Aristotle
Parva Naturalia
translated by J. I. Beare and G.R.T. Ross

On Sense and the Sensible
translated by J. I. Beare

1

Having now definitely considered the soul, by itself, and its several faculties, we must next make a survey of animals and all living things, in order to ascertain what functions are peculiar, and what functions are common, to them. What has been already determined respecting the soul [sc. by itself] must be assumed throughout. The remaining parts [sc. the attributes of soul and body conjointly] of our subject must be now dealt with, and we may begin with those that come first.

The most important attributes of animals, whether common to all or peculiar to some, are, manifestly, attributes of soul and body in conjunction, e.g. sensation, memory, passion, appetite and desire in general, and, in addition pleasure and pain. For these may, in fact, be said to belong to all animals. But there are, besides these, certain other attributes, of which some are common to all living things, while others are peculiar to certain species of animals. The most important of these may be summed up in four pairs, viz. waking and sleeping, youth and old age, inhalation and exhalation, life and death. We must endeavour to arrive at a scientific conception of these, determining their respective natures, and the causes of their occurrence.

But it behoves the Physical Philosopher to obtain also a clear view of the first principles of health and disease, inasmuch as neither health nor disease can exist in lifeless things. Indeed we may say of most physical inquirers, and of those physicians who study their art philosophically, that while the former complete their works with a disquisition on medicine, the latter usually base their medical theories on principles derived from Physics.

That all the attributes above enumerated belong to soul and body in conjunction, is obvious; for they all either imply sensation as a concomitant, or have it as their medium. Some are either affections or states of sensation, others, means of defending and safe-guarding it, while others, again, involve its destruction or negation. Now it is clear, alike by reasoning and observation, that sensation is generated in the soul through the medium of the body.

We have already, in our treatise On the Soul, explained the nature of sensation and the act of perceiving by sense, and the reason why this affection belongs to animals. Sensation must, indeed, be attributed to all animals as such, for by its presence or absence we distinguish essentially between what is and what is not an animal.

But coming now to the special senses severally, we may say that touch and taste necessarily appertain to all animals, touch, for the reason given in On the Soul, and taste, because of nutrition. It is by taste that one distinguishes in food the pleasant from the unpleasant, so as to flee from the latter and pursue the former: and savour in general is an affection of nutrient matter.

The senses which operate through external media, viz. smelling, hearing, seeing, are found in all animals which possess the faculty of locomotion. To all that possess them they are a means of preservation; their final cause being that such creatures may, guided by antecedent perception, both pursue their food, and shun things that are bad or destructive. But in animals which have also intelligence they serve for the attainment of a higher perfection. They bring in tidings of many

distinctive qualities of things, from which the knowledge of truth, speculative and practical, is generated in the soul.

Of the two last mentioned, seeing, regarded as a supply for the primary wants of life, and in its direct effects, is the superior sense; but for developing intelligence, and in its indirect consequences, hearing takes the precedence. The faculty of seeing, thanks to the fact that all bodies are coloured, brings tidings of multitudes of distinctive qualities of all sorts; whence it is through this sense especially that we perceive the common sensibles, viz. figure, magnitude, motion, number: while hearing announces only the distinctive qualities of sound, and, to some few animals, those also of voice. indirectly, however, it is hearing that contributes most to the growth of intelligence. For rational discourse is a cause of instruction in virtue of its being audible, which it is, not directly, but indirectly; since it is composed of words, and each word is a thought-symbol. Accordingly, of persons destitute from birth of either sense, the blind are more intelligent than the deaf and dumb.

2

Of the distinctive potency of each of the faculties of sense enough has been said already.

But as to the nature of the sensory organs, or parts of the body in which each of the senses is naturally implanted, inquirers now usually take as their guide the fundamental elements of bodies. Not, however, finding it easy to coordinate five senses with four elements, they are at a loss respecting the fifth sense. But they hold the organ of sight to consist of fire, being prompted to this view by a certain sensory affection of whose true cause they are ignorant. This is that, when the eye is pressed or moved, fire appears to flash from it. This naturally takes place in darkness, or when the eyelids are closed, for then, too, darkness is produced.

This theory, however, solves one question only to raise another; for, unless on the hypothesis that a person who is in his full senses can see an object of vision without being aware of it, the eye must on this theory see itself. But then why does the above affection not occur also when the eye is at rest? The true explanation of this affection, which will contain the answer to our question, and account for the current notion that the eye consists of fire, must be determined in the following way: Things which are smooth have the natural property of shining in darkness, without, however, producing light. Now, the part of the eye called ‘the black’, i.e. its central part, is manifestly smooth. The phenomenon of the flash occurs only when the eye is moved, because only then could it possibly occur that the same one object should become as it were two. The rapidity of the movement has the effect of making that which sees and that which is seen seem different from one another. Hence the phenomenon does not occur unless the motion is rapid and takes place in darkness. For it is in the dark that that which is smooth, e.g. the heads of certain fishes, and the sepia of the cuttle-fish, naturally shines, and, when the movement of the eye is slow, it is impossible that that which sees and that which is seen should appear to be simultaneously two and one. But, in fact, the eye sees itself in the above phenomenon merely as it does so in ordinary optical reflexion.

If the visual organ proper really were fire, which is the doctrine of Empedocles, a doctrine taught also in the Timaeus, and if vision were the result of light issuing from the eye as from a lantern, why should the eye not have had the power of seeing even in the dark? It is totally idle to say, as the Timaeus does, that the visual ray coming forth in the darkness is quenched. What is the meaning of this ‘quenching’ of light? That which, like a fire of coals or an ordinary flame, is hot and dry is, indeed, quenched by the moist or cold; but heat and dryness are evidently not attributes of light. Or if they are attributes of it, but belong to it in a degree so slight as to be imperceptible to us, we

