases, and this paper will also have to concern itself, although not at great length, with ancient ideas and perceptions of contagion. Historians have occasionally denied to the doctors of antiquity a knowledge of contagion on the grounds that they had no theory of seeds of disease or of germs, but this is to confuse an appreciation of contagion *qua* contagiousness with one explanation of its mechanics. A belief in a theory of seeds presupposes a belief in contagious (or communicable) diseases, but the reverse is not true, for there were always other possible hypotheses, like that of putrid air, to explain why, for instance, phthisis was easily caught. Usually, contagion was

*Vivian Nutton, MA, PhD, Wellcome Institute for the History of Medicine, 183 Euston Road, London NW1 2BP.

¹ K. Sudhoff, ‘Vom “Pestsamen” des Galenos’, *Mitteilungen zur Geschichte der Medizin und der Naturwissenschaften*, 1915, 14: 227–229. As far as I know, only R. Dilg-Frank, ‘Zu Begriff und Bedeutung von pestis/pestilentia und ihrer Verwendung bei Paracelsus’, *Salzburger Beiträge zur Paracelsusforschung*, 1980, 21: 48–59, among recent scholars, has used this article, although her reference at p. 62, n. 24, is inexact. H. G. Schmitt, *Die Pest des Galenos*, Diss. med., Würzburg, 1936, makes no comment on Galen’s aetiologies, being concerned only to interpret with modern clinical judgment Galen’s notices of the great plague of AD 166 and, pp. 21–23, his descriptions of “anthrax” and “Hungerseuche”.

discussed in terms of what could be observed, but the temptation was always there to seek for its invisible causes. But, as we shall see, for Galen these invisible causes were but the first step towards the patient's being ill, and the doctor's intervention might be made with greater profit and insight at a later stage. Finally, this paper will trace the knowledge of a theory of seeds of disease down to Fracastoro, and consider both his achievements and some of the immediate reactions to his theories of contagion.

It is important first to remember that in all this we are dealing with descriptions of the invisible, with hypothetical reconstructions of how things are or act, based only on the observance of "macrophenomena". No ancient doctor ever *saw* the seeds, animalcula, or effluvia that were said to cause the disease or to carry it from person to person: he inferred their existence by logic from visible "facts". The famous sentence of Anaxagoras, "What appears before us, a glimpse of the invisible", provided ample justification for a whole range of causal theories, some taken for granted, others expressly defended in argument, and it allowed the ancient doctor and philosopher to explain a relationship between particular phenomena by exploiting a range of analogies drawn from all aspects of life.² When Thrasylochus fell ill with phthisis, several of his friends warned the relative who had determined to look after him that many who had been in attendance on such a disease had likewise themselves perished:³ how and why this was so could be explained only by logic and metaphorical analogy.

But each analogy carries a message of its own that may limit and define the speaker's own thoughts, depending, of course, on the extent of his awareness of the implications of his chosen analogy, his own verbal precision, and the context in which the analogy is used. We may dismiss as windy rhetoric a reference to the "horrible seed of dissension blown abroad by Satan's pestiferous breath" in a Papal letter of John XXII in 1317,⁴ but Galen's references to "seeds" of plague and fevers cannot be so lightly scorned, for they occur in a writer who avowedly took pains over his terminology and who was fully conscious of the medical and philosophical resonances of his vocabulary. A satisfying analogy also carries with it a range of implications that elucidate more than one aspect of the posited relationship and that often locate it within a particular ideological tradition. This is certainly true of the metaphor of "seeds", which had been used in cosmological and philosophical discussion of causes at least as far back as Anaxagoras, Galen's favourite among the Pre-Socratics.⁵ He had declared that all creation sprang from globules containing the "seeds of all things", the proportion of the different seeds in each mass determining the individual

² H. Diels and W. Kranz, *Die Fragmente der Vorsokratiker*, ed. 11, Zurich and Berlin, Weidmannsche Buchhandlung, 1964, II, 59B, fr. 21A, with full references to later classical authors, Cf. G. E. R. Lloyds, *Polarity and analogy*, Cambridge University Press, 1966, pp. 338–360; H. Diller, *Kleine Schriften zur antiken Literatur*, Munich, C. H. Beck, 1971, pp. 119–143; I. M. Lonie, *The Hippocratic treatises 'On generation', 'On the nature of the child', 'Diseases IV', (Ars Medica, Abt. II. 7)*, Berlin and New York, W. De Gruyter, 1981, pp. 76–86.

³ Isocrates, *Aegineticus* 390B 29 (of c. 380 BC).

⁴ R. M. T. Hill, 'John XXII's excommunication of Robert Bruce', in G. J. Cuming, D. Baker (editors), *Popular belief and practice, Studies in Church History VIII*, Cambridge University Press, 1972, p. 135.

⁵ P. H. Schrijvers, 'Le regard sur l'invisible. Etude sur l'emploi de l'analogie dans l'oeuvre de Lucrèce', in D. J. Furley (editor), *Lucretius, Vandoeuvres and Geneva, Fondation Hardt, 1977*, pp. 77–114.

The seeds of disease

object or being. The botanist Theophrastus and later the agriculturalist Varro both commended his notion that the air contained the invisible seeds of all things,⁶ and Galen developed some aspects of Anaxagoras' physiology in the late 170s in his book *On the different types of uniform parts* (which Galen described somewhat in the manner of our "tissues").⁷ The aptness of the seed analogy lies in the fact that it emphasizes three things: that the object posited is a living entity; that it is in origin very small; and that it contains within itself the potentiality for growth. As every gardener knows, not every seed planted becomes a flower, but when growth is achieved, the result is far larger than the original tiny seed. All these obvious resonances may be found at any time when the seed analogy is used. Whether a particular author was always aware of them all is harder to determine, but it is clear that by choosing this analogy rather than another, he was committing himself to a view of the workings of the unknown and invisible that bore some approximation to those of the seeds he saw in the natural world about him.

It is very striking that the three instances in which Galen utilized the seed analogy in his explanation of disease all occur in tracts that were written very closely together in time, within at most four years, and perhaps even within two, and in which problems raised in one were taken up again in its successor. Nowhere else is the analogy used, even in contexts where it would have been relevant. Neither in his later exposition of the epidemic at Cranon in *Epidemics II* nor, still later, in commenting on Hippocrates' ascription in *On the nature of man* of the cause of putrefaction in the air to an excretion from a sick body does Galen talk of seeds,⁸ and when towards the end of his life he considered communicable diseases again, he employed an even more striking hypothesis.⁹ It is this close interrelation, chronological and thematic, that compels us to read the three passages together, as if forming or developing a theory involving seeds, rather than, as has been done in the past, as mere isolated metaphors, to be disregarded both for being metaphors and for their isolation. Sudhoff noted the first two, but by reversing their chronological relationship in his exposition and importing further material on contagion he obscured the links between them, while the third has lurked forgotten in a Galenic commentary on Hippocrates.¹⁰

The first passage occurs in a little tract *On initial causes*, written about AD 175 and surviving today only in an excellent "word-for-word" medieval Latin translation from

⁶ Theophrastus, *Enquiry into plants* III.1.4; *On causes of plants* I.5.2; Varro, *On agriculture* I.40.1; see also Diels and Kranz, op. cit., note 2 above, II. 59B, fr. 4, and the secondary literature cited in note 2 above.

⁷ Galen, *Über die Verschiedenheit der homoiomeren Körperteile*, C[orpus] M[edicorum] G[raecorum] Suppl. Orient. 3, 1970, Cf. G. Strohmaier, 'Eine bisher unbekannte Galenschrift', *Helikon*, 1966, 6: 608–620; *idem*, *Deutsche Literaturzeitung*, 1973, 94: 887f., where he tries to establish the claim of Arabic biographers that Galen once owned a copy of Anaxagoras' writings.

⁸ Galen, *Commentary on Epidemics II.1*: CMG V 10, 1, p. 155–158 (of about AD 181); *Commentary on On the nature of man II.3–4*: CMG V 9, 1, pp. 62–63 = XV 119–122 K. (of about AD 189).

⁹ Below, p. 8.

¹⁰ The late C. R. S. Harris, in his manuscript notes on Galen, also linked the first two passages, but without reference to Sudhoff. M. Greenwood, 'Galen as an epidemiologist', *Proc. Roy. Soc. Med., Sect. Hist. of Med.*, 1921, 14: 3–16, also discussed the two passages in a useful comparison between ancient and modern ideas on contagion. However, he treated the Lucretian hypothesis of seeds solely as a mere conduction of, as it were, vibrations via inanimate objects and different from the idea of *contagium vivum* as found in Fracastoro and modern epidemiology. This distinction is far too schematic.

the Greek.¹¹ This is one of a pair of tracts where Galen discussed the causes of disease in a way that modified his favourite Aristotelian doctrine of the four causes, formal, efficient, material, and final, to fit the more practical requirements of the doctor. For his purpose, the treatment of a sick patient, the efficient cause was the most important, for if the doctor could identify what created the harmful change called the disease, he could take steps towards its elimination. This efficient cause Galen, following the Stoics and Athenaeus of Attalia, subdivided into three, a “cohesive” cause, *causa contentiva*, an antecedent cause, *causa antecedens*, and an initial cause, *causa procatartica*.¹² The initial cause was something external – heat, cold, a blow on the head – that led to harmful changes in the body’s condition by an alteration of the humours. The antecedent cause was a predisposition of the body to be affected by a disease: some people catch colds more readily than others, even though they inhabit the same environment; a trained athlete and a lazy glutton react differently to a hundred yard dash. Finally, the cohesive cause, which was brought about by the other two, acting either singly or together, was a state of an organ or bodily part which prevented it from exercising its proper function: a chill wind may create an excess of phlegm in the stomach which causes indigestion, but it is only the excess of phlegm, not the wind nor even a susceptibility to chills, that impedes the digestive process. This tripartite system of causation was thus more subtle than strict Aristotelianism and certainly, in Galen’s eyes, far superior to the mechanistic aetiologies of Erasistratus, who paid less attention to such initial causes. In an attempt to refute Erasistratus’ simplistic contention that fever was always the result of an inflammation, Galen raised the question why, say, in a great crowd of spectators watching a show in the open theatre under a blazing summer sun, only one or two went down with heatstroke and fever. It could not be that the weather alone was responsible, for everyone was experiencing exactly the same conditions, nor could one correlate a rise in the intensity of body heat with a high fever, as strict humoralism would demand, for the one did not lead inevitably to the other. Galen’s explanation why only a few suffered in this way was that not everyone had (*habuerunt*) the “seeds of fevers”. But what these seeds were, he refused to say, contenting himself with the thought that by using them in his argument he had adequately demonstrated the weakness of Erasistratus’ premisses.¹³ There can be no doubt, however, that Galen was conceding some independent existence to these seeds, for if they are merely a metaphor for a humoral predisposition to fever, his language is strangely flowery, and his failure to say clearly, and his reluctance to explain, what he meant very unusual. Besides, the argument of the tract demands that he was viewing them, *pace* Sudhoff, as initial rather than

¹¹ Galen, *De causis procatarticae*, ed. K. Bardong, CMG Suppl. 2, 1937; for the date, see p. XI.

¹² The second tract, *On cohesive causes*, is preserved in Arabic and Latin, and edited with an English translation by M. C. Lyons, CMG Suppl. Orient. 2, 1969, pp. 52–73, 133–141. On Galenic causes, see now M. Frede, ‘The original notion of cause’, in M. Schofield, M. Burnyeat, and J. Barnes (editors), *Doubt and dogmatism*, Oxford, Clarendon Press, 1980, pp. 237–244; P. Moraux, ‘Galen comme philosophe: la philosophie de la nature’, in V. Nutton (editor), *Galen: problems and prospects*, Cambridge, The Wellcome Institute, 1981, p. 106f.

¹³ Galen, *On initial causes*, §100–108, esp. §108: sed quidam eorum neque omnino habuerunt febrium semina. quae autem sint febrium semina, nunc non praecet, dicere, sed quoniam non est sanum adiunctum aufficit ostendere.

The seeds of disease

antecedent causes.¹⁴ Unfortunately, Niccolò's Latin is here not precise enough to let us say whether these seeds existed in the atmosphere and impinged on various individuals or whether they were seen as also residing within the body, to be awakened by an alteration of diet or environment. But, whichever alternative is chosen, by rejecting a strictly humoral explanation in terms of the suitability of an individual's humours to be affected by a rise in temperature, Galen was having to borrow for his case from an alternative ontological theory of disease.

Very soon after writing *On initial causes*, Galen returned to the problem at greater length in the first book of *On the different types of fever*.¹⁵ He was well aware that some diseases could easily be caught from association with sufferers from *psora* (a contagious skin disease regularly termed *scabies* in Latin), some eye diseases, plague (which covered for him more than bubonic plague), and phthisis, especially when they breathed out putrid air. Not that he ever expressly called this form of transmission by the Greek equivalent of "contagion", for scholars who claim this for him have been misled by a Renaissance translator, but he was familiar with the phenomenon and expected his readers equally to be so.¹⁶ That he was not wrong in this can be seen from the evidence patiently collected a century and a half ago by K. F. H. Marx of Göttingen in his dissertation of 1824, *Origines contagii*.¹⁷ One should note in particular the scientific tradition associated with the *Problems* ascribed to Aristotle and Alexander of Aphrodisias, which attempted to provide a coherent explanation for the swift spread by contact of precisely the diseases with which Galen was here concerned.¹⁸

¹⁴ Sudhoff, op. cit., note 1 above, p. 228, who thought that they represented "eine schlummernde Anlage, Disposition oder sonst etwas."

¹⁵ For the date, see K. Bardong, 'Beiträge zur Hippokrates- und Galenforschung'. *Nachr. Akad. Wiss. Göttingen, phil.-, hist. Kl.*, 1942: 626, 637, arguing for AD 176; and D. W. Peterson, 'Observations on the chronology of the Galenic Corpus', *Bull. Hist. Med.*, 1977, 51: 488, suggesting 174 or 175. The close relationship in time between this and *On initial causes* is unaffected by Peterson's redating. Direct use of *On initial causes* is plain at I.3: VII 280 K., and I.6: VII 292 K.

¹⁶ Galen, *On the different types of fever* I.3: VII 279 K. The subjoined Latin version, "ne a contagio laedantur" is a re-working in the seventeenth century by Chartier of an earlier version by Leonicensio, "ne inde contagium contrahatur", *Galenus De differentiis febrium*, Venice, O. Scotus, 1521, fol. 7v. That no direct Greek equivalent could be found among the writings of Galen and Hippocrates was well known, and baffling, to the doctors of the late sixteenth century, e.g. F. Vallerioli, *Appendix ad tres superiores locorum medicinae communium libros*, Lyons, Gryphus, 1562, pp. 62–64. The presence of the word "contagium" in Caelius Aurelianus, page 10 below, might suggest that its equivalent was used by his Greek source, Soranus, but this should not be pressed. Greek authors preferred verbal compounds with "συν -" (together) or verbs of sharing to indicate a communicable disease, Cf. also Galen, *On properties of simples* XI.1: XII 312 K. = *Sketch of empiricism* 10: K. Deichgräber (editor), *Die griechische Empirikerschule*, ed. 2. Berlin and Zurich, Weidmannsche Verlagsbuchhandlung, 1965, p. 75.