should have expected that in the daytime the light of the sun should be quenched when rain falls, and that darkness should prevail in frosty weather. Flame, for example, and ignited bodies are subject to such extinction, but experience shows that nothing of this sort happens to the sunlight.
Empedocles at times seems to hold that vision is to be explained as above stated by light issuing forth from the eye, e.g. in the following passage: –
As when one who purposes going abroad prepares a lantern,
A gleam of fire blazing through the stormy night,
Adjusting thereto, to screen it from all sorts of winds,
transparent sides,
Which scatter the breath of the winds as they blow,
While, out through them leaping, the fire,
i.e. all the more subtile part of this,
Shines along his threshold old incessant beams:
So [Divine love] embedded the round "lens", [viz.]
the primaeval fire fenced within the membranes,
In [its own] delicate tissues;
And these fended off the deep surrounding flood,
While leaping forth the fire, i.e. all its more subtile part. –
Sometimes he accounts for vision thus, but at other times he explains it by emanations from the visible objects.
Democritus, on the other hand, is right in his opinion that the eye is of water; not, however, when he goes on to explain seeing as mere mirroring. The mirroring that takes place in an eye is due to the fact that the eye is smooth, and it really has its seat not in the eye which is seen, but in that which sees. For the case is merely one of reflexion. But it would seem that even in his time there was no scientific knowledge of the general subject of the formation of images and the phenomena of reflexion. It is strange too, that it never occurred to him to ask why, if his theory be true, the eye alone sees, while none of the other things in which images are reflected do so.
True, then, the visual organ proper is composed of water, yet vision appertains to it not because it is so composed, but because it is translucent – a property common alike to water and to air. But water is more easily confined and more easily condensed than air; wherefore it is that the pupil, i.e. the eye proper, consists of water. That it does so is proved by facts of actual experience. The substance which flows from eyes when decomposing is seen to be water, and this in undeveloped embryos is remarkably cold and glistening. In sanguineous animals the white of the eye is fat and oily, in order that the moisture of the eye may be proof against freezing. Wherefore the eye is of all parts of the body the least sensitive to cold: no one ever feels cold in the part sheltered by the eyelids. The eyes of bloodless animals are covered with a hard scale which gives them similar protection.
It is, to state the matter generally, an irrational notion that the eye should see in virtue of something issuing from it; that the visual ray should extend itself all the way to the stars, or else go out merely to a certain point, and there coalesce, as some say, with rays which proceed from the object. It would be better to suppose this coalescence to take place in the fundament of the eye itself. But even this would be mere trifling. For what is meant by the ‘coalescence’ of light with light? Or how is it possible? Coalescence does not occur between any two things taken at random. And how could the light within the eye coalesce with that outside it? For the environing membrane comes between them.
That without light vision is impossible has been stated elsewhere; but, whether the medium between the eye and its objects is air or light, vision is caused by a process through this medium.

Accordingly, that the inner part of the eye consists of water is easily intelligible, water being translucent.

Now, as vision outwardly is impossible without [extra-organic] light, so also it is impossible inwardly [without light within the organ]. There must, therefore, be some translucent medium within the eye, and, as this is not air, it must be water. The soul or its perceptive part is not situated at the external surface of the eye, but obviously somewhere within: whence the necessity of the interior of the eye being translucent, i.e. capable of admitting light. And that it is so is plain from actual occurrences. It is matter of experience that soldiers wounded in battle by a sword slash on the temple, so inflicted as to sever the passages of [i.e. inward from] the eye, feel a sudden onset of darkness, as if a lamp had gone out; because what is called the pupil, i.e. the translucent, which is a sort of inner lamp, is then cut off [from its connexion with the soul].

Hence, if the facts be at all as here stated, it is clear that – if one should explain the nature of the sensory organs in this way, i.e. by correlating each of them with one of the four elements, – we must conceive that the part of the eye immediately concerned in vision consists of water, that the part immediately concerned in the perception of sound consists of air, and that the sense of smell consists of fire. (I say the sense of smell, not the organ.) For the organ of smell is only potentially that which the sense of smell, as realized, is actually; since the object of sense is what causes the actualization of each sense, so that it (the sense) must (at the instant of actualization) be (actually) that which before (the moment of actualization) it was potentially. Now, odour is a smoke-like evaporation, and smoke-like evaporation arises from fire. This also helps us to understand why the olfactory organ has its proper seat in the environment of the brain, for cold matter is potentially hot. In the same way must the genesis of the eye be explained. Its structure is an offshoot from the brain, because the latter is the moistest and coldest of all the bodily parts.

The organ of touch proper consists of earth, and the faculty of taste is a particular form of touch. This explains why the sensory organ of both touch and taste is closely related to the heart. For the heart as being the hottest of all the bodily parts, is the counterpoise of the brain.

This then is the way in which the characteristics of the bodily organs of sense must be determined.

3

Of the sensibles corresponding to each sensory organ, viz. colour, sound, odour, savour, touch, we have treated in On the Soul in general terms, having there determined what their function is, and what is implied in their becoming actualized in relation to their respective organs. We must next consider what account we are to give of any one of them; what, for example, we should say colour is, or sound, or odour, or savour; and so also respecting [the object of] touch. We begin with colour.

Now, each of them may be spoken of from two points of view, i.e. either as actual or as potential. We have in On the Soul explained in what sense the colour, or sound, regarded as actualized [for sensation] is the same as, and in what sense it is different from, the correlative sensation, the actual seeing or hearing. The point of our present discussion is, therefore, to determine what each sensible object must be in itself, in order to be perceived as it is in actual consciousness.

We have already in On the Soul stated of Light that it is the colour of the Translucent, [being so related to it] incidentally; for whenever a fiery element is in a translucent medium presence there is Light; while the privation of it is Darkness. But the ‘Translucent’, as we call it, is not something peculiar to air, or water, or any other of the bodies usually called translucent, but is a common ‘nature’ and power, capable of no separate existence of its own, but residing in these, and subsisting likewise in all other bodies in a greater or less degree. As the bodies in which it subsists must have some extreme bounding surface, so too must this. Here, then, we may say that Light is a

‘nature’ inhering in the Translucent when the latter is without determinate boundary. But it is manifest that, when the Translucent is in determinate bodies, its bounding extreme must be something real; and that colour is just this ‘something’ we are plainly taught by facts – colour being actually either at the external limit, or being itself that limit, in bodies. Hence it was that the Pythagoreans named the superficies of a body its ‘hue’, for ‘hue’, indeed, lies at the limit of the body; but the limit of the body; is not a real thing; rather we must suppose that the same natural substance which, externally, is the vehicle of colour exists [as such a possible vehicle] also in the interior of the body.

Air and water, too [i.e. as well as determinately bounded bodies] are seen to possess colour; for their brightness is of the nature of colour. But the colour which air or sea presents, since the body in which it resides is not determinately bounded, is not the same when one approaches and views it close by as it is when one regards it from a distance; whereas in determinate bodies the colour presented is definitely fixed, unless, indeed, when the atmospheric environment causes it to change. Hence it is clear that that in them which is susceptible of colour is in both cases the same. It is therefore the Translucent, according to the degree to which it subsists in bodies (and it does so in all more or less), that causes them to partake of colour. But since the colour is at the extremity of the body, it must be at the extremity of the Translucent in the body. Whence it follows that we may define colour as the limit of the Translucent in determinately bounded body. For whether we consider the special class of bodies called translucent, as water and such others, or determinate bodies, which appear to possess a fixed colour of their own, it is at the exterior bounding surface that all alike exhibit their colour.

Now, that which when present in air produces light may be present also in the Translucent which pervades determinate bodies; or again, it may not be present, but there may be a privation of it. Accordingly, as in the case of air the one condition is light, the other darkness, in the same way the colours White and Black are generated in determinate bodies.

We must now treat of the other colours, reviewing the several hypotheses invented to explain their genesis.

(1) It is conceivable that the White and the Black should be juxtaposed in quantities so minute that [a particle of] either separately would be invisible, though the joint product [of two particles, a black and a white] would be visible; and that they should thus have the other colours for resultants. Their product could, at all events, appear neither white nor black; and, as it must have some colour, and can have neither of these, this colour must be of a mixed character – in fact, a species of colour different from either. Such, then, is a possible way of conceiving the existence of a plurality of colours besides the White and Black; and we may suppose that [of this ‘plurality’] many are the result of a [numerical] ratio; for the blacks and whites may be juxtaposed in the ratio of 3 to 2 or of 3 to 4, or in ratios expressible by other numbers; while some may be juxtaposed according to no numerically expressible ratio, but according to some relation of excess or defect in which the blacks and whites involved would be incommensurable quantities; and, accordingly, we may regard all these colours [viz. all those based on numerical ratios] as analogous to the sounds that enter into music, and suppose that those involving simple numerical ratios, like the concords in music, may be those generally regarded as most agreeable; as, for example, purple, crimson, and some few such colours, their fewness being due to the same causes which render the concords few. The other compound colours may be those which are not based on numbers. Or it may be that, while all colours whatever [except black and white] are based on numbers, some are regular in this respect, others irregular; and that the latter [though now supposed to be all based on numbers], whenever they are not pure, owe this character to a corresponding impurity in [the arrangement of]

their numerical ratios. This then is one conceivable hypothesis to explain the genesis of intermediate colours.

(2) Another is that the Black and White appear the one through the medium of the other, giving an effect like that sometimes produced by painters overlaying a less vivid upon a more vivid colour, as when they desire to represent an object appearing under water or enveloped in a haze, and like that produced by the sun, which in itself appears white, but takes a crimson hue when beheld through a fog or a cloud of smoke. On this hypothesis, too, a variety of colours may be conceived to arise in the same way as that already described; for between those at the surface and those underneath a definite ratio might sometimes exist; in other cases they might stand in no determinate ratio. To [introduce a theory of colour which would set all these hypotheses aside, and] say with the ancients that colours are emanations, and that the visibility of objects is due to such a cause, is absurd. For they must, in any case, explain sense-perception through Touch; so that it were better to say at once that visual perception is due to a process set up by the perceived object in the medium between this object and the sensory organ; due, that is, to contact [with the medium affected,] not to emanations. If we accept the hypothesis of juxtaposition, we must assume not only invisible magnitude, but also imperceptible time, in order that the succession in the arrival of the stimulatory movements may be unperceived, and that the compound colour seen may appear to be one, owing to its successive parts seeming to present themselves at once. On the hypothesis of superposition, however, no such assumption is needful: the stimulatory process produced in the medium by the upper colour, when this is itself unaffected, will be different in kind from that produced by it when affected by the underlying colour. Hence it presents itself as a different colour, i.e. as one which is neither white nor black. So that, if it is impossible to suppose any magnitude to be invisible, and we must assume that there is some distance from which every magnitude is visible, this superposition theory, too [i.e. as well as No. 3 infra], might pass as a real theory of colour-mixture. Indeed, in the previous case also there is no reason why, to persons at a distance from the juxtaposed blacks and whites, some one colour should not appear to present itself as a blend of both. [But it would not be so on a nearer view], for it will be shown, in a discussion to be undertaken later on, that there is no magnitude absolutely invisible.

(3) There is a mixture of bodies, however, not merely such as some suppose, i.e. by juxtaposition of their minimal parts, which, owing to [the weakness of our] sense, are imperceptible by us, but a mixture by which they [i.e. the 'matter' of which they consist] are wholly blent together by interpenetration, as we have described it in the treatise on Mixture, where we dealt with this subject generally in its most comprehensive aspect. For, on the supposition we are criticizing, the only totals capable of being mixed are those which are divisible into minimal parts, [e.g. genera into individuals] as men, horses, or the [various kinds of] seeds. For of mankind as a whole the individual man is such a least part; of horses [as an aggregate] the individual horse. Hence by the juxtaposition of these we obtain a mixed total, consisting [like a troop of cavalry] of both together; but we do not say that by such a process any individual man has been mixed with any individual horse. Not in this way, but by complete interpenetration [of their matter], must we conceive those things to be mixed which are not divisible into minima; and it is in the case of these that natural mixture exhibits itself in its most perfect form. We have explained already in our discourse 'On Mixture' how such mixture is possible. This being the true nature of mixture, it is plain that when bodies are mixed their colours also are necessarily mixed at the same time; and [it is no less plain] that this is the real cause determining the existence of a plurality of colours – not superposition or juxtaposition. For when bodies are thus mixed, their resultant colour presents itself as one and the same at all distances alike; not varying as it is seen nearer or farther away.

Colours will thus, too [as well as on the former hypotheses], be many in number on account of the fact that the ingredients may be combined with one another in a multitude of ratios; some will be based on determinate numerical ratios, while others again will have as their basis a relation of quantitative excess or defect not expressible in integers. And all else that was said in reference to the colours, considered as juxtaposed or superposed, may be said of them likewise when regarded as mixed in the way just described.
Why colours, as well as savours and sounds, consist of species determinate [in themselves] and not infinite [in number] is a question which we shall discuss hereafter.