¹⁷ I owe my acquaintance with this admirable work to Dr Walter Pagel. Two articles by Sudhoff, both reprinted in *Sudhoffs Archiv*, 1929, 21, contain good summaries of ancient ideas on infection: 'Eπαφή der Aussatz?', pp. 204–206, an article neglected by lexicographers; and 'Infektion und Infektionsverhütung im Wandel der Zeiten und Anschauungen', pp. 207–214; M. L. Cogliandro, 'Sul concetto di infezione nell' antichità', *Medicina nei secoli*, 1973, 10: 23–31, is very jejune. Better is S. Jarcho, 'Medical and nonmedical comments on Cato and Varro, with historical observations on the concept of infection', *Trans. Stud. Coll. Physns Philadelphia*, 1975–6, 43: 372–378. The old article of B. Meinecke, 'Consumption (tuberculosis) in classical antiquity', *Ann. Med. Hist.*, 1927, 9: 379–402, is a useful collection of primary material; cf. p. 399, "Its contagious and infectious aspect was quite generally observed and known, though not correctly understood."

¹⁸ [Aristotle], *Problems* VII.8: 887A, of c. AD 100; [Alexander], *Problems* II.42: p. 64 Ideler, from the fourth century AD.

Galen nowhere explained the transmissibility of the skin diseases, but he argued that plagues were spread by the inspiration of air already infected by a “putrid exhalation” (ὕπὸ σηπεδονώδους ἀναθυμιάσεως μίανθέντος) – witness the deadly rotten air from corpses left unburnt after a battle, the exhalations from swamps and pools in summer, and the hot pestilential atmosphere described by Thucydides during the great plague of Athens of 429 BC. Yet this external cause was not enough by itself: it needed a suitable material, a suitable body, to work on:

Suppose, for example, that the circumambient air carries certain seeds of plague, and that of the bodies which share [breathe] it, some are full of various residues which are soon to become putrefied in themselves, while others are clean and free of such residues. Assume also that in the former there is a general blockage of their pores, a so-called plethora, and a life of ease devoted to gluttony, drink and sex, with all their necessarily concomitant digestive disorders. The others, which are clean and lack these residues, as well as being fine in themselves, have all a wholesome transpiration through pores that are neither blocked nor constricted; they take appropriate exercise and lead a temperate life. Assuming all this, which of these bodies is most likely to be affected by the rotting air they inspire?¹⁹

The Greek of this passage is not entirely elegant, and the precise meaning of its opening words, “Suppose, for example, . . .”, is open to various interpretations. Are we to take them to mean that seeds of plague are put forward as an example and no more, and that their existence is assumed purely for the sake of argument? Or is it, as I would prefer, that Galen is choosing as part of his hypothetical situation the, to him plausible, existence of seeds of plague in the air which impinge on individuals? – and that these seeds are in some way an explanation, at least partially, for the general putridity of the air? C. E. A. Winslow, who remarked in detail on this passage, apparently chose the former alternative, for his subsequent discussion was confined entirely to the standard pairing of bad air *tout court* and individual predisposition.²⁰ But, as we shall see, even if Galen himself was unsure of the existence of these seeds, there was such a theory current in his day, and the argument that Galen is here setting out demands as an initial cause of the plague the impinging of these seeds on an individual. Sudhoff, indeed, preferred this alternative, adducing a passage from a possibly suppositious work, *On theriac, for Piso*, whose author ascribed the destructiveness of plague to the inspiration of “something deadly” in the air.²¹ But both authorship and text are too uncertain to be relied upon for an opinion of Galen, and, typical of medical authors, the passage does not give any clear idea of the way in which the bad air was actually bad, whether it was changed qualitatively or now contained extraneous matter such as seeds or poisons.

However, a third passage demonstrates that Galen was compelled at one time to posit entities, “seeds”, that were in some way responsible for the onset of disease. It comes in his commentary on the first book of the *Epidemics*, a work which often refers

¹⁹ Galen, *On the different types of fever* I.6: VII 289–291 K.

²⁰ C. E. A. Winslow, *The conquest of epidemic disease*, Princeton University Press, 1943, p. 73f.; cf. Greenwood, *op. cit.*, note 10 above, p. 6f.

²¹ Sudhoff, *op. cit.*, note 1 above, p. 227. Galen, *On theriac, for Piso* 16: XIV 281 K. For the date, not before AD 198, cf. the reference to joint emperors at I: XIV 212 K. It is assumed genuine by A. v. Premerstein, ‘Das Troiaspiel’, *Festschrift O. Benndorf*, Vienna, 1898, pp. 261–266, but it has long been considered spurious, cf. L. Richter-Bernburg, *Eine arabische Version der pseudogalenischen Schrift De Theriaca ad Pisonem*, Diss., Göttingen, 1969, p. 42. The question deserves further investigation, for the biographical details fit a court doctor active among the Roman aristocracy.

The seeds of disease

to *On the different types of fever* and which was written no later than AD 178 and possibly as early as 176.²² Here Galen warned his readers against taking every relapse during a recovery from fever as a simple recurrent attack of an intermittent periodic fever: they should understand that in some people, even though they were apparently well, there still lurked some “seed of the disease”, which, under certain conditions of regimen, would bring about a recurrence of fever after a few days or even longer. The difference between this and a recurrent periodic attack lay in the fact that the periodic attack would recur to all sufferers from the disease at the same time in the cycle, even when they were following the regimen prescribed for them: it was predictable, even inevitable. By contrast, although the course and final state of an illness caused by a revived seed of disease were similar to those of a recurrent attack, they were brought about through the patient’s failure to keep to the proper regimen. If he continued his disobedience, there could be any number of relapses, provided that there still existed some residual seed.

This brief observation goes beyond its predecessors in two ways. First, it clearly locates the causative seed within the body; and, second, the seed’s power to bring about disease is perhaps somewhat greater than, and certainly differs from, the “last-straw” type of initial cause implied in *On the different types of fever*. The seed is in origin something external, but its reactivation cannot occur without another initial cause, unwise regimen. Indeed, the part played by the seed of disease in a relapse is, in Galen’s tripartite doctrine of causation, very like that of the antecedent cause, the predisposition of the humours to respond to an initial cause. More than in the other two passages, Galen’s use of the word “seed” here may be the result of loose writing, especially as, in his commentary of *Aphorisms*, which was written between *On the different types of fever* and the commentary on *Epidemics I*, a similar function was ascribed to the corrupt humours left behind after a crisis, which might bring about a relapse unless properly attended to.²³ On this argument, the “seed of disease” is a mere figurative expression, in no way to be understood literally.

But to dismiss this passage so easily may be rash. Even if the chronological tie with its two predecessors is not as tight as that between them, it is still close, and, unlike the commentary on *Aphorisms*, the commentary on *Epidemics I* makes several cross-references to material in *On the different types of fever*.²⁴ Besides, the picture that can be gained from putting all three passages together bears a considerable resemblance to a theory that, as we shall see, was certainly current in the second century AD. According to this theory, fevers and other diseases are carried in the atmosphere as seeds, but their potentiality only becomes actual when they impinge on and enter suitable bodies. Although the symptoms of disease may disappear, there may still remain in the body

²² Galen, *Commentary on Epidemics I*, Book III.7: CMG V 10, 1, 1934, p. 119f. = XVIII A 239 K. For the date, see Bardong, *op. cit.*, note 15 above, pp. 620–622, 637, arguing for AD 176 or 177; and Peterson, *op. cit.*, note 15 above, p. 493f., preferring 178 or even 179. But 179 is impossible on other grounds, and 178 may be correct.

²³ Galen, *Commentary on Aphorisms* II.12: XVII B 468 K.; for the date, see Peterson, *op. cit.*, note 15 above, pp. 492–494.

²⁴ For the cross references, see the list at CMG V 10, 2, 3, p. 3, col. b.

some residual seed, which can be prevented from withering away, and, indeed, brought to life and activity again, if the patient follows a wrong regimen.

This picture, it should be emphasized, is a modern reconstruction from fragments, and is never explicitly described by Galen; only their close conjunction in time and the interrelations between the books in which they appear justify this assemblage of the various pieces into a coherent pattern of doctrine. But the theory of seeds need never have been held securely or in its entirety by Galen at any one time, and it may be more accurate to place it among the category of *ad hoc* arguments or interesting historical guesses. Although Galen's great achievements lay in his rare capacity for systematic thought, he was also liable to an occasional flash of ingenious speculation. That he tended to despise many of the theories of the *physici* as unprovable did not mean that he always refrained from putting forward such hypotheses. A particularly daring one occurs in his treatise on local pathology, *On affected parts*, and significantly also relates to the transmission of disease.

Galen speaks first in general terms:

Some people think that some substances can alter things that are close to them just by contact through the power of the (transmitted) quality. This can easily be seen in the marine torpedo-fish, for it possesses such a strong force that it can numb the arm of a fisherman simply by transmitting this alterative power through his (metal) trident. This is a satisfactory proof that even a small thing can produce large changes just by contact. One can see this too in the Heraclian stone, otherwise known as the magnet, which suspends from itself without any fastening any metallic object that touches it, and, indeed, a second object that just touches the first, and even a third that touches the second.

Having shown that certain things, though small, can exercise immense power, Galen then asks whether there can be found in the human body anything with as powerful an effect as the poison of a wild animal, and, not surprisingly, discovers it – in distempered semen and menses which have turned to putrefaction through being held back for some reason. In rabies, too, although only dogs have the proper receptivity to the disease, their humours become so rotten that even a drop of saliva falling on a man's hand can in time infect his whole body with its poison.²⁵

Galen is again here trying to explain the hidden mechanics of an obvious medical relationship by applying suggestive analogies from the teachings of others about certain natural phenomena.²⁶ This “magnetic” or “electrical” hypothesis, which appears nowhere else in the Galenic corpus, is put forward as a possible model for the transmission of disease, and, like that of the seeds of disease, is in no way integrated into Galen's general system. It is an isolated guess, and testifies more to Galen's range of knowledge and willingness to consider arguments from the world of the natural scientists than to his powers of detailed investigation and logical synthesis. If the idea of seeds of disease appears tame by comparison, it is still more adventurous than the explanation for similar phenomena that is found in the *Problems* tradition.

²⁵ Galen, *On affected parts* VI.5: VIII 421f. K.; for the date, c. AD 194, see Bardong, op. cit., note 11 as above, p. 640. Cf. also the translation by R. E. Siegel, *Galen On the affected parts*, Basle, Karger, 1976, p. 185f. The discussion of this passage by K. F. H. Marx, *Origines contagii*, Karlsruhe, D. R. Marx, 1824, p. 73f., is misleading in its transposition of the extracts.

²⁶ The discussion of the torpedo fish goes back at least to Aristotle, *History of animals* IX.37: 620B. Cf. also Dioscorides, *Materia medica* II.15; Pliny, *Natural History* XXXII.2.7. On the problem of the magnet, see the discussion in S. Sambursky, *The physical world of late antiquity*, London, Routledge, 1962, pp. 119–121; Galen, *On the natural faculties* I.14: 11 44–53 K.

The seeds of disease

In the *Problems* ascribed to Aristotle, which were probably written by AD100, and in the much later series that passed under the name of Alexander of Aphrodisias, the question is posed why sufferers from phthisis, *psora*, and *ophthalmia* infect those who come near them, whereas sufferers from dropsy, fever, and apoplexy do not.²⁷ The answer is that the first three diseases all transmit something to others. In *ophthalmia*, noxious rays are sent with the (psychic?) pneuma to fall upon the observer's naturally receptive eye;²⁸ the sufferer from phthisis exhales putrid air, which is then breathed in by others; while in *psora*, there is a thin exudate which is easily passed on. In other diseases, the affection is either deep-seated, as in dropsy and apoplexy, has no exudate, as in *lepra*, or, as in normal fevers, is partly deep-seated and produces an exudate that is neither pestilential nor putrid. That Galen knew of this sort of explanation is very likely, especially as, in *On the different types of fever*, he takes phthisis, *psora*, and *ophthalmia* as the chief examples of easily communicable diseases.

It is perhaps worth emphasizing that almost all discussions of contagious diseases before Fracastoro confine themselves largely to what we would term non-epidemic diseases. Most fevers are excluded as not being contagious, and even although plague and pestilential fevers, which are regarded as unusual types of fever, are often accepted as contagious, the scholarly discussions on the causes and mechanics of contagion have little to say about them in detail, perhaps because the variety of possible causative factors involved is more than in the standard trio of *ophthalmia/lippitudo*, *psora/scabies*, and phthisis. Nor do theories of transmissibility concern themselves with such diseases or symptoms as diarrhoeas and colds, perhaps because they were so common in summer and winter respectively that they could be considered "normal" and hence explained by the straightforward humoral cycle as it was altered by the seasons.

As an intellectual who prided himself on his learning and possessed wide interests, a copious memory, and an extensive library, Galen may well have been acquainted with another tradition which did indeed make use of "seeds" in its explanation of disease. Its most extensive exposition, however, is found not in a medical textbook but in a philosophical poem, Lucretius' *On the nature of things*, composed about 56 BC. In the course of his poem, Lucretius discussed at length various diseases, including, in his final book, plague, for which he followed closely the account in Thucydides with some modifications.²⁹ For Lucretius, the world contains seeds of all kinds, both good and bad; some, in food, give life, others induce diseases like erysipelas and even premature death. Their different atomic shapes and combinations account for their different

²⁷ [Aristotle], *Problems* VII.8: 887A; [Alexander], *Problems* II.42: p. 64 Ideler, which differs only in the addition of "as in normal fevers" to its final section. For the development of the *Problems* tradition, B. Lawn, *The Salernitan questions*, Oxford, Clarendon Press, 1963, p. 3f., is fundamental. See also below, p. 24f, and nn. 103 and 104.

²⁸ One should compare the explanations offered by the "natural scientists" for the workings of *fascinatio*, the evil eye, which are often couched in the same terms as the discussions of *ophthalmia*, e.g. Plutarch, *Table talk* V.7: 680C–683B; [Alexander], *Problems* II.53: p. 67 Ideler.