4
We have now explained what colour is, and the reason why there are many colours; while before, in our work On the Soul, we explained the nature of sound and voice. We have next to speak of Odour and Savour, both of which are almost the same physical affection, although they each have their being in different things. Savours, as a class, display their nature more clearly to us than Odours, the cause of which is that the olfactory sense of man is inferior in acuteness to that of the lower animals, and is, when compared with our other senses, the least perfect of Man's sense of Touch, on the contrary, excels that of all other animals in fineness, and Taste is a modification of Touch.
Now the natural substance water per se tends to be tasteless. But [since without water tasting is impossible] either (a) we must suppose that water contains in itself [uniformly diffused through it] the various kinds of savour, already formed, though in amounts so small as to be imperceptible, which is the doctrine of Empedocles; or (b) the water must be a sort of matter, qualified, as it were, to produce germs of savours of all kinds, so that all kinds of savour are generated from the water, though different kinds from its different parts, or else (c) the water is in itself quite undifferentiated in respect of savour [whether developed or undeveloped], but some agent, such for example as one might conceive Heat or the Sun to be, is the efficient cause of savour.
(a) Of these three hypotheses, the falsity of that held by Empedocles is only too evident. For we see that when pericarpal fruits are plucked [from the tree] and exposed in the sun, or subjected to the action of fire, their sapid juices are changed by the heat, which shows that their qualities are not due to their drawing anything from the water in the ground, but to a change which they undergo within the pericarp itself; and we see, moreover, that these juices, when extracted and allowed to lie, instead of sweet become by lapse of time harsh or bitter, or acquire savours of any and every sort; and that, again, by the process of boiling or fermentation they are made to assume almost all kinds of new savours.
(b) It is likewise impossible that water should be a material qualified to generate all kinds of Savour germs [so that different savours should arise out of different parts of the water]; for we see different kinds of taste generated from the same water, having it as their nutriment.
(C) It remains, therefore, to suppose that the water is changed by passively receiving some affection from an external agent. Now, it is manifest that water does not contract the quality of sapidity from the agency of Heat alone. For water is of all liquids the thinnest, thinner even than oil itself, though oil, owing to its viscosity, is more ductile than water, the latter being uncohesive in its particles; whence water is more difficult than oil to hold in the hand without spilling. But since perfectly pure water does not, when subjected to the action of Heat, show any tendency to acquire consistency, we must infer that some other agency than heat is the cause of sapidity. For all savours [i.e. sapid liquors] exhibit a comparative consistency. Heat is, however, a coagent in the matter.
Now the sapid juices found in pericarpal fruits evidently exist also in the earth. Hence many of the old natural philosophers assert that water has qualities like those of the earth through which it

flows, a fact especially manifest in the case of saline springs, for salt is a form of earth. Hence also when liquids are filtered through ashes, a bitter substance, the taste they yield is bitter. There are many wells, too, of which some are bitter, others acid, while others exhibit other tastes of all kinds. As was to be anticipated, therefore, it is in the vegetable kingdom that tastes occur in richest variety. For, like all things else, the Moist, by nature's law, is affected only by its contrary; and this contrary is the Dry. Thus we see why the Moist is affected by Fire, which as a natural substance, is dry. Heat is, however, the essential property of Fire, as Dryness is of Earth, according to what has been said in our treatise on the elements. Fire and Earth, therefore, taken absolutely as such, have no natural power to affect, or be affected by, one another; nor have any other pair of substances. Any two things can affect, or be affected by, one another only so far as contrariety to the other resides in either of them.

As, therefore, persons washing Colours or Savours in a liquid cause the water in which they wash to acquire such a quality [as that of the colour or savour], so nature, too, by washing the Dry and Earthy in the Moist, and by filtering the latter, that is, moving it on by the agency of heat through the dry and earthy, imparts to it a certain quality. This affection, wrought by the aforesaid Dry in the Moist, capable of transforming the sense of Taste from potentiality to actuality, is Savour. Savour brings into actual exercise the perceptive faculty which pre-existed only in potency. The activity of sense-perception in general is analogous, not to the process of acquiring knowledge, but to that of exercising knowledge already acquired.

That Savours, either as a quality or as the privation of a quality, belong not to every form of the Dry but to the Nutrient, we shall see by considering that neither the Dry without the Moist, nor the Moist without the Dry, is nutrient. For no single element, but only composite substance, constitutes nutriment for animals. Now, among the perceptible elements of the food which animals assimilate, the tangible are the efficient causes of growth and decay; it is qua hot or cold that the food assimilated causes these; for the heat or cold is the direct cause of growth or decay. It is qua gustable, however, that the assimilated food supplies nutrition. For all organisms are nourished by the Sweet [i.e. the 'gustable' proper], either by itself or in combination with other savours. Of this we must speak with more precise detail in our work on Generation: for the present we need touch upon it only so far as our subject here requires. Heat causes growth, and fits the food-stuff for alimentation; it attracts [into the organic system] that which is light [viz. the sweet], while the salt and bitter it rejects because of their heaviness. In fact, whatever effects external heat produces in external bodies, the same are produced by their internal heat in animal and vegetable organisms. Hence it is [i.e. by the agency of heat as described] that nourishment is effected by the sweet. The other savours are introduced into and blended in food [naturally] on a principle analogous to that on which the saline or the acid is used artificially, i.e. for seasoning. These latter are used because they counteract the tendency of the sweet to be too nutrient, and to float on the stomach.

As the intermediate colours arise from the mixture of white and black, so the intermediate savours arise from the Sweet and Bitter; and these savours, too, severally involve either a definite ratio, or else an indefinite relation of degree, between their components, either having certain integral numbers at the basis of their mixture, and, consequently, of their stimulative effect, or else being mixed in proportions not arithmetically expressible. The tastes which give pleasure in their combination are those which have their components joined in a definite ratio.

The sweet taste alone is Rich, [therefore the latter may be regarded as a variety of the former], while [so far as both imply privation of the Sweet] the Saline is fairly identical with the Bitter. Between the extremes of sweet and bitter come the Harsh, the Pungent, the Astringent, and the Acid. Savours and Colours, it will be observed, contain respectively about the same number of species. For there are seven species of each, if, as is reasonable, we regard Dun [or Grey] as a

variety of Black (for the alternative is that Yellow should be classed with White, as Rich with Sweet); while [the irreducible colours, viz.] Crimson, Violet, leek-Green, and deep Blue, come between White and Black, and from these all others are derived by mixture.

Again, as Black is a privation of White in the Translucent, so Saline or Bitter is a privation of Sweet in the Nutrient Moist. This explains why the ash of all burnt things is bitter; for the potable [sc. the sweet] moisture has been exuded from them.

Democritus and most of the natural philosophers who treat of sense-perception proceed quite irrationally, for they represent all objects of sense as objects of Touch. Yet, if this is really so, it clearly follows that each of the other senses is a mode of Touch; but one can see at a glance that this is impossible.