²⁹ Lucretius, *On the nature of things* VI.1090–1286; the passages from Thucydides are best set out in Cyril Bailey's edition of Lucretius, Oxford, Clarendon Press, 1947, pp. 1723–1744. See also J. H. Phillips, 'Lucretius on the inefficacy of the medical art', *Classical Philology*, 1982 77: 133–135. For Galen's use of Thucydides, see F. Kudlien, 'Galens Urteil über die Thukydideische Pestbeschreibung', *Episteme* 1971, 5: 132f.

capacities and means of action. When the deadly seeds flying about in the atmosphere come together, the air putrefies and becomes dangerous, and it is this putrefied air which then causes illness, by acting either directly on an individual as a result of inspiration or indirectly by poisoning the water, crops, and animals that he uses as food. Finally, Lucretius argues that the air may be corrupted in two ways; the seeds of plague either rise up to it from the soil which has become putrefied through an excess of rain or sunshine, or they are introduced into it “from outside”, that is, they come into the world from the outer void and the spaces between the worlds.³⁰

Lucretius, for all his greatness as a poet, was not a man of great philosophical ingenuity and independence, and scholars have expended much effort on attempting to identify his sources. It is possible that the idea of seeds of disease goes back to Epicurus (341–271 BC) or even to the Pre-Socratic atomists Democritus and Leucippus, or it could have been first formulated or developed by a slightly later authority. The later head of the Epicurean sect, Demetrius of Laconia (fl. 120 BC), suggested by Lück, has little to recommend him save a vaguely reported interest in medicine and a convenient absence of relevant fragments of doctrine.³¹ Far more plausible is Bailey’s tentative ascription to the celebrated physician Asclepiades of Cius (fl. 95 BC), although his actual proof is not compelling.³² But two considerations strengthen the case for Asclepiades’ involvement with a theory of seeds of disease. The first is that the theory is found first in a Latin author, and Asclepiades’ success was notoriously among the Romans; the second, and far more cogent, is that Plutarch clearly associates it with the Methodists,³³ and that Galen, in the second passage, mentions seeds in a context of blocked and open pores. This recalls Asclepiades’ famous doctrine of disease, although in the form in which Galen adopts it, it could equally have been derived from a later and more sympathetic Methodist like Soranus.³⁴ Soranus may well have dealt at some length with contagion, for the late Latin writer Caелиus Aurelianus, who, it is agreed, derived much of his material from the Greek of Soranus, notes that *elephantiasis*,³⁵ incubus, and plague are all in some way spread by

³⁰ Lucretius VI.655–666, 769–830, 1090–1137, esp. 1093–1102. This interpretation of “outside” is confirmed by Plutarch, *Table talk* VIII.9: 733D, discussed below, p. 12. See also, J. H. Phillips, ‘The etiology of disease: a late Republican view’, *Proc. 27 Int. Congr. Hist. Med.*, Barcelona, 1981, I, pp. 327–330.

³¹ W. Lück, *Die Quellenfrage im 5. u. 6. Buch des Lukrez*, Diss., Breslau, 1932, cited by Bailey, op. cit., note 29 above, pp. 1719, 1723.

³² Bailey, *ibid.*, p. 1718, citing Aetius V. 30, 6 (=H. Diels, *Doxographici graeci*, Berlin, Weidmann, 1879, p. 443) [=Galen], *History of philosophy* 39: XIX 344f. K. (=Doxogr. graec., p. 648), for Asclepiades’ doctrine that there were naturally physical differences between the inhabitants of different areas. But this idea, which in medicine goes back at least to *Airs, Waters and Places* of the fifth century BC, was already commonplace in Lucretius’ (and Asclepiades’) day. See also Phillips, op. cit., note 30 above; J. Pigeaud, ‘La physiologie de Lucrèce’, *Rev. Et. Latines*, 1980, 58: 176–200.

³³ Below, p. 12.

³⁴ A “plausible apology” of Asclepiades may also be relevant (in Cassius the iatrosophist, *Problems* 40: p. 157f. Ideler, c. AD 400), for he compared the passage of peccant material over the body to that of water over a plain, filling up whatever holes it found, blocking the narrow pores and then passing on to other sites. But this refers to the transmission of disease within the body rather than from person to person, although the analogy could be easily extended.

³⁵ This is not modern elephantiasis, but one of several skin diseases which produce in the affected part the appearance of an elephant’s hide. The traditional identification of this skin disease with leprosy needs considerable qualification, especially as Renaissance medical men, on whose work the modern identification ultimately rests, were by no means agreed on the comparable symptoms.

The seeds of disease

contagion, although his description of arthritis as being passed on *cum semine* is rather a reference to its hereditary transmission through the semen.³⁶

There is also the remote possibility that this Lucretian seminal explanation for plague and disease comes from a practical Roman agricultural tradition, for some twenty years after Lucretius, Varro, who knew of Anaxagoras' seeds, offered a variation on the same theme. In warning his readers against siting their steadings near swamps and marshes, he declared that swamps bred invisible animalcula (*animalia quaedam minuta*), which on being breathed in through the nose and mouth, caused disease. He also believed that there were harmful "little beasties" (*bestiolae*) which might breed near a farm and could be blown away or killed by solar desiccation. At the same time he referred to unhealthy miasmata and to bad air as a cause of disease. These inconsistencies and his somewhat confusing idea of animalcula reveal the truth about Varro. Far from being a repository of practical country lore, he was a polymath and an erudite compiler from literary sources, Lucretius perhaps among them.³⁷

A century later, Columella, another agricultural theorist, amplified and enlarged Varro's picture: his animalcula are correspondingly greater.³⁸

Just as well site your farm near a military highway, where you are constantly subject to harassment and requisitioning, as by a swamp. For from it issue forth not only a harmful stench (*virus*) but also animals with vicious spikes that fly about us; it sends out snakes and vipers filled with deadly venom, from which come unseen diseases that defy doctors to know their causes. Animals, fruits, even farm implements, all rot away in this murderous atmosphere.

Interestingly, Columella, in taking up and enlarging Varro's insight into the causes of disease, turns what had been a description of the invisible into a very literal and rhetorical description of a rather different and certainly obvious pest, the mosquito, although he equally still retains some traces of Varro's unhealthy atmosphere. Whether his contemporary Seneca's "many deadly things that lurk deep down in the earth and are released by earthquakes to poison the air" are to be identified with seeds or animalcula cannot be determined,³⁹ but it is beyond question that long before Galen there were those who, as well as accepting that disease was often caused by bad or putrefied air, wished to go further and specify exactly how and why the air was bad.

That these included some Methodists is clear from a long section in Plutarch's *Table talk* (c. AD 110), briefly noticed but not fully exploited by Marx and left in obscurity since his day.⁴⁰ Plutarch and his friends were discussing the problem of whether there were any new diseases being created in the world. This view was put forward by a local doctor from Hyampolis, Philo, who was considered a Democritean and who elsewhere was said to espouse the Methodist or Asclepiadean doctrine that thirst results from a change in the shape of the body's relevant channels or pores

³⁶ Caelius Aurelianus, *Chronic diseases* IV.1.13; I.3.57; *Acute diseases* I.pf.; *Chronic diseases* V.2.29: pp. 822, 476, 12, 924 Drabkin.

³⁷ Varro, *On agriculture* I.12.2–4, cf. I.4.4f. There are good discussions of these passages by Jarcho, op. cit., note 17 above, and by J. H. Phillips, 'On Varro's *animalia quaedam minuta* and etiology of disease', *Trans. Stud. Coll. Physns Philadelphia*, 1982, ser. V.4, pp. 12–25.

³⁸ Columella, *On agriculture* I.5.6. Jarcho's translation "harmful virus" may mislead, for *virus* in Latin can mean slime, poison, or stench and has none of the modern connotations of "virus".

³⁹ Seneca, *Natural questions* VI.27.2. K. D. Keele, 'The Sydenham-Boyle theory of morbid particles', *Med. Hist.*, 1974, 18: 240–248 (p. 244f.), misses this reference in hunting telluric factors.

⁴⁰ Marx, op. cit., note 25 above, p. 65f.

(*poroi*).⁴¹ Philo argued that there were new diseases in his own day, for many diseases were not described by early medical authors, and he cited Athenodorus' *Epidemics* to the effect that rabies and *elephantiasis* had first been become apparent in Asclepiades' time.⁴² What further arguments Philo used can only be divined from the comments of his opponents. Both Diogenianus and Plutarch attacked the notion that there could be any external causes impinging on us from the spaces between the worlds, as well as the view of the Democriteans that when worlds perished out beyond our own, foreign atoms would flow in from the infinite void and there would then arise the first principles (*archai*) of plagues and strange diseases.⁴³ Diogenianus was scathing about the whole idea of new diseases:

There cannot be a new disease without a cause, for this would introduce into the world, contrary to natural law, a coming-to-be from non-being; and to find a new cause for disease would be hard, unless one could demonstrate that a new kind of air, or a strange type of water, or foods never tasted by former generations are flowing into our world from some other worlds or the spaces between them. For it is the things that sustain life that cause sickness. There are no specific seeds of disease:⁴⁴ it is the disagreements of our food and drink with us or our mistakes in using them that upset our system.

For Diogenianus, these invasions from other worlds were implausible; hence no new "seeds" or Plutarch's "first principles". Diseases were not being created anew: merely their names changed, for names were a matter of variable custom, while the diseases themselves belonged to unchanging nature. Their apparent novelty was the result either of the fickleness of custom, or of a simple human failure to describe or recognize them.⁴⁵ To Plutarch himself, there was a middle way between these extremes. There were indeed new diseases, not created by the impact of atoms from another world but produced both by qualitative changes within existing diseases and by alterations in our bodily structure as a result of differences of lifestyle. Primitive man suffered from deficiencies in his diet: not surprisingly, the luxurious life of Plutarch's contemporaries, with new foods arriving from all over the Roman world and beyond, engendered different and new diseases of superfluity.⁴⁶ Both Plutarch and Diogenianus thus favoured a typically Hippocratic correlation of disease and bad regimen, and

⁴¹ Plutarch, *Table talk* VIII.9: 731B, 733D. By interpreting Philo's belief in *poroi* as channels at *Table talk* VI.2: 687B, the Loeb translator, Minar, obscures the use of this Methodist technical term, μετασχηματισμός τῶν πόρων.

⁴² *Table talk* VIII.9: 731B. Cf. also Caelius Aurelianus, *Chronic diseases* IV.1.4: p. 817 Drabkin.

⁴³ *Table talk* VIII.9: 731D, 733D, 734D. In Democritean/Lucretian cosmology, the infinite universe was made up of atoms and void in constant flux. Our own world was formed by concatenations of atoms and could be reproduced by similar masses of worlds out beyond our own. These worlds, formed from ever-changing atoms and void, could pass out of existence as a result of a collision and the dissolution of their atomic parts, which would then be free to attach themselves to other groups of atoms throughout the universe. The spaces between the worlds were void, into which might enter at any time atoms in flux, which were invisible except when they came together to form stars, meteors, etc., and which were in no way prevented from reaching our world. See J. M. Rist, *Epicurus*, Cambridge University Press, 1972, pp. 56–61.

⁴⁴ This sentence makes it clear that this theory could encompass a definitely ontological interpretation of disease, and that "seeds" was more than a metaphorical substitute for "causes". It is also probable that the particular seeds could be of specific diseases, i.e. this seed of plague, that of *lepra*, but this argument is not developed in our extant sources.

⁴⁵ Plutarch, *Table talk* VIII.9: 731D–E. Whether Diogenianus was himself a doctor is unclear. The whole debate shows the overlap between professional medical and non-medical men in discussing scientific and medical theories.

⁴⁶ Plutarch, *Table talk* VIII.9: 732A, 732C, 733C, 733E.

The seeds of disease

rejected the arguments of Philo the Democritean Methodist for causative seeds, atoms, or first principles.

If the belief in seeds of disease was a Methodist doctrine that could be found in both the Greek and the Latin worlds, there should be no doubt that it or a variation was known to the polymathic Galen, or that its origin in the theories of the, to him, dangerous and illiterate Methodists afforded a reason both for the hesitancy with which he approached the doctrine – no names, and several indefinite articles – and for the abrupt way in which he dropped it. But, as Renaissance authors were to show, a theory of seeds was not incompatible with an explanation of epidemic diseases like plague in terms of bad air, especially as the Hippocratic tract *On the nature of man* offered a suggestion that might seem to differ only in its choice of metaphor.⁴⁷ Its author, while emphasizing that epidemic diseases were the result of “bad air”, went further and ascribed the cause of the bad air to the fact that it was charged with some unhealthy exhalation or excretion (*ἀπόκρισις*). In his commentary on this text, Galen strongly approved of the Hippocratic notion of bad air as a cause of epidemics, but passed over this further explanation in a mere paraphrase.⁴⁸

His own proof of the rightness of Hippocrates’ general theory of bad air was drawn from experience: an army camp pitched near a stagnant pool or a marsh was exceptionally unhealthy. This observation was typical also of his fellow doctors. They were able to trace or infer various sources of contagion and bad air: mephitic vapours emerging from clefts in the ground, the stench of the sickroom, corpses unburnt on the battlefield, and the general unhealthiness of certain areas, like those near marshes and stagnant pools, and they gave positive advice to avoid building in such areas, to make streets broad and well-aired, and to site cities so as to avoid extremes of temperature.⁴⁹ Such injunctions can be found in the medical writers in the Hippocratic tradition well down into Byzantine times, and historians, with the model of Thucydides before them, were ever ready to describe in detail the horrors of plague, with often impressive results. The local chronicle of Joshua the Stylite eloquently depicts the consequences for a small town and its region of the impact of plague, while a late and generally despised compiler, George Cedrenus (fl. AD 1060), notes that the plague was passed on through clothing (and also by a simple look).⁵⁰

But both descriptions and palliatives are on the grand scale: they deal with the macro-phenomena. Indeed, given the techniques and tools of investigation available,

⁴⁷ Hippocrates, *On the nature of man* 9: IV, p. 27, tr. Jones. The wondrously anachronistic rendering in the latest edition, J. Jouanna, *Hippocrate, La nature de l’homme*, CMG I 1, 3, 1975, p. 191. “C’est parce qu’il contient le germe pathogène que l’air est nocif”, proves the point: Jouanna has Renaissance predecessors in this type of rendering.

⁴⁸ Galen, *Commentary on On the nature of man* II.3–4: CMG V 9, 1, p. 62f. = XV 118–122 K.

⁴⁹ The bad air theory was strongly supported by Galen at *On the different types of fever* I.4–6: VII 282–294 K; see also Winslow, op. cit., note 20 above, pp. 66–74. The injunctions on town planning, which come from Galen, Antyllus, and the Hippocratic tradition, are given by Oribasius, *Medical collections* IX.6 and 10–13: CMG VI 1, 2, 1929, pp. 9–15.

⁵⁰ Joshua Stylites, *Chronicle* XLI–XLIII Wright (in AD 500–501), on which see also J. B. Segal, *Edessa, the Blessed City*, Oxford, Clarendon Press, 1970, p. 147f.; Cedrenus, *Historical compendium* 452: *Patrolog. graec.* 121.495A, who combines medical observation with the theory of action at a distance discussed by investigators of the evil eye. On Greek historians and plague, see now T. L. Bratton, ‘The identity of the plague of Justinian’, *Trans. Stud. Coll. Physns. Philadelphia*, 1981, ser. V, 5.3: 113–124, 174–180.

this was the most that could be done to collect the data of experience. To go further was to describe the invisible, and to resort to speculation that was perhaps incapable of any conclusive proof. In his philosophical autobiography, Galen took particular pride in his refusal to take sides where the argument, whether derived from the senses or by logic, was inconclusive, and throughout his writings he expressed a general reluctance to indulge in theoretical investigations that departed far from empirical evidence.⁵¹ His own tract *On demonstration* would have further alerted him to the danger of unchecked theorizing, although, from time to time, he liked to hint that he too could put forward as cogent and as exciting a hypothesis as the next man. But this was left for the “natural scientists”;⁵² it was enough for the doctor to know the general effect, the putrefaction of the air, rather than its particular cause, especially if invisible, since, on Galen’s logical analysis, it was this effect which functioned as the initial cause of the disease. One need not go further in regression to attack the cause of the cause, for where would it end? This reluctance to string together long causal chains, and a strong division between effects and causes, is an inhibiting factor in Galen’s formulation of scientific theories and may have been shared by most of the natural scientists of antiquity.^{52a}

Besides, as it stood, the theory of seeds of disease was of little value to the doctor in his practical task of curing the patient. The deadly seeds could not be identified either in the atmosphere or in the patient, and the hypothesis of their existence in no way contributed, in Galen’s time, to their elimination. Galen constantly affirmed the need to bring certitude into medicine, yet each time he mentions these seeds there is a, perhaps unavoidable, fuzziness of meaning. The most that the doctor could do was to deal with the macro-phenomena in which the seeds were supposed to act, the air and the individual patient. The hypothesis of causative seeds was a philosophical luxury for the intellectual practitioner; it did not lead, either in antiquity, the Renaissance, or even down to the mid-nineteenth century, to the cure of disease by the elimination of these tiny agents from a diseased body.⁵³

But above all, there were theoretical considerations which would have made it hard for Galen fully to reconcile his “seeds of disease” with his other ideas about disease. The major objections were clearly stated by Diogenianus in the passage from Plutarch already cited, and Galen would, on the whole, have agreed with them. At one level, they rest on a view of nature as operating within certain self-prescribed limits, like a ship tossing about its anchor.⁵⁴ Just as there are no miraculous instant changes from wood to stone, or from man to mongoose, so nature is not constantly devising and producing novelties such as new and specific diseases or, in Plutarch’s striking phrase,

⁵¹ Galen, *On my own opinions*, chap. 2, in my forthcoming edition.

⁵² I. v. Müller, ‘Über Galens Werk vom wissenschaftlichen Beweis’, *Abh. Bay. Akad. Wiss., phil.–hist. Kl.*, 1895: 403–478. A good example occurs at *On the properties of drugs* II.20: XI 517f. K., where Galen abandons a complex discussion of the properties of olive oil in scientific terms as being unprofitable to the doctor.

^{52a} Cf. J. Barnes, ‘Proof destroyed’, in Schofield *et al.* (eds.), *op. cit.*, note 12 above, p. 180.

⁵³ M. Pelling, *Cholera, fever and English medicine, 1825–1865*, Oxford University Press, 1978, pp. 112–145. This is not to deny that *preventive* treatment was not assisted by such ideas.

⁵⁴ Plutarch, *Table talk* VIII.9: 731D.

The seeds of disease

perpetually creating a New Order (*καινοτομεῖν*) in man as if in some body politic.⁵⁵ But such a theory would be perfectly compatible with an Epicurean and Methodist cosmology, in which the natural world was in a constant flux of atoms moving within the void, and in which change and innovation were always present.⁵⁶ On this scheme, there would be no difficulty in classing as a new, individual, and specific disease the symptoms which appeared in a patient if they differed appreciably from the general common conditions of named disease entities, or in imagining an infinite variety of possible specific diseases.

More important, the approach of Galen, and indeed of all writers in the Hippocratic tradition, was, to use Temkin's description, physiological rather than ontological.⁵⁷ A disease did not have an existence in its own right, but as a deviation from the normal within the patient, and although these authors accepted and wrote of such disease entities as fever and phthisis, they insisted on always taking into account "the peculiar nature of each individual". The nature of disease was to be found in man's temperament, the structure of his parts, his physiological and psychological dynamism, and could be defined very much in terms of impeded function. Set against this background, the seeds of disease act only as an initial cause: they are not the disease, any more than a blow to the head or a poisonous mushroom. They merely trigger a situation which eventually may lead to a humoral disorder and a bodily malfunction, and it is the latter which for Galen constituted disease and illness.

On this schema, then, the seeds of diseases, even if they existed and could be reconciled with a physiological approach to disease, would play only a minor role at best; they are merely one among many variable initial causes. Far more crucial, and arguably far more accessible, was the patient's humoral balance, for, as Galen stressed, without the receptivity of the individual's humours to these external causes, there would be no alteration in their proper balance. Such a receptivity or suitability could be characteristic of individuals or groups. Dogs have a particular receptivity towards rabies, which attacks them alone among animals and which engenders such a violent change in their humours that their saliva, dropping on to a human body, communicates the madness. And, above all, it was an individual's own susceptibility that ensured his death or survival during plague.⁵⁸ In Galen's terms, this suitability was the

⁵⁵ *Ibid.*: 731D. For Galen's view of miracles and the limitations set by the Creator to his own handiwork, see R. Walzer, *Galen on Jews and Christians*, Oxford, Clarendon Press, 1949; F. Kudlien, 'Galen's religious belief', in Nutton, *op cit.*, note 12 above, p. 118.

⁵⁶ It was precisely on this point that the German physician Johannes Lange (1485–1565) parted company with Fracastoro. The Galenist Lange was quite prepared to accept that epidemics were spread by seeds, and that diseases could wane and be revived by bad diet, but not that there could be new diseases of an entirely new specific form, or a possible infinity of new diseases, see J. Lange, *Epistolae medicales*, Frankfurt, A. Wechel, 1589, Ep. II.15: p. 619f. (written perhaps c. 1555 or even earlier): cf. also Epp. II.13 and 14: pp. 610–618. Lange cites the arguments of Diogenianus/Plutarch against new diseases.

⁵⁷ O. Temkin, *The double face of Janus*, Baltimore, Johns Hopkins University Press, 1977, pp. 442–448, 459–463 = 'The scientific approach to disease: specific entity and individual sickness,' in A. C. Crombie (editor), *Scientific change*, London, Heinemann, 1961, pp. 630–638; and 'An historical analysis of the concept of infection', *Studies in intellectual history*, Baltimore, Johns Hopkins University Press, 1953, pp. 129–135; cf. also W. Pagel, 'Paracelsus, Van Helmont und die Wandlungen im ontologischen Krankheitsbegriff', *Virchows Archiv*, 1974, **363**: 183–211.

⁵⁸ Galen, *On affected parts* VI.5: VIII 423 K.; *On the different types of fever* I.6: VII 290 K.

antecedent cause of the disease, and its elimination was just as effective as that of the initial cause. It was also easier to see and to regulate, for although individual differences were “ineffable and could not be subjected to concepts”, it was the mark of the good doctor to recognize them in his patients.⁵⁹ Celsus’ scorn at the medicine of slave hospitals for relying entirely on common characteristics reflected the Hippocratic practitioner’s desire to know his individual patient,⁶⁰ and Galen’s hatred of the Methodists was in part due to their reliance on these common and gross features. In Galen’s medicine, prophylaxis and treatment were directed largely to the creation and maintenance of the proper humoral balance in each individual, which varied from person to person and which it took the good physician some time to know in full. Although in his own practice, with its instant “miracle-cures” and its “prescriptions by post”,⁶¹ Galen did not always adhere to his own precepts, his ideal doctor was a long-term friend and adviser to his (relatively few) patients, and his skill and experience together made it possible for him to understand the changes in his patient. He knew his habits, his way of life, his emotions, all that contributed to his health. It was both easier and more rewarding, as Diogenianus had argued, to concentrate on “the things by which we live”, on providing a proper regimen for a known person, than to hunt for invisible and possibly random seeds of specific diseases, whose deleterious influence could in any case be negated by the attainment of a balanced constitution.

It is therefore not surprising that Galen devoted little attention to these seeds of plague and disease; both practical and theoretical presuppositions made it hard for him to fit them into his overall scheme of ideas on disease or to use them in his day-to-day work as a doctor. His subsequent followers paid even less attention to this theory, and the fate of the three passages where the master had briefly touched on it offers an eloquent illustration of the complex development of Galenism over almost a millennium and a half.

The little theoretical tract *On initial causes* was forgotten until the early fourteenth century, when it was turned from Greek into Latin by the great South Italian translator, Niccolò da Reggio. Even this did not save it from obscurity, for major collections of the many small treatises translated by Niccolò were few, and despite its inclusion in the Latin *Opera Omnia* editions of Galen from 1490 onwards,⁶² it was rarely cited in debate, with one significant exception that will be mentioned later.⁶³ The Greek text perished shortly after Niccolò, perhaps sinking into the Adriatic with other manuscripts from the Naples Royal Library,⁶⁴ and there was not even an Arabic version to tantalize scholars. Sudhoff quoted it briefly in his note of 1915, but it was

⁵⁹ Stephanus, *Commentaries*, p. 235 Dietz; Temkin, op. cit., note 57 above, p. 446. Cf. Galen, *Method of healing* III. 7: X 206 K.

⁶⁰ Celsus, *On medicine* Pref. 65.

⁶¹ Galen, *On prognosis* 8.1: XIV 641 K; *On affected parts* IV.2: VIII 224 K.

⁶² Probably it was included among the Galenic texts given to Robert of Naples by the Byzantine emperor Andronicus III and brought from Constantinople by Niccolò in 1331, see R. J. Durling, ‘A chronological census of Renaissance editions and translations of Galen’, *J. Warburg Courtauld Inst.*, 1961, 24: 230–305 (p. 283, n. 25).

⁶³ Below, pp. 31f.

⁶⁴ R. Weiss, *Medieval and humanist Greek*, Padua, Antenore, 1977, p. 121, cf. also pp. 124–135.

The seeds of disease

not until Kurt Bardong in 1932, and subsequently in his *Corpus Medicorum Graecorum* edition and retro-version of 1937, that it received appropriate attention and comment.⁶⁵ Even today its existence remains unnoticed by many historians of ancient medicine and philosophy.

The fate of Galen's commentary on *Epidemics I* was only slightly less unhappy. It was translated into Arabic, but its difficult text, its prolixity, and its heterogeneity (essential in a comprehensive commentary), all contributed to its neglect. Oribasius made relatively few excerpts from it for his various compendia, and, with the singular exception of Maimonides, authors in the Arabic tradition seem to have drawn very rarely upon it.⁶⁶ Its popularity in the Renaissance was a little greater. A translation by Cruserius was printed in 1531 and thrice more before the decade was out, and a second version, by Vassaeus, was printed twice in 1546 and 1550.⁶⁷ Significantly, both versions appeared with the *Epidemics* and were designed more to elucidate Hippocrates than to expound Galen. The inclusion of Cruserius' version (with the addition of a preface) in the Giunta editions of the *Omnia opera Galeni* from 1541 onwards ensured its survival among scholars, but did not greatly contribute to its accessibility or reputation, for it was not Galen's commentary but the Hippocratic *Epidemics* themselves that were the object of lectures. Not surprisingly, Galen's throw-away comment passed unremarked.

On the different types of fever, by contrast, enjoyed a marked success. It was a major monograph on a topic which, to judge from the number of treatises devoted to it, occupied most of the doctor's time and attention. It was included among the "set texts" of the Alexandrian physicians of late antiquity, commented upon in the *Studium* at Bologna from the end of the thirteenth century, and was still being used as a set book in most of the medical faculties of Europe well into the seventeenth century.⁶⁸ It was translated into Syriac and Arabic, and into medieval Latin by Burgundio of Pisa (c. 1110–1193); there was even a summary of it in Hebrew.⁶⁹ The Renaissance seized upon it eagerly, and even before the first Aldine edition of the Greek text appeared in 1525, it had been translated anew into Latin by two of the

⁶⁵ Sudhoff, op. cit., note 1 above, p. 228; K. Bardong, *Galen De causis procatarcticis libellus*, Diss., Giessen, 1932 = CMG Suppl. 2, 1937, which contains in its introduction an excellent summary of the contents of the text and of its problems. Bardong was unaware of the important manuscript of the tract contained in Paris, Académie Nationale de Médecine, MS. 53, fols. 152r–169r, see V. Nutton, 'A forgotten manuscript of Galenus Latinus', in K. Treu (editor), *Studia Codicologica*, Berlin, Akademie Verlag, 1977, pp. 331–340.

⁶⁶ See the list at Oribasius, *Medical collections*, CMG VI 2, 2, p. 328, col. 3. For Maimonides, see the extracts given by K. Deichgräber and K. H. Deller in the appendix to Wenkebach and Pfaff's edition of Galen's *Commentaries on Epidemics VI*, ed. 2, CMG V 10,2,2, 1956, pp. 517–543. Our little passage is not among them.

⁶⁷ Durling, op. cit., note 62 above, p. 294f., n. 152.

⁶⁸ N. G. Siraisi, *Taddeo Alderotti and his pupils*, Princeton University Press, 1981, p. 107: her attribution of a specific commentary on it to Taddeo at pp. 103 and 446 is an uncorrected first thought, for, as she rightly remarks on p. 244f., what Taddeo wrote was a *Practica de febribus*, which used this text. G. N. Clark, *A history of the Royal College of Physicians of London*, Oxford, Clarendon Press, 1964, p. 387 (statutes of 1563) and p. 410 (1647).

⁶⁹ E. Lieber, 'Galen in Hebrew', in Nutton, op. cit., note 12 above, p. 173; P. Classen, 'Burgundio von Pisa', *Sitzber. Akad. Wiss. Heidelberg, phil.-, hist. Kl.*, 1974.

most distinguished of the humanist physicians, Laurentianus and Leonicensus.⁷⁰ A new version of it, by the Spaniard Francisco Valles, was published at Alcalá in 1569 and again at Cologne in 1592.⁷¹

Can we then detect any interest in the hypothesis of seeds of disease either in the many commentaries and summaries of this book or in the various medical traditions before the Renaissance? The answer is, hardly any. Although Oribasius' major abridgement of Galen's views on fever is now lost, it is clear from his lesser summaries, and from the later compendia of Aetius and Paul which derive from him, that, as a good practical physician, he omitted any theoretical speculation about the causes of the infection of the air.⁷² His discussion of plague is taken from Rufus of Ephesus, not Galen, whose own account, being largely a restatement of Thucydides, Renaissance scholars in particular found distressingly unhelpful.⁷³ The tradition of *Problems* seems to have been well established before Galen, and although its authors mention contagion, they show no acquaintance with any specifically Galenic thoughts on the topic.⁷⁴ Similarly, the later Greek medical tradition, which is strongly Hippocratic and Galenist in its bias, also becomes more and more anti-speculative, and such Byzantine authors as Palladius and Pseudo-Alexander in their tracts on fevers do no more than declare the importance of the circumambient air as an initial cause.⁷⁵ Since very little has been done to elucidate the ways in which the Arabs modified and developed the medical traditions they inherited from the Greeks, it is perhaps unwise to pronounce on their general understanding of this problem. Yet it is clear from a study of the books of their major authors which passed into Latin that although they extended the idea of contagious diseases far beyond the limited number given in their Greek sources, they preferred to explain the corruption of the air by miasmata and vapours rather than by seeds. In his *Canon* Avicenna several times mentioned corrupt air, but associated it with atmospheric changes and with the standard marshes, battlefields with rotting corpses, chasms in the earth, and with the flooded places where flax and *aspalathos*(?) were steeped,⁷⁶ all of which sent out fumes

⁷⁰ Durling, op. cit., note 62 above, p. 285, n. 40.