Again, they treat the percepts common to all senses as proper to one. For [the qualities by which they explain taste viz.] Magnitude and Figure, Roughness and Smoothness, and, moreover, the Sharpness and Bluntness found in solid bodies, are percepts common to all the senses, or if not to all, at least to Sight and Touch. This explains why it is that the senses are liable to err regarding them, while no such error arises respecting their proper sensibles; e.g. the sense of Seeing is not deceived as to Colour, nor is that of Hearing as to Sound.

On the other hand, they reduce the proper to common sensibles, as Democritus does with White and Black; for he asserts that the latter is [a mode of the] rough, and the former [a mode of the] smooth, while he reduces Savours to the atomic figures. Yet surely no one sense, or, if any, the sense of Sight rather than any other, can discern the common sensibles. But if we suppose that the sense of Taste is better able to do so, then – since to discern the smallest objects in each kind is what marks the acutest sense. – Taste should have been the sense which best perceived the common sensibles generally, and showed the most perfect power of discerning figures in general.

Again, all the sensibles involve contrariety; e.g. in Colour White is contrary to Black, and in Savours Bitter is contrary to Sweet; but no one figure is reckoned as contrary to any other figure. Else, to which of the possible polygonal figures [to which Democritus reduces Bitter] is the spherical figure [to which he reduces Sweet] contrary?

Again, since figures are infinite in number, savours also should be infinite; [the possible rejoinder – ‘that they are so, only that some are not perceived’ – cannot be sustained] for why should one savour be perceived, and another not?

This completes our discussion of the object of Taste, i.e. Savour; for the other affections of Savours are examined in their proper place in connection with the natural history of Plants.

5

Our conception of the nature of Odours must be analogous to that of Savours; inasmuch as the Sapid Dry effects in air and water alike, but in a different province of sense, precisely what the Dry effects in the Moist of water only. We customarily predicate Translucency of both air and water in common; but it is not qua translucent that either is a vehicle of odour, but qua possessed of a power of washing or rinsing [and so imbibing] the Sapid Dryness.

For the object of Smell exists not in air only: it also exists in water. This is proved by the case of fishes and testacea, which are seen to possess the faculty of smell, although water contains no air (for whenever air is generated within water it rises to the surface), and these creatures do not respire. Hence, if one were to assume that air and water are both moist, it would follow that Odour is the natural substance consisting of the Sapid Dry diffused in the Moist, and whatever is of this kind would be an object of Smell.

That the property of odorousness is based upon the Sapid may be seen by comparing the things which possess with those which do not possess odour. The elements, viz. Fire, Air, Earth, Water, are inodorous, because both the dry and the moist among them are without sapidity, unless some added ingredient produces it. This explains why sea-water possesses odour, for [unlike 'elemental' water] it contains savour and dryness. Salt, too, is more odorous than natron, as the oil which exudes from the former proves, for natron is allied to ['elemental'] earth more nearly than salt. Again, a stone is inodorous, just because it is tasteless, while, on the contrary, wood is odorous, because it is sapid. The kinds of wood, too, which contain more ['elemental'] water are less odorous than others. Moreover, to take the case of metals, gold is inodorous because it is without taste, but bronze and iron are odorous; and when the [sapid] moisture has been burnt out of them, their slag is, in all cases, less odorous the metals [than the metals themselves]. Silver and tin are more odorous than the one class of metals, less so than the other, inasmuch as they are water [to a greater degree than the former, to a less degree than the latter].

Some writers look upon Fumid exhalation, which is a compound of Earth and Air, as the essence of Odour. [Indeed all are inclined to rush to this theory of Odour.] Heraclitus implied his adherence to it when he declared that if all existing things were turned into Smoke, the nose would be the organ to discern them with. All writers incline to refer odour to this cause [sc. exhalation of some sort], but some regard it as aqueous, others as fumid, exhalation; while others, again, hold it to be either. Aqueous exhalation is merely a form of moisture, but fumid exhalation is, as already remarked, composed of Air and Earth. The former when condensed turns into water; the latter, in a particular species of earth. Now, it is unlikely that odour is either of these. For vaporous exhalation consists of mere water [which, being tasteless, is inodorous]; and fumid exhalation cannot occur in water at all, though, as has been before stated, aquatic creatures also have the sense of smell.

Again, the exhalation theory of odour is analogous to the theory of emanations. If, therefore, the latter is untenable, so, too, is the former.

It is clearly conceivable that the Moist, whether in air (for air, too, is essentially moist) or in water, should imbibe the influence of, and have effects wrought in it by, the Sapid Dryness. Moreover, if the Dry produces in moist media, i.e. water and air, an effect as of something washed out in them, it is manifest that odours must be something analogous to savours. Nay, indeed, this analogy is, in some instances, a fact [registered in language]; for odours as well as savours are spoken of as pungent, sweet, harsh, astringent rich [='savoury']; and one might regard fetid smells as analogous to bitter tastes; which explains why the former are offensive to inhalation as the latter are to deglutition. It is clear, therefore, that Odour is in both water and air what Savour is in water alone. This explains why coldness and freezing render Savours dull, and abolish odours altogether; for cooling and freezing tend to annul the kinetic heat which helps to fabricate sapidity.

There are two species of the Odorous. For the statement of certain writers that the odorous is not divisible into species is false; it is so divisible. We must here define the sense in which these species are to be admitted or denied.

One class of odours, then, is that which runs parallel, as has been observed, to savours: to odours of this class their pleasantness or unpleasantness belongs incidentally. For owing to the fact that Savours are qualities of nutrient matter, the odours connected with these [e.g. those of a certain food] are agreeable as long as animals have an appetite for the food, but they are not agreeable to them when sated and no longer in want of it; nor are they agreeable, either, to those animals that do not like the food itself which yields the odours. Hence, as we observed, these odours are pleasant or unpleasant incidentally, and the same reasoning explains why it is that they are perceptible to all animals in common.

The other class of odours consists of those agreeable in their essential nature, e.g. those of flowers. For these do not in any degree stimulate animals to food, nor do they contribute in any way to appetite; their effect upon it, if any, is rather the opposite. For the verse of Strattis ridiculing Euripides –

Use not perfumery to flavour soup, contains a truth.

Those who nowadays introduce such flavours into beverages deforce our sense of pleasure by habituating us to them, until, from two distinct kinds of sensations combined, pleasure arises as it might from one simple kind.