⁷¹ F. Valles, *In Galeni de differentiis febrium libros commentarium*, Alcalá, A. de Angulo, 1569, not in Durling.

⁷² Oribasius, *Synopsis, for Eustathius* VI.24: CMG VI 3, p. 198f.; *Synopsis, for Eunapius* III.1: CMG VI 3, p. 396f., together with the citations listed at CMG VI 2,2, p. 320, col. a; Aetius, *Summary* V 95: CMG VIII 2, pp. 80–82; Paul, *Compendium* II.34: CMG IX 1, p. 107f., with the invaluable commentary by Francis Adams, *Commentary on Paulus Aegineta*, London, Sydenham Society, 1844, I, pp. 273–288.

⁷³ E.g., F. Vallerioli, op. cit., note 16 above, p. 64f.; H. Mercurialis, *De peste . . . praelectiones*, Basle, P. Perna, 1577, p. 11.

⁷⁴ Above, note 18.

⁷⁵ Palladius, *Synopsis of fevers* IX.2: p. 111 Ideler; [Alexander], *On fevers* 27.2: p. 100 Ideler.

⁷⁶ Avicenna, *Canon*, lib. IV, fen 1, tract II, cap. 1; and tract IV, caps 1–5. Venice, P. De Paganinis, 1507 (repr. Hildesheim, G. Olms, 1964), fols. 398r., 416r.–v. At lib. IV, fen I, tract II, cap. 1, the text reads: sicut aeris pestilentiae et aeris lacunarum et locorum infusorum in quibus res madefiunt sicut linum et asfaltum. The clause "in quibus . . . asfaltum" is absent from the Arabic edition of the *Canon*, Baghdad, 1960, III, p. 16, line 10, and "asphalt" is hardly grown like flax in marshy ground or steeped for retting. It is possible that the Latin abbreviates or mistranslates the original Arabic, which might have referred to the fumes given off while pitch was being boiled for caulking. A second, although less likely, possibility is of a transcription of the Greek "aspalathos", the camel's thorn, which would then refer to the process whereby its perfumed oil was extracted. I gratefully acknowledge the help of Miss F. Keshevarz with this and the

The seeds of disease

or miasmata to putrefy the air. Even Ibn Al-Khatib, whose treatise of 1348 expressly defended contagion and infection against the attacks of religious jurists for whom God alone sent the plague, gave no detailed account of its mode of transmission. Although for him infection existed and was confirmed by experience, research, insight, observation, and its frequent occurrence in historical records, and although his description of symptoms has merited the praise lavished upon it, all that he could conclude about the badness of the air which caused the epidemic was that it was in some way poisonous. Sober and enlightened he may have been, but, as Ullmann has rightly pointed out, he was only repeating what had been recognized from time immemorial by doctors and enshrined in the administrative practice of the towns.⁷⁷

One looks similarly in vain for any mention of the seeds of disease among the many Western discussions of the causes of the Black Death, but although contagion and miasmata are both invoked, they are regarded as sufficient explanations in themselves, and the process of their formation goes without comment.⁷⁸ The earlier Western medical tradition is also silent on seeds, although both the Methodist doctor Caelius Aurelianus, fl. AD 410, and late writers on veterinary medicine talk about contagion.⁷⁹ The Greek writer Apsyrus (c. AD 225), the author of the Latin *Mulomedicina Chironis*, and Vegetius (both of c. AD 400), recommend the segregation of beasts infected particularly by *malis* (a disease akin to glanders), for, says Apsyrus, the disease is passed on and easily harms the rest.⁸⁰ The fragments of Apsyrus give no explanation for this contagion, but the source of the *Mulomedicina* and Vegetius records variant opinions about its cause. These authors reject a simple aetiology in terms of tiredness, a chill, or divine judgment in favour of a constitutional and pestilential defilement of the air through the action of a south wind blowing from Africa. The *pneuma* or *spiritus* is taken into the lung and becomes a disease in the

next note. Antonio Carreras Panchón, 'Sobre el concepto de pestilencia (waba) en el Canon de Avicena', *Asclepio*, 1981, 33: 267–273, does not discuss this passage.

⁷⁷ M. Ullmann, *Islamic medicine*, Edinburgh University Press, 1978, pp. 86–96; note also his scepticism of all generalizations, p. XII f. For other studies of Arabic ideas on contagion and plague, see M. W. Dols, *The Black Death in the Middle East*, Princeton University Press, 1977, pp. 84–98; L. I. Conrad, 'Arabic plague chronologies and treatises: social and historical factors in the formation of a literary genre', *Studia Islamica*, 1981, 54: 52–94; *idem*, 'Tā ūn and wabā': conceptions of plague and pestilence in early Islam', *J. Econ. Soc. Hist. Orient*, 1982.

A possible exception is al-Qazwini (ob. 1283), who thinks of the poisonous principles in the air being changed by God into harmful insects, *Cosmography* quoted by E. Seidel, 'Die Lehre von der Kontagion bei den Arabern', *Sudhoffs Archiv*, 1913, 6: 88, although De Sacy's translation used there, "germes pestilentiels" is wildly anachronistic. There is almost certainly a link here with the Aristotelian doctrine of the birth of many insects from decaying residues: cf. C. Thomasset, *Commentaire du Dialogue de Placides et Timéo*, Geneva, Librairie Droz, 1982, pp. 184–189; P. Louis, 'La génération spontanée chez Aristote', *Actes XII^e Congr. Int. Hist. Sci.*, Paris, 1970, I, pp. 291–305.

⁷⁸ D. Palazzotto, 'The Black Death and medicine: a report and analysis of the tractates written between 1348 and 1350', Diss., Univ. of Kansas, 1973, pp. 73–99. Cf. also *De febribus opus sane aureum*, Venice, G. Perchacino, 1576, fols. 112 (Rhazes); 142v. (Isaac); 215v. (Bernard Gordon); 252v. (Arnold of Villanova); and K. Sudhoff, 'Die acht ansteckenden Krankheiten einer angeblichen Baseler Ratsverordnung vom Jahre 1400', *Sudhoffs Archiv*, 1929, 21: 219–227; Thomasset, op. cit., note 77 above, pp. 81–91.

⁷⁹ Caelius Aurelianus, loc. cit., note 36 above.

⁸⁰ Apsyrus, in E. Oder and C. Hoppe, *Corpus Hippiatricorum Graecorum*, repr., Stuttgart, Teubner, 1971, *Hipp. Berol.* II.8: I, p. 18. For the date, G. Björck, *Apsyrus, Julius Africanus et l'hippiatrique grecque*, Uppsala and Leipzig, Lundequist, Harrassowitz, 1944, pp. 7–12.

blood. It gains greater strength, infects more people, and their exhalations and odour cause a greater morbid change in the air, which increases the vehemence and extent of the infection. The disease clinging to the numerous flocks and herds produces contagion and consumes all the animals with its sickness. The only remedy is the isolation of healthy animals, the slaughtering of infected animals, and fumigation.⁸¹ These veterinarians, then, take over and apply to their animals precisely the same theories of disease as doctors to their human patients, and although they are eclectic in their terminology and ideas, in this instance they firmly come down on the side of bad air, and do not look further for seeds.⁸²

But the idea of seeds reappears among the theologians, in Isidore of Seville's treatise *On the nature of things* (c. AD 613). Here, when discussing plague, "a disease which ravages widely and which infects almost all those whom it touches with its contagion", he set out various possible explanations. It was, of course, a scourge sent to men for their sins, and could not happen without the judgment of God, but how it was in fact brought into this world was open to dispute. Some ascribed it to a disturbed balance of the natural order leading to a corruption of the air and a pestilent exhalation, while others claimed that:

many plague-bearing seeds of things (*pestifera semina rerum*) were carried into the air and borne upwards to be transported by winds or clouds to the farthest parts of the heavens. These transported seeds either dropped to the ground in various places and corrupted all the grasses to the destruction of animals; or they remained suspended in the atmosphere and were taken in with the air which we breathe and were thus absorbed into the body. The body would then fall ill, and be killed either by foul ulcers or by a sudden blow . . . for the air coming together from all the other parts of the heavens would seize on the body with a sudden assault and swiftly extinguish life.⁸³

Renaissance commentators had no difficulty in identifying Isidore's sources. The first opinion comes from the *Recognitiones* ascribed to the early Christian writer and philosopher, Clement of Alexandria; the second is taken from Lucretius, Book VI, lines 1093–1130.⁸⁴

Although Isidore's great compilation, the *Etymologies*, was widely studied by theologians and grammarians well into the seventeenth century, the *fortuna* of this cosmological tract is far more obscure. Whether the ideas contained in it had any

⁸¹ *Mulomedicina Chironis* 191–194 = Vegetius I.17. Cf. also *Mulomedicina* 164–172, Vegetius I. Praef.; I; 13; 14; III. 2; 23. An alternative explanation, but still involving air, is given for the disease at *Corp. Hipp. Graec.*, *Hipp. Paris.* 29: II, p. 31. For the contagion of *scabies*, cf. *Mulomedicina* 172 = Vegetius: III. 71.

⁸² For the veterinarians' eclectic preservation of ideas and technical terms from doctors, see G. Björck, *Zum Corpus Hippiatricorum Graecorum*, Uppsala, Lundequist, 1932, pp. 71–78. The parallel of "malis" with human plague is drawn specifically by Vegetius I.17. In the Middle Ages, Albertus Magnus (c. 1200–1280) discussed human and animal plagues together, deriving them both from changes in temperature and condition of the air, which then created a poison in the body, *On animals* VII.2, 1–2; ed. Venice, heirs of O. Scotus, 1519, fols. 68v.–69r.

⁸³ Isidore, *On the nature of things* 39; ed. J. Fontaine, *Isidore de Séville: Traité de la nature*, Bordeaux, Féret, 1960, pp. 303–305. My translation differs markedly from that of W. D. Sharpe, 'Isidore of Seville, the medical writings', *Trans. Am. Philos. Soc.*, 1964, 54, pt. 2: p. 66, who fails to realize the dependence on Lucretius VI, 1125–1130. Cf. also for Isidore's support of contagion, *Etymologies* IV.6, 17, translated by Sharpe, p. 57. On the influence of *On the nature of things* in the later Middle Ages, see Fontaine's edition, pp. 19–38, 141f.; and B. Bischoff, 'Die europäische Verbreitung der Werke Isidoros von Sevilla', in his *Mittelalterliche Studien*, I, Stuttgart, Hiersemann, 1966, pp. 171–194.

⁸⁴ [Clement], *Recognitiones* VIII.45: Patrolog. graec. I.1392. Cf. J. Du Brevi, *Isidori opera omnia*, Paris, M. Sonnius, 1601, fol. 894.

The seeds of disease

effect on medical authors cannot be determined at all, nor can the possibility be excluded that some doctors and scholars read it. But evidence for any knowledge of the theory of seeds of disease in the medieval West is very difficult to find. Pietro d'Abano, professor of medicine at Padua at the end of the thirteenth century, although expounding at length the Aristotelian problem on the transmissibility of diseases, faithfully explained it as the result of evil vapours, bad and corrupt breath, or a thick and viscous humour that could pass from the sufferer's skin to that of his contact.⁶⁵ Neither are the medical professors at contemporary Bologna any more helpful. Taddeo Alderotti's *Practica de febribus* talks about the causes of fever in philosophical terms and describes the precise humoral combination that is most susceptible to plague.⁶⁶ Nor does his pupil and successor Dino del Garbo mention seeds in his commentary on *On the different types of fever*. But at least he does consider the problem raised in the second of our Galenic passages about the part played by the blocking of pores in rendering a body more susceptible to fever, although his answer is couched entirely in terms of the effect of this blockage in turning the humours to the hot and moist state that characterizes the onset of putrid and pestilential fevers.⁶⁷

It comes then as a surprise to find in the commentary on the same Galenic text written at Bologna in 1345 by his son, Tommaso del Garbo, the bare, brief and unequivocal statement that: "In plague Galen had declared that certain seeds of plague were added to the first group of bodies already full of superfluities."

Unfortunately, Tommaso does not develop this idea further, but continues with the same sort of explanation as his father had given.⁶⁸ But the significance of this text extends beyond its own day. Several manuscripts of this course of lectures survive; the earliest is dated to 1386, and others come from the next century. It was first printed in 1514 alongside two Latin versions, and in the Venice edition of 1521 it accompanies three versions of the tract as if it enjoyed some authoritative status.⁶⁹ If this is so, then Tommaso's blunt statement would have been accessible to many medical men, especially since, as we have seen, this Galenic tract was among those most studied in the later Middle Ages and Renaissance.

In the sixteenth century, the doctrine of seeds of disease, or at least hints of it, was accessible to scholars and doctors in a variety of traditions surviving from Antiquity, including such familiar authors as Galen, Plutarch, and Isidore, even if the actual works in which they briefly noted the theory were rarely among the most popular, and their statements often brief and cryptic. With this in mind, we may now approach the problem of Fracastoro, who in his *De contagione, contagiosis morbis et eorum*

⁶⁵ P. D'Abano, *Expositio problematum Aristotelis*, Venice, G. Herbort, 1482, pars 7, probl. 7, fols. 99v.–100v., sig. iiii verso a–v recto b; and notes 102–103 below.

⁶⁶ Taddeo Alderotti, *Practica de febribus*, Padua, Bibl. Universit., MS. prov. 202, fol. 107r.–v.

⁶⁷ Dino del Garbo, *Recollectio de differentiis febrium*, Vatican, MS. lat. 4450, fols. 4v.–5r. I am grateful to Professor Siraisi for providing me with photostats of this and the preceding MS.

⁶⁸ Tommaso del Garbo, *Commentaria non parum utilia in libros Galeni*, Lyons, S. Vincent, 1514, fol. xxi verso = *In libros de differentiis febrium Galeni commentum*, Venice, O. Scotus, 1521, fol. 16r.: verum dixit quedam pestilentiae semina adiciantur autem (?) id est adiungantur prioribus.

⁶⁹ L. Thorndike and P. Kibre, *Incipits of mediaeval scientific writings in Latin*, 2nd ed., London, Mediaeval Academy of America, 1963, cols. 578, 757.

curatione libri III of April, 1546, and much earlier in a letter to Giovanni Battista della Torre, unequivocally propounded a theory of contagion based upon airborne seeds.⁹⁰ He defined a contagion as a precisely similar corruption, developing in the substance of a combination of elements, which passed from one thing to another and was the result of an infection first occurring in the imperceptible particles. There were three different types of contagion, by direct contact, by contact leaving behind "fomites" which preserved the seeds of contagion and infected by them; and at a distance as if by some impetus or poison. In all three, infection was produced not by an unknown "occult" cause, but by seeds (*semina, seminaria*) of contagion, which varied with the type. Seeds that infected at a distance had a greater hardness, subtlety, and power than the others, and perhaps an antipathy to the animal organism. Why and how contagion occurred depended on the composition of the seeds, which might be produced within or without the body, and even as a result of astral conjunctions.⁹¹

For this theory, Fracastoro has been frequently and loudly praised. "It contains the first scientific statement of the true nature of contagion, of infection of disease germs, and the mode of transmission of infectious diseases." "Fracastoro . . . states with wonderful clairvoyance the modern germ theory of disease." "[His book] best exhibits the scientific vision of Fracastoro . . . and . . . places him among the great biologists of his time."⁹² His speculations about the causes of disease are proclaimed to be comparable with Vesalius' achievements in anatomy, for, so it is argued, with the exception of Paracelsus, only Fracastoro altered or added significantly to the ancient and medieval conceptions of disease and illness. Both Vesalius and Fracastoro were thus leaders of the Scientific Revolution and the onward march of Progress.

Such a view, as Norman Howard-Jones has suggested, demands considerable modification and correction.⁹³ Fracastoro was no Robert Koch, and his explanations for phenomena, which, it should be recalled, were visible to him only through the eye of logic, involved a whole range of assumptions and entities foreign to modern medical science. If Fracastoro is to retain his high place in the pantheon of medical history, his

⁹⁰ G. Fracastoro, *De sympathia et antipathia liber unus, De contagione et contagiosis morbis et eorum curatione libri tres*, Venice, Giunta, 1546. I have cited *On contagion* from the pages of the edition, translation, and commentary of W. C. Wright, New York, G. P. Putnam's Sons, 1930. The letter to Della Torre is printed in F. Pellegrini, *Origini e primi sviluppi della dottrina fracastoriana del contagium vivum*, Verona, 1950, pp. 35–51 (= *Letter*); for the date, see p. 30. It must antedate 1535, and possibly 1530. In his early poem *Alcon sive de cura canum venaticorum*, in *H. Fracastorii poemata omnia*, Padua, J. Cominus, 1718, lines 169f., Fracastoro used "seeds of disease", but as a metaphor for the "worm" in the tongue of a rabid dog:

Nil tandem usque adeo prodest, ac prima sub ipsum
Principium morbi rescindere semina ferro.

I owe this reference to Dr K. D. Fischer, who also advises caution about its authenticity. The phrase "semina morbi" occurs also in Fracastoro's *Syphilis*, ed. H. Wynne-Finch, London, Heinemann, 1935, I, 119; II, 196, 244; III, 361.

⁹¹ *On contagion*, pp. 4, 6, 18, 20, 36, 44, 52–60; cf. *Letter*, pp. 36–39, 49–51.

⁹² Respectively, F. H. Garrison, 'Fracastorius, Athanasius Kircher and the germ theory of disease', *Science*, 1910, 31: 500; *idem*, *An introduction to the history of medicine*, 4th ed., Philadelphia and London, W. B. Saunders, 1929, p. 233; A. Castiglioni, *A history of medicine*, 2nd ed., New York, A. A. Knopf, 1947, p. 457.

⁹³ N. Howard-Jones, 'Fracastoro and Henle: a reappraisal of their contribution to the concept of communicable diseases', *Med. Hist.*, 1977, 21: 61–68.

claim must rest on grounds other than mere clairvoyance and scientific vision: on the originality of his conception, the range of his influence, or the cogency, consistency, and thoroughness with which he applied his or others' insights to a variety of problems. We shall examine each of these possibilities in turn.

Charles and Dorothea Singer, in what still remains a very valuable discussion of Fracastoro's sources and influence, shrewdly pointed out that nowhere in *On contagion* does Fracastoro expressly claim to be espousing novel or revolutionary views.⁹⁴ They are indeed put forward, in typical Renaissance fashion, as a continuation of earlier doctrines, as modifications and extensions of older, classical ideas. In contrast to Paracelsus, the only innovative medical theorist of the sixteenth century, Fracastoro is working within the same classical and Hippocratic framework as the great majority of his fellow doctors, and his theory of seeds and contagion gains in acceptability precisely because of the ease with which it could be grafted on to standard views.⁹⁵ Yet the overall impression made by both *On contagion* and the letter to Della Torre is that these *seminaria* were the invention of Fracastoro and that he was the first to apply the theory to contagious diseases. The answer to this riddle lies in an art at which both Vesalius and Fracastoro excelled, the art of judicious silence. By not making explicit their debts to others, they gained credit for themselves at the expense of the dead or the less astute.⁹⁶

Let us look in detail at this accusation, and begin by considering the whole style of both treatise and letter. At first sight, to a reader accustomed to modern textbooks, there is nothing strange. The argument flows from one medical example to another; the Latin is clear and elegant; and there are no ugly parentheses or wandering diversions. What else should be expected of an intimate friend of the most Ciceronian of the Renaissance Latinists, Pietro Bembo? But one glance at a typical Renaissance medical text shows that this limpidity is both deliberate and deceptive. It obscures Fracastoro's debts to his predecessors by omitting all, or almost all, reference to them. We need not expect every writer to follow the practice of the great medical philologists, like Leonicens, Manardi, J. C. Scaliger, Mercurialis, or, later and in English, Burton, who loved to confute their opponents by learned quotation and almost to bury them under a heap of authorities, but the refusal to cite any name in the letter, and only three in *On contagion*, Book I, where Fracastoro sets out his theories, and none of direct relevance to his actual seeds,⁹⁷ goes far beyond what even such practical authors as Paré and Vesalius did.

It could, of course, be argued that Fracastoro, who never expressly claims originality for his *seminaria*, was acting on purely literary principles and that his

⁹⁴ C. and D. Singer, 'The scientific position of Girolamo Fracastoro', *Ann. med. Hist.*, 1917, 1: 30.

⁹⁵ Cf. Fracastoro's apology for the failure of earlier authors, *Letter*, p. 35f. = *On contagion*, p. B. For Paracelsus' ideas on contagion and seeds of disease, which are more fully worked out and play a rather different role, see W. Pagel, *Paracelsus*, Basle and New York, S. Karger, 1958, pp. 140f., 172–185.

⁹⁶ On this aspect of Vesalius, note the contemporary comment, full of sour grapes, by N. Massa, *Epistulae* 5, Venice, Bindon and Pasino, 1550, 52. This reluctance to acknowledge his sources could rebound on Fracastoro, see note 141 below.

⁹⁷ *On contagion*, p. 26; Aristotle and Galen agree that in infection at a distance there must be the same common principle and mode of infection: and p. 54; Thucydides on the plague. The number of named authors increases in Book II, but is still relatively small, and neither Lucretius nor *Problems* is mentioned.

readers might well have picked up the echoes of earlier writers and correctly attributed them to their sources. But three considerations militate against this. The first is that some of the passages already discussed in this article come from very obscure bits of classical antiquity, even if their authors were well known, and were unlikely to have been at the fingertips of the average physician. Only the first two Galenic arguments, Plutarch, the *Problems* and Lucretius (in Montanus' Lectures on Rhazes and Galen in the early 1540s), figure, as far as I can tell, in the contemporary literature on contagion, and how many would have been known to Fracastoro is hard to say, especially as the estimates of his learning made by his supporters and opponents differ greatly. Lange called him a man of rare erudition; Valles' "no small learning" is lukewarm; while Montanus who, unlike the others, knew him well, upbraided him for forgetting that he was talking with men who knew far more than he, and declared that Fracastoro had no deep acquaintance with philosophy, and still less with medicine.⁹⁸

Second, especially in *On contagion*, the allusions to earlier writers are so well embedded in the general style and argument of the book that their detection is by no means easy. The Singers' argument for a derivation from Lucretius was based entirely on the known friendship between Fracastoro and Navagero, an important renaissance editor of the poet.⁹⁹ Thanks to Pellegrini's researches, the Lucretian reminiscences are now far clearer, especially on pp. 41 to 43 of the early letter, and other sources can also be identified in general terms.¹⁰⁰

Finally, both letter and book contain several half-truths which together impute greater credit for originality to Fracastoro. The two opening paragraphs of the letter declare that the ancients wrote little or nothing about the general question of contagion and that Fracastoro should not be accounted foolhardy for re-examining the matter. What this little was is not made clear before Fracastoro passes on to later authors, whom he criticizes for their smug satisfaction with others' discoveries or for their inadequate explanations of contagion in terms of altered properties and bad air. No one, he says, has discussed how contagion takes place, its different types, or why only some diseases are contagious, although he qualifies this in the book by claiming that the (later) authors have all been satisfied by a reference to occult properties.¹⁰¹ Even if we refer "no one" to medieval and renaissance authors alone, this statement is not entirely true. We have already noted Pietro d'Abano's commentary on the Aristotelian *Problems*, where the question is specifically discussed. This was printed at least six times before 1525,¹⁰² and both the Aristotelian and Alexandrian *Problems*

⁹⁸ Lange, *Epist. med.* II.15: p. 619; Valles, note 140 below; J. B. Montanus, *Lectiones in secundam Fen primi Canonis Avicennae*, Venice, V. Valgrisi, 1557, pp. 437, 440.

⁹⁹ On which now see Fracastoro, *Scritti inediti*, Verona, Edizioni Valdonega, 1954, p. 26. For the knowledge of Lucretius in the Renaissance, see G. D. Hadsits, *Lucretius and his influence*, London, Harrap, 1935, pp. 257–283; W. B. Fleischmann, 'Lucretius', *Catalogus translationum et commentariorum*, II, Washington, Catholic University of America Press, 1971, pp. 356–365.

¹⁰⁰ In his introduction to the *Letter*, pp. 8–14, Pellegrini gives a good summary of Lucretian elements; cf. also *Scritti inediti*, p. 28. The Singers also drew attention to possible influences from medieval theologians like St. Augustine and Albertus Magnus on "seminal principles", possibly correctly: see now *Scritti inediti*, pp. 71–230, for Fracastoro's theological erudition.

¹⁰¹ *Letter*, p. 35f. = *On contagion*, pp. A–C, 22–24; *De sympathia*, pref., sig. iii verso – iv recto.

¹⁰² In 1475, 1482, 1501, 1519, and twice in 1520.

The seeds of disease

appeared in new Latin translations, by Theodore Gaza and Giorgio Valla, before 1500.¹⁰³ Most of the medieval Latin *Problems*, however, omit the question on the communicability of various diseases, although traces of it can be found in questions about the evil eye or involving eye diseases.¹⁰⁴

Renaissance writers on plague, and occasionally on epilepsy, acknowledge the concept of contagion in their explanations and often devoted some time to an examination of the mode of transmission and the method of action. Ficino argued for the creation of poisonous vapours in the air which on entering the body could corrupt the humours, just like poisons. Cats and dogs could act as the agents of transmission and traces of the poison could remain on walls, implements, and wood for a year unless washed, fumigated, or fired. Indeed, woollen cloth might harbour the poison still longer unless it was disinfected.¹⁰⁵ Filippo Beroaldo, another celebrated humanist and doctor, quoted with approval Seneca's belief that harmful and pestilential things lived deep in the earth and were released by earthquakes to scatter their pollution far and wide in the air.¹⁰⁶ The contagion particularly affected those closest to the sick, and it delighted to catch fire from the disease of a patient as if from a chip of wood (*fomite*) and then to be caught by others. Beroaldo's simile is very striking, and if his tract was accessible to Fracastoro, this could have been an influence on his, slightly different, emphasis on fomites in contagion.¹⁰⁷

But the workings of poison had long been ascribed to an occult or hidden quality, and explanations like that given by Ficino and his followers could well be dismissed by Fracastoro as insufficient. Yet one major figure, his acquaintance and rival Montanus, was already strongly attacking in his lectures at Padua and in his minor occasional pieces the notion that occult qualities were enough to explain contagion. This doctrine, which was totally foreign to his teachers and authorities, was for him a confession of ignorance. Occult causes had their place in explanations where manifest causes were lacking, but this was not so in plague.¹⁰⁸ For Montanus, the cause was still the immensity of putrefaction in the body brought about by putrefied air, whose own putrefaction he identified with the "something poisonous" of the Galenic tract to Piso,

¹⁰³ The versions of Gaza (1400–1476) and Valla (1447–1500) were first printed at Venice in 1489. An Italian version by Manfredi was also published in 1490. Cf. also F. E. Cranz, 'Alexander of Aphrodisias', *Catalogus translationum et commentariorum*, I, Washington, Catholic University of America Press, 1960, pp. 126–134: II, 1971, p. 419.

¹⁰⁴ B. Lawn, *The prose Salernitan questions*, London, Oxford University Press, 1979, set B. 129; R. 16. Cf. also Lawn's book, note 27 above, p. 188.

¹⁰⁵ M. Ficino, *Epidemiarum antidotus*, in J. Hasfurt, *De cognoscendis et medendis morbis ex corporum coelestium positione*, Venice, D. Zenario, 1584, fols. 197v., 198v., 219v., 220r.

¹⁰⁶ P. Beroaldus, *De terremoto et pestilentia*, Bologna, J. de Herbona, 1505, sigg. B. iiii recto, A. viii verso.

¹⁰⁷ *Ibid.*, sig. B. vi verso: *contagia morbi serpunt in proximos . . . fit autem ut morbo cubantis veluti quodam fomite succendere vicium illud protinus exultet atque in aliis concipiatur*. See below, p. 34.

¹⁰⁸ J. B. Montanus, *In libros Galeni de arte curandi ad Glauconem explanationes*, Venice. B. Constantino, 1554, fol. 175r. = *idem*, *De febre pestilenti*, in *Opuscula varia ac praeclara*, Basle, P. Perna, 1558, II, p. 388, lectures delivered c. 1541, when Caius was in Padua; *idem*, *In primi libri Canonis Avicennae primam Fen profundissima commentaria*, Venice, V. Valgrisi, B. Constantino, 1557, fol. 359f., of c. 1544; *idem*, *De characterismis februm*, *Opuscula*, II, pp. 273–280, comes from a later lecture course, perhaps of 1548.

produced partly by changes of climate, partly by vapours arising from the earth.¹⁰⁹ His remedy was to temper the air or to resort to flight, but “in flight there is no art, merely the utilization of feet”.¹¹⁰ In his lectures on Rhazes of 1540, he expounded at some length the possible causes of contagion, noting its various manifestations in *scabies*, *ophthalmia*, and plague and rejecting strongly any “spiritual” causes, like imagination.¹¹¹ He was here a little more favourable to the workings of occult causes, although still emphasizing that it was the secondary quality, putrefaction, that was responsible for the greater contagion of plague over other fevers. But these lectures are more interesting for the way in which Montanus accounted for the variations in contagion between diseases. In some, like plague or phthisis, it was due to the immensity of the putrefaction; in others, like *ophthalmia*, to the sensitivity and receptivity of the part affected; in others, as in *scabies*, to its surface manifestation.¹¹² What distinguished contagious from non-contagious pleurisy was a difference not of species, but of medium and receptivity.¹¹³ This receptivity could be either natural or induced. The lungs were very easily mortified by phthisis, as Montanus had seen in his post-mortem dissections, and the small particles of infected lung and putrefied blood cast out by spitting were so deadly that they would pass the disease on to those who stepped on them in bare feet.¹¹⁴ The putrefaction in syphilis, with its thin sharp vapour, was not of itself able to penetrate the body until its pores had been opened by the pleasure and friction of intercourse, when contagion would then inevitably occur.¹¹⁵ In all this, as Montanus himself was to argue later, there were obvious similarities to what Fracastoro was propounding and there is evidence enough that there was a lively contemporary debate on various aspects of contagion already by 1540.¹¹⁶

¹⁰⁹ *Idem*, *In libros Galeni*, fols. 175r., 177r.-v., 203r. = *Opuscula*, II, pp. 388, 392, 437.