Of this species of odour man alone is sensible; the other, viz. that correlated with Tastes, is, as has been said before, perceptible also to the lower animals. And odours of the latter sort, since their pleasureableness depends upon taste, are divided into as many species as there are different tastes; but we cannot go on to say this of the former kind of odour, since its nature is agreeable or disagreeable per se. The reason why the perception of such odours is peculiar to man is found in the characteristic state of man's brain. For his brain is naturally cold, and the blood which it contains in its vessels is thin and pure but easily cooled (whence it happens that the exhalation arising from food, being cooled by the coldness of this region, produces unhealthy rheums); therefore it is that odours of such a species have been generated for human beings, as a safeguard to health. This is their sole function, and that they perform it is evident. For food, whether dry or moist, though sweet to taste, is often unwholesome; whereas the odour arising from what is fragrant, that odour which is pleasant in its own right, is, so to say, always beneficial to persons in any state of bodily health whatever.

For this reason, too, the perception of odour [in general] effected through respiration, not in all animals, but in man and certain other sanguineous animals, e.g. quadrupeds, and all that participate freely in the natural substance air; because when odours, on account of the lightness of the heat in them, mount to the brain, the health of this region is thereby promoted. For odour, as a power, is naturally heat-giving. Thus Nature has employed respiration for two purposes: primarily for the relief thereby brought to the thorax, secondarily for the inhalation of odour. For while an animal is inhaling, – odour moves in through its nostrils, as it were 'from a side-entrance.'

But the perception of the second class of odours above described [does not belong to all animal, but] is confined to human beings, because man's brain is, in proportion to his whole bulk, larger and moister than the brain of any other animal. This is the reason of the further fact that man alone, so to speak, among animals perceives and takes pleasure in the odours of flowers and such things. For the heat and stimulation set up by these odours are commensurate with the excess of moisture and coldness in his cerebral region. On all the other animals which have lungs, Nature has bestowed their due perception of one of the two kinds of odour [i.e. that connected with nutrition] through the act of respiration, guarding against the needless creation of two organs of sense; for in the fact that they respire the other animals have already sufficient provision for their perception of the one species of odour only, as human beings have for their perception of both.

But that creatures which do not respire have the olfactory sense is evident. For fishes, and all insects as a class, have, thanks to the species of odour correlated with nutrition, a keen olfactory sense of their proper food from a distance, even when they are very far away from it; such is the case with bees, and also with the class of small ants, which some denominate knipes. Among marine animals, too, the murex and many other similar animals have an acute perception of their food by its odour.

It is not equally certain what the organ is whereby they so perceive. This question, of the organ whereby they perceive odour, may well cause a difficulty, if we assume that smelling takes place in animals only while respiring (for that this is the fact is manifest in all the animals which do respire),

whereas none of those just mentioned respires, and yet they have the sense of smell – unless, indeed, they have some other sense not included in the ordinary five. This supposition is, however, impossible. For any sense which perceives odour is a sense of smell, and this they do perceive, though probably not in the same way as creatures which respire, but when the latter are respiring the current of breath removes something that is laid like a lid upon the organ proper (which explains why they do not perceive odours when not respiring); while in creatures which do not respire this is always off: just as some animals have eyelids on their eyes, and when these are not raised they cannot see, whereas hard-eyed animals have no lids, and consequently do not need, besides eyes, an agency to raise the lids, but see straightway [without intermission] from the actual moment at which it is first possible for them to do so [i.e. from the moment when an object first comes within their field of vision].

Consistently with what has been said above, not one of the lower animals shows repugnance to the odour of things which are essentially ill-smelling, unless one of the latter is positively pernicious. They are destroyed, however, by these things, just as human beings are; i.e. as human beings get headaches from, and are often asphyxiated by, the fumes of charcoal, so the lower animals perish from the strong fumes of brimstone and bituminous substances; and it is owing to experience of such effects that they shun these. For the disagreeable odour in itself they care nothing whatever (though the odours of many plants are essentially disagreeable), unless, indeed, it has some effect upon the taste of their food.

The senses making up an odd number, and an odd number having always a middle unit, the sense of smell occupies in itself as it were a middle position between the tactual senses, i.e. Touch and Taste, and those which perceive through a medium, i.e. Sight and Hearing. Hence the object of smell, too, is an affection of nutrient substances (which fall within the class of Tangibles), and is also an affection of the audible and the visible; whence it is that creatures have the sense of smell both in air and water. Accordingly, the object of smell is something common to both of these provinces, i.e. it appertains both to the tangible on the one hand, and on the other to the audible and translucent. Hence the propriety of the figure by which it has been described by us as an immersion or washing of dryness in the Moist and Fluid. Such then must be our account of the sense in which one is or is not entitled to speak of the odorous as having species.

The theory held by certain of the Pythagoreans, that some animals are nourished by odours alone, is unsound. For, in the first place, we see that food must be composite, since the bodies nourished by it are not simple. This explains why waste matter is secreted from food, either within the organisms, or, as in plants, outside them. But since even water by itself alone, that is, when unmixed, will not suffice for food – for anything which is to form a consistency must be corporeal – , it is still much less conceivable that air should be so corporealized [and thus fitted to be food]. But, besides this, we see that all animals have a receptacle for food, from which, when it has entered, the body absorbs it. Now, the organ which perceives odour is in the head, and odour enters with the inhalation of the breath; so that it goes to the respiratory region. It is plain, therefore, that odour, qua odour, does not contribute to nutrition; that, however, it is serviceable to health is equally plain, as well by immediate perception as from the arguments above employed; so that odour is in relation to general health what savour is in the province of nutrition and in relation to the bodies nourished.

This then must conclude our discussion of the several organs of sense-perception.

6

One might ask: if every body is infinitely divisible, are its sensible qualities – Colour, Savour, Odour, Sound, Weight, Cold or Heat, [Heaviness or] Lightness, Hardness or Softness – also infinitely divisible? Or, is this impossible?

[One might well ask this question], because each of them is productive of sense-perception, since, in fact, all derive their name [of 'sensible qualities'] from the very circumstance of their being able to stimulate this. Hence, [if this is so] both our perception of them should likewise be divisible to infinity, and every part of a body [however small] should be a perceptible magnitude. For it is impossible, e.g. to see a thing which is white but not of a certain magnitude.

Since if it were not so, [if its sensible qualities were not divisible, pari passu with body], we might conceive a body existing but having no colour, or weight, or any such quality; accordingly not perceptible at all. For these qualities are the objects of sense-perception. On this supposition, every perceptible object should be regarded as composed not of perceptible [but of imperceptible] parts. Yet it must [be really composed of perceptible parts], since assuredly it does not consist of mathematical [and therefore purely abstract and non-sensible] quantities. Again, by what faculty should we discern and cognize these [hypothetical real things without sensible qualities]? Is it by Reason? But they are not objects of Reason; nor does reason apprehend objects in space, except when it acts in conjunction with sense-perception. At the same time, if this be the case [that there are magnitudes, physically real, but without sensible quality], it seems to tell in favour of the atomistic hypothesis; for thus, indeed, [by accepting this hypothesis], the question [with which this chapter begins] might be solved [negatively]. But it is impossible [to accept this hypothesis]. Our views on the subject of atoms are to be found in our treatise on Movement.