¹¹⁰ *In libros Galeni*, fol. 193v. = *Opuscula*, II, p. 420: in fuga nulla est ars sed usus pedum.

¹¹¹ *Idem*, *In nonum librum Rhasis ad Mansorem . . . expositio*, Venice, B. Constantino, 1554, fol. 220v. = *idem*, *Medicina Universa*, Frankfurt, A. Wechel, 1587, p. 382, a discussion on the contagion of epilepsy. The date is assured by Wellcome MS. 568, which records the course of 1540 and which is with very few exceptions word-for-word identical with the printed text. Only at MS. sig. P. viii verso, 8–21 = *In nonum librum*, fol. 223v., 23 is there new material, and here Montanus ended lecture 44 and began lecture 45 with a brief recapitulation of the question so far.

¹¹² *In nonum librum*, fols. 225r.–225v., 227r.–v. = *Medicina Universa*, pp. 384–387.

¹¹³ *In nonum librum*, fol. 224r. = *Medicina Universa*, p. 385.

¹¹⁴ *In nonum librum*, fol. 225v. = *Medicina Universa*, p. 385.

¹¹⁵ *In nonum librum*, fol. 226r. = *Medicina Universa*, p. 385f.

¹¹⁶ *In nonum librum*, fol. 220r.–v. = Wellcome, MS. 568, sig. vii recto, 16–20, where he talks of many of his friends thinking that contagion can occur through the “*impressio malae qualitatis de genere qualitatum intentionalium*”, i.e. through the power of imagination. In the edition of these lectures by Crato von Krafftheim, Basle, H. Petri, P. Perna, 1562, p. 447 = *Medicina Universa*, p. 382, the text is changed to read “many people and a friend (*et amici* for *ex amicis*), who wrote on contagion. He was otherwise learned – Montanus refrains from naming him *honoris causa* – and had been warned against publication by threat of public contradiction. But though he is a friend, truth is one still greater”, and he was citing neither Galen nor Aristotle for his belief that contagion could occur through the impression of an evil quality etc. Was this anonymous Fracastoro? Against the identification is the fact that the opinion ascribed to the friend was not held by Fracastoro, and that Montanus’ view of Fracastoro’s scholarship in 1546–7 was decidedly low. However, by 1549, when Crato left Padua, Montanus had mellowed; and Crato’s text is such an obvious and extremely clumsy amplification of that of Lublin that the friend need only have written on contagion and not have held the precise doctrine originally ascribed to “many of my friends”. The question can be left open.

The seeds of disease

Indeed, there is a striking conjunction of contagion and seeds of fevers in a *consilium* of the College of Physicians of Padua, given in 1541 to the government in Venice on the causes of a deadly fever afflicting Padua. Having carefully distinguished epidemic diseases from endemic, like the suffusions of spleen, liver, and gall-bladder of Forlì, the leg tumours of Ferrara, and the goitres of Brescia, and pointed out the difference in virulence and contagiousness between pestilence and the less deadly pestilential fever, the doctors decided that they were dealing with an epidemic pestilential fever, caused by some putrefaction of the air. They rejected in turn various explanations for this local fever. The general weather had been too wet and cold to produce appropriate conditions for the general putrefaction of the air, neither were there any chasms, mines, or masses of unburied corpses in the area. Nor was the fever a disease of poverty, for all classes in society were affected and it was confined to Padua, which suffered no more and no less from the present bad harvests than any other part of Italy. The doctors equally refused to believe in astrological explanations, for the effect of the stars, if there was one, would be at best minimal, and the apparent health of mice and other burrowing animals disproved any theory of deadly underground putrefaction. The problem was a local one, for Venice, Vicenza, and other towns nearby were unaffected. The site of Padua was and had been extremely healthy, and its main river used to be sparkingly clean. There could be one culprit only: the stagnant pools and slow streams left by the heavy rain and, in particular, newly created by the locks built by the Contarini. The excrement, filth, and industrial waste, especially from the tanneries, which used to be carried swiftly away, now moved slowly along, a mass of stinking and putrefying rubbish, attracting an unprecedented mass of harmful insects. A visible cloud of filth now hung over the city; and areas by the streams were plagued by disease and insects. The blame rested fairly and squarely on the new locks. When they were open, the water flowed freely again and removed the rubbish; and although it was true that there had been locks before, they had been much less efficient and permitted a much faster flow. Ever since the new locks were installed, the city of Padua had steadily become more and more unhealthy, and the residual seeds of these poisonous fevers stayed always around, whereas formerly they had appeared rarely, or at least by no means as frequently as after the lock foundations had been laid in place.¹¹⁷

The words “*harum venenosarum febrium relicta semina*” are indeed striking, and they are reminiscent of the passage in Galen’s commentary on *Epidemics I*, a book cited by the physicians. But they in no way developed the implications in the idea of residual seeds, and the whole *consultum* was a sensible and practical piece of detection based on the standard texts. What it does show is that, at least at this point, the

J. Lange, *Medicinalium epistolarum miscellanea*, Basle, J. Oporinus, 1554, *Epp.* 16, 18, 19; pp. 59, 64, 69, may also represent a contribution to the debate from before 1546.

¹¹⁷ Printed in J. B. Montanus, *Consultationes medicae*, Basle, 1583, pp. 1106–1120: the seeds of fevers appear on p. 1117. The date is assured, as Dr Palmer showed me, by Venice, Archivio di Stato, Provveditori alla Sanità, Reg. 12, fols 96r.–97v. (cf. also fols 93v.–94r.), which records the receipt of the *consilium* and the decision of the commissioners, confirmed by the Venetian senate on 30 April 1541, that the Contarini should pull down the locks and offending structures and return the water level and flow to what it had been in 1523, and that the stagnant pools should be drained.

leading physicians of Padua saw nothing incongruous in using the metaphor of seeds alongside that of the putrefaction of the air, and that “seeds of pestilential fevers” could be talked about, even if only as a literary conceit, before the publication of *On contagion* in 1546. But the details of this *consulium* may not have been widely known; Montanus’ ideas on contagion were not put into print until his death in 1551; and Fracastoro may well have finished Book I of *On contagion* before the topic became of passionate interest to his contemporaries.

Fracastoro’s claim, then, that no one before him had discussed the different types of contagious diseases and the mechanics of contagion, if it referred only to medieval and renaissance authors, would not be as obviously wrong or revealing of his own “ignorance of the literature” as it would if it also included classical authors. Fracastoro almost certainly knew the *Problems*, for the main examples he gives of contagious diseases dandruff, *elephantiasis*, *scabies (psora)*, and plague, had long been standard there and among some doctors, and we may also assign to the *Problems*, although with less conviction, for the stories were widely known, his references to the deadly basilisk and the *katablepha*, the snake that could kill at a distance by a glance.¹¹⁸ His triple division of types of contagion into that of skin diseases, the more subtle and deeper-acting contagion entering through pores, and that breathed in, is also found adumbrated in the *Problems* tradition.¹¹⁹ And this is to make no mention of Lucretius, who provided him with both ideas and expressions.

Fracastoro’s claim to greatness cannot lie in the originality of his conception of seeds of disease or of contagion. The former went back, I have suggested, at least to Asclepiades and Lucretius; the latter was commonplace in his own day. Neither was the influence of his book immensely broad – his letter remained unread, in manuscript, until this century. He was not a professor at a leading university with many pupils throughout Europe, like Leoniceno, but a cultivated local physician, more famous for the elegance of his style and poetry,¹²⁰ including *Syphilis*, than for the penetration of his thought. Most of his manuscripts remained in disorder and decay at Verona for centuries, and *On contagion*, which enjoyed four printings before 1554, was then subsumed into the depths of the *Opera omnia* until the translations of the late-nineteenth century and Wright’s partial text of 1930.¹²¹ His ideas on contagion did not have any great effect on subsequent therapy, for, as with Galen and the Methodists before him, medical technology was not yet advanced enough to profit from his insights. Even his most effective suggestion, that diseases could be spread by fomites carried in clothing, was not new and would have raised no eyebrows among

¹¹⁸ *Letter*, p. 47: *On contagion*, pp. 20, 26, 48. It appears also in Pliny, *Nat. hist.* VIII.21.77. Note also Fracastoro’s reference to Lucretius and Alexander of Aphrodisias at *De sympathia*, p. 4v.

¹¹⁹ A fragment cited at *Letter*, p. 53: *On contagion*, p. 60, cf. the *Problems* quoted in note 27 above. Fracastoro’s triple division of contagious diseases may be his own, *On contagion*, p. 6, but cf. C. and D. Singer, *op. cit.*, note 94 above, p. 22.

¹²⁰ L. G. Giraldi, *De annis et mensibus*, Basle, M. Isingrin, 1541, p. 179, gives equal weight to his close friendship with his teacher Manardi and to the elegance of Fracastoro, and, not surprisingly, fails to decide between their opposing views on critical days.

¹²¹ Bibliography given in part by Wright in her edition, p. 346; for the *Omnia opera*, see L. Baumgartner and J. F. Fulton, *A bibliography of the poem Syphilis sive Morbus Gallicus*, New Haven, Conn., Yale University Press, 1935, pp. 60–67.

The seeds of disease

the hard-headed officials of the Italian municipal Health Boards, who had long been accustomed to burn the clothes of sufferers from plague and to impound bales of cloth coming from infected areas.¹²² At most, his ideas provided a theoretical justification for their practice, and a new metaphor for the writers of plague tracts to employ.¹²³ The list given by the Singers shows that his views of seeds and contagion were repeated by a whole string of, generally minor, authors on plague, from Spain to Hungary, from Sicily to France.¹²⁴ But even the Singers had to admit that “the views generally held were in the main retrograde as compared with his,” and Castiglioni’s harsh verdict, that his reputation rested more on his poetry and astronomy than on his medicine, may be more just.¹²⁵ Indeed, major discussions might omit all reference to him. The last great edition and commentary on Avicenna’s *Canon*, which appeared in a final revision at Venice in 1595, devoted a great deal of space to discussing the causes of putrid and pestilential fevers. Its editors, Giovanni Costeo, professor of medicine at Bologna, and Giovanni Paulo Mongio, quoted several modern examples and theories drawn especially from North Italy, but they made no mention at all of seeds, relying instead on the traditional atmospheric and dietary explanations.¹²⁶

If we reject Fracastoro’s originality, and deny him the immense range of influence of a Pasteur or a Koch, or even a Leonicensis, then we are left either with Castiglioni’s rhetorical claim for “l’integrità della figura, l’uomo del Rinascimento . . . lo scienziato e poeta, pensatore e ricercatore dei segreti della natura”,¹²⁷ or with a much more limited appreciation of his elegance and consistency as a writer and expositor. In this there is much to admire, for he went far beyond his models and predecessors in systematically applying the notions of contagion and seeds to a variety of diseases and conditions. He took up and extended the ontological implications of the Hippocratic’s classification of certain groups of symptoms as, for example, phthisis or *scabies*, and of the Methodist/Lucretian concept of seeds of specific diseases, and while leaving the possibility of a humoral, physiological explanation open for other diseases, he described contagious diseases solely and consistently in ontological terms, without reference to the balance of an individual’s temperament. He was thus fulfilling a good renaissance task of interpreting and expounding classical hints and ideas in an up-to-date way, so that the result seems markedly different from what had gone before.

This difference is exaggerated by the failure of medical historians to set Fracastoro in the proper context of North Italian medicine and science and to leave out the

¹²² R. J. Palmer, ‘The control of plague in Venice and N. Italy, 1348–1600’, Diss., University of Kent at Canterbury, 1978, pp. 9–13, 18–22.

¹²³ E.g., Lange, *Epist. med.* II.14; 15; 23: pp. 615, 620, 655; Valles, below, pp. 31–33.

¹²⁴ Palmer, *op. cit.*, note 122 above, pp. 94–98, 112–122; C. and D. Singer, *op. cit.*, note 94 above, p. 33f. But citation is not the same as understanding. I plan to study immediate reactions to Fracastoro in a second article.

¹²⁵ C. and D. Singer, *ibid.*, p. 33; A. Castiglioni, ‘Gerolamo Fracastoro e la dottrina del *contagium vivum*’, *Gesnerus*, 1950, 8: 54–65.

¹²⁶ Avicenna, *Canon medicinae*, Venice, Giunta, 1595, II, pp. 19f., 68–73.

¹²⁷ Castiglioni, *op. cit.*, note 125 above, p. 65. I pass over his odd suggestion that Fracastoro is worth remembering equally for the fact that *On contagion* was written almost (*sic*) at the same time as the masterpieces of Vesalius and Copernicus, for his first thoughts on the topic went back at least a decade. Castiglioni, however, in the middle section of this article made a valiant attempt to adjust his own interpretation to the new discoveries of Pellegrini: he has, alas, found few successors.

Middle Ages. The first book of *On contagion* is not just an argument on medicine: it is an important contribution to a long and vigorous debate among philosophers and others interested in the natural world on the problem of causation and, in particular, of action at a distance. Contagion was but one of a number of phenomena that were considered to be in some way or other related – poisons, magnets, the evil eye, the menstruating woman who caused the mirror to turn spotty, indeed, the whole realm of antipathy, sympathy, and their various causes, occult as well as manifest.¹²⁸ Not for nothing was *On contagion* always prefaced by *On antipathy and sympathy*, or understood in a context of contemporary physics. Whereas Galen and the classical authors of *Problems* were hardly concerned with deep causal explanations of the *method* of contagion, and Galen could mention both the poison of rabies and the action of the magnet only as suggestive parallels, for Fracastoro and Montanus contagion at a distance was explicable only in the same terms as them, as a medical example of a universal cause. Failure to understand that Fracastoro is sharing in a long-standing debate typical of the philosophical, scientific, and medical culture of both the Middle Ages and the Renaissance leads to a further exaggeration of his “scientific” originality. He seems more modern than Galen, not just because he is, but because the questions that he and his contemporaries were raising can easily be converted into the terms and rhetoric of modern science.¹²⁹

To the doctors of his own time, unburdened by hindsight, Fracastoro gave a whole set of fresh and striking metaphors to play with in their discussions of communicable diseases, as well as a new view of the universe based upon Lucretian atomism. Even if they rejected some or all of this, they could appreciate the way in which he applied his concepts of contagion and seeds with thoroughness, consistency, and elegance to diseases old and new. In this, his own claims to our attention, as expressed in both letter and book, are fully justified.¹³⁰ Whether this is enough to warrant some of the subsequent encomia and to rank him with Vesalius and Copernicus – “three great books and three great battles against scholasticism and absolutism”¹³¹ – is a matter not of scholarly argument but of personal prejudice.

The scattered threads of this piece can now be brought together by a consideration of two of Fracastoro’s contemporaries, both authors of commentaries on Galen’s *On the different types of fever*, who provide an eloquent contrast in their understanding

¹²⁸ Avowedly at *De sympathia*, pref., sig. iii verso (not translated by Wright). The whole argument at Montanus, *In nonum librum*, fols 219v.–227v. = *Medicina Universa*, pp. 381–387, is worth inspection. On occult causes in science and medicine, see, e.g., L. Thorndike, *A history of magic and experimental science*, V, New York, Columbia University Press, 1941, pp. 493–497, 550–562; D. P. Walker, *Spiritual and demonic magic, from Ficino to Campanella*, London, The Warburg Institute, 1958, pp. 75–84; B. P. Copenhaver, *Symphorien Champier and the reception of the occultist tradition in Renaissance France*, The Hague, Paris, and New York, Mouton, 1978. Professor Copenhaver and Andrew Wear will examine the problem of occult qualities in forthcoming articles.

¹²⁹ The basic argument of J. H. Randall jr., *The school of Padua and the emergence of modern science*, Padua, Antenore, 1961, is still valid: see, for further developments, C. B. Schmitt, *Studies in Renaissance philosophy and science*, London, Variorum reprints, 1981, essays V and VI. W. P. D. Wightman, *Science and the Renaissance*, Edinburgh, Oliver & Boyd, 1962, I, pp. 276–281, has some characteristically shrewd remarks on Fracastoro.

¹³⁰ *Letter*, p. 36: *On contagion*, pp. C–E.

¹³¹ Castiglioni, op. cit., note 125 above, p. 65

The seeds of disease

and exposition of the causes of plague and of Galen's comments on seeds. The first of them, Vettore Trincavella (1496–1563), was a leading professor at Padua, who edited jointly perhaps the best collection of Latin versions of Galen produced in the Renaissance.¹³² His commentary, the substance of his lectures, was not published until twelve years after his death, but it breathes the academic air of Padua. It begins on folio 1 with a typical Paduan disquisition on method before passing on to a very detailed commentary. Although his account of the causes of pestilential fever includes such interesting observations as that of the prevalence of goitre in the Alpine Valleys around Brescia, it sticks very closely to the ideas of Galen and his, largely Paduan, interpreters. Trincavella rightly refers his readers to *On intital causes* for Galen's demolition "to satiety" of a strict connexion between excessive heat and fever, so that he can devote more of his comments to "more useful matters". He believes in the putridity of air as a cause of pestilential fever, in the importance of the individual's own humoral state, and in the necessity for an appropriate regimen and diet. Hunger and its concomitant, plague, are particularly prevalent in war, sieges, and poor communities. But he is not interested in how the air becomes putrid, and he treats Galen's "seeds" purely as a metaphor. "There are putrid exhalations which originate from putrid matter and are, *as it were*, the seeds of putrefaction."¹³³ No need then for him to refer to Fracastoro, even if he had read him.

The story is far different with the second commentator, Francisco Valles (1524–1592), professor of medicine at Alcalà, a vigorous though not uncritical Galenist.¹³⁴ His commentary on *Epidemics* I.3 paraphrased Galen's comments without, however, mentioning anything about seeds,¹³⁵ but his commentary on *On the different types of fever* shows how he might have interpreted them there. For Valles, Galen's references to seeds were more than chance metaphors, and he explained Galen's example at I.6, to my mind correctly, on the grounds that Galen was proposing two alternative hypotheses for why an individual caught the plague, each of which involved the same external cause, "some seeds of pestilence (*nonnulla pestilentiae semina*)".¹³⁶ Although at this point in the commentary Valles said nothing in detail about these seeds, in his general discussion of the causes of fever a few pages earlier he had made his views clear.¹³⁷

How contagion occurs and what diseases are contagious I have already stated in the last section of the fourth book of my *Controversies*, entitled *On sympathy and antipathy*, where I have given my solution to the problems here under discussion. It is worth repeating just one thing: no contagion of disease can occur without the transmission of something from the already infected person to the person who is being

¹³² R. J. Durling, 'Lectiones Galenicæ', *Class. Philology*, 1968, 63: 57. Ricci may have been the acuter critic.

¹³³ V. Trincavella, *Omnia opera*, Lyons, Giunta and Guittius, 1586, fols. 19–20: fol. 19b: Qui ab aliqua putri materia ortum habuere, et sunt *veluti semina putrefactionis*. His tract on plague contained in the same volume, fols 146–155, repeats the same ideas, with ample quotations from Galen.

¹³⁴ E. Ortega and B. Marcos, *Francisco de Valles*, Madrid, Clásica Española, 1914, is not entirely superseded.

¹³⁵ *In libros Hippocratis de morbis popularibus commentaria*, Madrid, F. Sanchez, 1577, fol. 28r.–v.

¹³⁶ I have not cited it from the first edition, Alcalà, A. de Angulo, 1569, but from the later and more accessible *Commentaria illustrata in Cl. Galeni libros*, Cologne, F. de Franciscis and J. B. Ciottus, 1594, p. 625f.

¹³⁷ *Ibid.*, pp. 611–613.

infected. That is agreed, since every natural action occurs by contact There are thus sent out seeds of contagion, which are some sort of defilements, from the sufferer to the person about to be affected by contagion.

These defilements (*inquinamenta*) particularly affect the thorax (and occasionally the head, which acts partly as the respirator for the brain), the skin, and whatever parts are similar to their original site. Therefore, one should avoid the dangerous contact with sufferers from asthma, phthisis, pneumonia, leprosy, *scabies*, *ophthalmia*, vitiligo, and syphilis, and remember that it is not safe to associate with sufferers from pleurisy, frenzy, lethargy, or colds. Fever of itself is not contagious, but some of its forms, like that of plague, are extremely contagious. He ends this part of his exposition by referring his readers to Galen's *On initial causes* for a further and conclusive proof of the necessity for these external causes.

Before following up Valles' self-citation, in which he explicitly acknowledges Fracastoro's precedence, one further observation must be made. Valles is going beyond Fracastoro in positing two classes of contagious diseases, one to be avoided at all costs, the other to be approached with circumspection. This second group appears ill-assorted to the modern mind. We can readily accept pleurisy and the common cold as contagious, but what of frenzy and lethargy? Neither is mentioned by Fracastoro, but some versions of the famous *Salernitan Regimen* substituted frenzy for leprosy in their list of contagious diseases.¹³⁸ Valles may be referring here to what we would recognize as symptoms of other diseases – Sudhoff suggested typhus or meningitis for frenzy in the Salernitan list, and in lethargy there might lurk some form of meningitis – or he may be thinking of some psychosomatic disorder that would now be explained in modern terms of mass hysteria or depression.

If we now turn to Valles' *Controversiarum medicarum et philosophicarum libri decem*, we discover a lengthy discussion of diseases and their causes in which Valles takes issue with his contemporaries and instructs them at length in the doctrine of causation as set out in *On initial causes*.¹³⁹ But Valles is no strict Galenist, for he views the opinions of Epicurus and Asclepiades on the structure of the body with a certain sympathy,¹⁴⁰ rightly noting that both they and Galen considered health to be some sort of balance between either humours or atoms and pores. When he comes to discuss the question of sympathetic disorders and contagion, he acknowledges a debt to Fracastoro: "A certain neoteric, Fracastoro by name, has written particularly on this, with no small learning or acumen."¹⁴¹ Valles' borrowings are clear in both vocabulary and ideas. Naturally, when some part of the body is ailing, all other similar parts near to it are brought into contact (*contagio*) with it and suffer similar pains. But, as Galen pointed out, some "sympathy" is apparently brought about by some occult property or cause, although this is impossible, visibly or invisibly. In formulating his explana-

¹³⁸ Sudhoff, *op. cit.*, note 78 above, pp. 224, 227.

¹³⁹ F. Valles, *Controversiarum medicarum et philosophicarum libri X*, Alcalà, J. Brocarius, 1556, IV.4: fol. 70r.–v. The wording of the passages cited does not differ between the many subsequent editions.

¹⁴⁰ *Ibid.*, IV.1: fol. 65r.

¹⁴¹ *Ibid.*, IV.5: fol. 78v.: scripsit etiam praeter alios de his quidam neotericus Fracastorius nomine, non parum erudite et acute. Fracastoro's *De sympathia* was always printed with and as an introduction to *On contagion*.

The seeds of disease

tion for such physical disorders, Valles at first uses such expressions as “noxious effluvium” (*noxium quoddam effluvium*) and “contagion”, but later, in his discussion of the evil eye, *fascinatio*, he talks of seeds, *semina*. The general view, that a person can be harmed by receiving a long hard stare from someone else, is to Valles nonsense. The truth is that vapours are sent out which carry the seeds of contagion; for this “sympathy” cannot occur without the transfer of some substance or poisonous quality from and to suitable subjects.¹⁴² A clean and healthy man cannot infect anyone, unlike a man with a contagious disease or a menstruating woman; and no strong man can be bewitched by the evil eye, but only a weak baby (*tenellus infans*).

But not every apparent sympathetic disturbance is caused by seeds and effluvia. There is a place for imagination, for the power of mind to affect the body.¹⁴³ A man who feels his own tooth aching on looking at a man with a toothache has not been bewitched. He is in fact suffering, but not through anything emitted or passed on. His imagination, the ruling power in his brain, has awakened him to the realization of the existence of the pain in himself, which had previously been too small to notice. “For the imagination makes us feel discomfort; it does not create the discomfort itself.” Similarly, it is not imagination by itself that makes a small boy urinate the moment he thinks of urination. Imagination always precedes decision, and as we think of something, the relevant muscles begin to prepare themselves for the action consequent on decision: they are working by agreement (*consensus*). So if, as in small boys, the muscle at the neck of the bladder is weak and unsure, it may be unable to perform with full control, and instead of relaxing very gradually, does so fully at once and so permits premature urination. There is no need to explain this in terms of sympathy or occult properties: rather, this is a good example of the way in which the body works, thinks, and even conspires together to fulfil its various tasks.

Valles, then, in his commentary and book, accepts some of Fracastoro’s ideas but only to a limited extent. He accepts the importance of contagion in a whole range of diseases but shows little interest in the hypothetical mechanics of their transmission. It matters little to him whether infection occurs through seeds, effluvia, defilements, or simply air – one metaphor is as good as another –, and his discussion of the power of thought moves away from the type of sympathy that Fracastoro had described in *On sympathy* and in the preface to *On contagion*. Valles can be added to the list of those who were influenced by Fracastoro’s ideas, but he was too independent (and possibly too much a lover of Galen)¹⁴⁴ to assent to them entirely.

The search for seeds of plague and disease has led us far away from our original starting-point. We have seen how later generations interpreted three of Galen’s statements or simply ignored them and we have speculated about the origins of this theory, which Galen for a time regarded seriously, and we have discussed the possible sources available to its most famous adherent, Fracastoro. This is in more than one sense, the

¹⁴² Ibid.: fol. 80r.: immissis vaporibus qui defferunt semina contagii.

¹⁴³ Ibid.: fol. 80r.–v. Cf. V. Peset Llorca, *La psiquiatria de un medico humanista*, Madrid, Ediciones Castilla, 1961, pp. 34–36, a sound discussion. His comments on frenzy and lethargy, p. 20f., ignore the passage here discussed.

¹⁴⁴ Ibid., pref.; I.1: fols. 2v.–3r.

history of a medical idea, for, it should again be emphasized, none of the authors mentioned in this article ever saw any of the seeds, animalcula, or aerial poisons that they described so graphically. Theirs was the eye of logic, or, as some would say with almost equal justice, the eye of faith: and faith had its reward in the bacteriological revolution of the nineteenth century. But we should not forget the losers in all this, not Galen, or even Lucretius, but the Democriteans, the Methodists, who, I have argued, first brought the idea of seeds into direct relationship with practical medicine. The idea of specific diseases goes back at least to them, and was easily assimilable to their view of a world constantly subject to change and infinite variety in its atoms and pores. But their doctrines were gradually filtered out in the process of time, and, particularly in the Greek world, Galen and his Hippocratism came to dominate medical thought. Democritean Methodism survived, where it did, outside the medical mainstream, in the *Problems*, in Caelius Aurelianus, and in Plutarch, and when the Arabs and the Middle Ages came to develop the idea of contagion, they did so with a conceptual framework that hampered them from enquiring too deeply into the processes of contagion and the transfer of disease. It was, in particular, Fracastoro's reception of a new world-view in Lucretian atomism that enabled him to combine and expand the ideas of his predecessors to produce an ontological theory of contagious diseases. Although he believed in humours, his contagious diseases did not depend for their effect upon a particular humoral predisposition, and although such a disease might attack and corrupt one humour only, its onset and activity were independent of an individual's humoral balance. Similarly, the treatment of such a contagious disease was by specifics which worked on the seeds of disease whether a patient was phlegmatic or choleric. In other diseases, common principles of plethora or distemper would suffice, and standard "physiological" explanations and therapies would account for and relieve the individual's complaint. But in contagions, once destroy, expel, or break up the seeds, and the disease would not progress further.¹⁴⁵ Yet in the end, even Fracastoro's forceful rhetoric and limpid exposition could not overcome the technological handicaps that any theory of seeds then faced. Better to treat the patient visible before the doctor and to avoid malodorous miasmata than to chase unprofitably after invisible and hypothetical seeds.¹⁴⁶

¹⁴⁵ Fracastoro, *On contagion*, pp. 184, 190.

¹⁴⁶ Many friends and colleagues have helped in the preparation of this paper, and I should like to thank in particular Faye Getz, Iain Lonie, Walter Pagel, Richard Palmer, Andrew Wear, and Lise Wilkinson, who commented on earlier drafts of this article. The errors and imperfections that remain are my own.

ADDENDUM TO p. 25, n. 107

A much more likely source for the metaphor of *fomes* is theology. According to many theologians, from the fourth century onwards, even after baptism or penance had wiped away sin (which is often termed a disease or contagion), there still remained some *fomes peccati* (concupiscence), which inclined man towards evil, but which could be checked by true belief and Christian living. See, for example, St Thomas Aquinas, *apud* L. Schütz, *Thomas-Lexikon*, Paderborn, Schöningh, 1895, s.v. *fomes*; G. Biel, *Collectorium circa quatuor libros Sententiarum*, ed. W. Werbeck, U. Hofmann, IV.1, Tübingen, J. C. B. Mohr, 1975, p. 155f. Fracastoro was no mean theologian himself, writing a dialogue on Grace, see note 100 above, and the parallel between his *fomes morbi* and the theologians' *fomes peccati* is very close. The doctrine of *fomes peccati* was formally proclaimed on 17 June 1546 by the Council of Trent, which Fracastoro attended as doctor to the Council, see *Canones et decreta concilii Tridentini*, Leipzig, Tauchnitz, 1887, Sessio V, p. 20; E. A. Barletta, *La depositaria del concilio di Trento*, Rome, Archivio di Stato, 1970, pp. 85f., 159, showing Fracastoro being paid from 17 March 1546.