The solution of these questions will bring with it also the answer to the question why the species of Colour, Taste, Sound, and other sensible qualities are limited. For in all classes of things lying between extremes the intermediates must be limited. But contraries are extremes, and every object of sense-perception involves contrariety: e.g. in Colour, White x Black; in Savour, Sweet x Bitter, and in all the other sensibles also the contraries are extremes. Now, that which is continuous is divisible into an infinite number of unequal parts, but into a finite number of equal parts, while that which is not per se continuous is divisible into species which are finite in number. Since then, the several sensible qualities of things are to be reckoned as species, while continuity always subsists in these, we must take account of the difference between the Potential and the Actual. It is owing to this difference that we do not [actually] see its ten-thousandth part in a grain of millet, although sight has embraced the whole grain within its scope; and it is owing to this, too, that the sound contained in a quarter-tone escapes notice, and yet one hears the whole strain, inasmuch as it is a continuum; but the interval between the extreme sounds [that bound the quarter-tone] escapes the ear [being only potentially audible, not actually]. So, in the case of other objects of sense, extremely small constituents are unnoticed; because they are only potentially not actually [perceptible e.g.] visible, unless when they have been parted from the wholes. So the footlength too exists potentially in the two-foot length, but actually only when it has been separated from the whole. But objective increments so small as those above might well, if separated from their totals, [instead of achieving 'actual' exisistence] be dissolved in their environments, like a drop of sapid moisture poured out into the sea. But even if this were not so [sc. with the objective magnitude], still, since the [subjective] of sense-perception is not perceptible in itself, nor capable of separate existence (since it exists only potentially in the more distinctly perceivable whole of sense-perception), so neither will it be possible to perceive [actually] its correlatively small object [sc. its quantum of pathema or sensible quality] when separated from the object-total. But yet this [small object] is to be considered as perceptible: for it is both potentially so already [i.e. even when

alone], and destined to be actually so when it has become part of an aggregate. Thus, therefore, we have shown that some magnitudes and their sensible qualities escape notice, and the reason why they do so, as well as the manner in which they are still perceptible or not perceptible in such cases. Accordingly then when these [minutely subdivided] sensibles have once again become aggregated in a whole in such a manner, relatively to one another, as to be perceptible actually, and not merely because they are in the whole, but even apart from it, it follows necessarily [from what has been already stated] that their sensible qualities, whether colours or tastes or sounds, are limited in number.

One might ask: – do the objects of sense-perception, or the movements proceeding from them ([since movements there are,] in whichever of the two ways [viz. by emanations or by stimulatory kinesis] sense-perception takes place), when these are actualized for perception, always arrive first at a spatial middle point [between the sense-organ and its object], as Odour evidently does, and also Sound? For he who is nearer [to the odorous object] perceives the Odour sooner [than who is farther away], and the Sound of a stroke reaches us some time after it has been struck. Is it thus also with an object seen, and with Light? Empedocles, for example, says that the Light from the Sun arrives first in the intervening space before it comes to the eye, or reaches the Earth. This might plausibly seem to be the case. For whatever is moved [in space], is moved from one place to another; hence there must be a corresponding interval of time also in which it is moved from the one place to the other. But any given time is divisible into parts; so that we should assume a time when the sun's ray was not as yet seen, but was still travelling in the middle space.

Now, even if it be true that the acts of 'hearing' and 'having heard', and, generally, those of 'perceiving' and 'having perceived', form co-instantaneous wholes, in other words, that acts of sense-perception do not involve a process of becoming, but have their being none the less without involving such a process; yet, just as, [in the case of sound], though the stroke which causes the Sound has been already struck, the Sound is not yet at the ear (and that this last is a fact is further proved by the transformation which the letters [viz. the consonants as heard] undergo [in the case of words spoken from a distance], implying that the local movement [involved in Sound] takes place in the space between [us and the speaker]; for the reason why [persons addressed from a distance] do not succeed in catching the sense of what is said is evidently that the air [sound wave] in moving towards them has its form changed) [granting this, then, the question arises]: is the same also true in the case of Colour and Light? For certainly it is not true that the beholder sees, and the object is seen, in virtue of some merely abstract relationship between them, such as that between equals. For if it were so, there would be no need [as there is] that either [the beholder or the thing beheld] should occupy some particular place; since to the equalization of things their being near to, or far from, one another makes no difference.

Now this [travelling through successive positions in the medium] may with good reason take place as regards Sound and Odour, for these, like [their media] Air and Water, are continuous, but the movement of both is divided into parts. This too is the ground of the fact that the object which the person first in order of proximity hears or smells is the same as that which each subsequent person perceives, while yet it is not the same.

Some, indeed, raise a question also on these very points; they declare it impossible that one person should hear, or see, or smell, the same object as another, urging the impossibility of several persons in different places hearing or smelling [the same object], for the one same thing would [thus] be divided from itself. The answer is that, in perceiving the object which first set up the motion – e.g. a bell, or frankincense, or fire – all perceive an object numerically one and the same; while, of course, in the special object perceived they perceive an object numerically different for each, though specifically the same for all; and this, accordingly, explains how it is that many persons

together see, or smell, or hear [the same object]. These things [the odour or sound proper] are not bodies, but an affection or process of some kind (otherwise this [viz. simultaneous perception of the one object by many] would not have been, as it is, a fact of experience) though, on the other hand, they each imply a body [as their cause].

But [though sound and odour may travel,] with regard to Light the case is different. For Light has its raison d'etre in the being [not becoming] of something, but it is not a movement. And in general, even in qualitative change the case is different from what it is in local movement [both being different species of kinesis]. Local movements, of course, arrive first at a point midway before reaching their goal (and Sound, it is currently believed, is a movement of something locally moved), but we cannot go on to assert this [arrival at a point midway] like manner of things which undergo qualitative change. For this kind of change may conceivably take place in a thing all at once, without one half of it being changed before the other; e.g. it is conceivable that water should be frozen simultaneously in every part. But still, for all that, if the body which is heated or frozen is extensive, each part of it successively is affected by the part contiguous, while the part first changed in quality is so changed by the cause itself which originates the change, and thus the change throughout the whole need not take place coinstantaneously and all at once. Tasting would have been as smelling now is, if we lived in a liquid medium, and perceived [the sapid object] at a distance, before touching it.

Naturally, then, the parts of media between a sensory organ and its object are not all affected at once – except in the case of Light [illumination] for the reason above stated, and also in the case of seeing, for the same reason; for Light is an efficient cause of seeing.

7

Another question respecting sense-perception is as follows: assuming, as is natural, that of two [simultaneous] sensory stimuli the stronger always tends to extrude the weaker [from consciousness], is it conceivable or not that one should be able to discern two objects coinstantaneously in the same individual time? The above assumption explains why persons do not perceive what is brought before their eyes, if they are at the time deep in thought, or in a fright, or listening to some loud noise. This assumption, then, must be made, and also the following: that it is easier to discern each object of sense when in its simple form than when an ingredient in a mixture; easier, for example, to discern wine when neat than when blended, and so also honey, and [in other provinces] a colour, or to discern the nete by itself alone, than [when sounded with the hypate] in the octave; the reason being that component elements tend to efface [the distinctive characteristics of] one another. Such is the effect [on one another] of all ingredients of which, when compounded, some one thing is formed.

If, then, the greater stimulus tends to expel the less, it necessarily follows that, when they concur, this greater should itself too be less distinctly perceptible than if it were alone, since the less by blending with it has removed some of its individuality, according to our assumption that simple objects are in all cases more distinctly perceptible.

Now, if the two stimuli are equal but heterogeneous, no perception of either will ensue; they will alike efface one another's characteristics. But in such a case the perception of either stimulus in its simple form is impossible. Hence either there will then be no sense-perception at all, or there will be a perception compounded of both and differing from either. The latter is what actually seems to result from ingredients blended together, whatever may be the compound in which they are so mixed.

Since, then, from some concurrent [sensory stimuli] a resultant object is produced, while from others no such resultant is produced, and of the latter sort are those things which belong to different sense provinces (for only those things are capable of mixture whose extremes are contraries, and no one compound can be formed from, e.g. White and Sharp, except indirectly, i.e. not as a concord is formed of Sharp and Grave); there follows logically the impossibility of discerning such concurrent stimuli coinstantaneously. For we must suppose that the stimuli, when equal, tend alike to efface one another, since no one [form of stimulus] results from them; while, if they are unequal, the stronger alone is distinctly perceptible.

Again, the soul would be more likely to perceive coinstantaneously, with one and the same sensory act, two things in the same sensory province, such as the Grave and the Sharp in sound; for the sensory stimulation in this one province is more likely to be unitemporal than that involving two different provinces, as Sight and Hearing. But it is impossible to perceive two objects coinstantaneously in the same sensory act unless they have been mixed, [when, however, they are no longer two], for their amalgamation involves their becoming one, and the sensory act related to one object is itself one, and such act, when one, is, of course, coinstantaneous with itself. Hence, when things are mixed we of necessity perceive them coinstantaneously: for we perceive them by a perception actually one. For an object numerically one means that which is perceived by a perception actually one, whereas an object specifically one means that which is perceived by a sensory act potentially one [i.e. by an energeia of the same sensuous faculty]. If then the actualized perception is one, it will declare its data to be one object; they must, therefore, have been mixed. Accordingly, when they have not been mixed, the actualized perceptions which perceive them will be two; but [if so, their perception must be successive not coinstantaneous, for] in one and the same faculty the perception actualized at any single moment is necessarily one, only one stimulation or exertion of a single faculty being possible at a single instant, and in the case supposed here the faculty is one. It follows, therefore, that we cannot conceive the possibility of perceiving two distinct objects coinstantaneously with one and the same sense.

But if it be thus impossible to perceive coinstantaneously two objects in the same province of sense if they are really two, manifestly it is still less conceivable that we should perceive coinstantaneously objects in two different sensory provinces, as White and Sweet. For it appears that when the Soul predicates numerical unity it does so in virtue of nothing else than such coinstantaneous perception [of one object, in one instant, by one energeia]: while it predicates specific unity in virtue of [the unity of] the discriminating faculty of sense together with [the unity of] the mode in which this operates. What I mean, for example, is this; the same sense no doubt discerns White and Black, [which are hence generically one] though specifically different from one another, and so, too, a faculty of sense self-identical, but different from the former, discerns Sweet and Bitter; but while both these faculties differ from one another [and each from itself] in their modes of discerning either of their respective contraries, yet in perceiving the co-ordinates in each province they proceed in manners analogous to one another; for instance, as Taste perceives Sweet, so Sight perceives White; and as the latter perceives Black, so the former perceives Bitter.

Again, if the stimuli of sense derived from Contraries are themselves Contrary, and if Contraries cannot be conceived as subsisting together in the same individual subject, and if Contraries, e.g. Sweet and Bitter, come under one and the same sense-faculty, we must conclude that it is impossible to discern them coinstantaneously. It is likewise clearly impossible so to discern such homogeneous sensibles as are not [indeed] Contrary, [but are yet of different species]. For these are, [in the sphere of colour, for instance], classed some with White, others with Black, and so it is, likewise, in the other provinces of sense; for example, of savours, some are classed with Sweet, and others with Bitter. Nor can one discern the components in compounds coinstantaneously (for these

are ratios of Contraries, as e.g. the Octave or the Fifth); unless, indeed, on condition of perceiving them as one. For thus, and not otherwise, the ratios of the extreme sounds are compounded into one ratio: since we should have together the ratio, on the one hand, of Many to Few or of Odd to Even, on the other, that of Few to Many or of Even to Odd [and these, to be perceived together, must be unified].

If, then, the sensibles denominated co-ordinates though in different provinces of sense (e.g. I call Sweet and White co-ordinates though in different provinces) stand yet more aloof, and differ more, from one another than do any sensibles in the same province; while Sweet differs from White even more than Black does from White, it is still less conceivable that one should discern them [viz. sensibles in different sensory provinces whether co-ordinates or not] coinstantaneously than sensibles which are in the same province. Therefore, if coinstantaneous perception of the latter be impossible, that of the former is a fortiori impossible.

Some of the writers who treat of concords assert that the sounds combined in these do not reach us simultaneously, but only appear to do so, their real successiveness being unnoticed whenever the time it involves is [so small as to be] imperceptible. Is this true or not? One might perhaps, following this up, go so far as to say that even the current opinion that one sees and hears coinstantaneously is due merely to the fact that the intervals of time [between the really successive perceptions of sight and hearing] escape observation. But this can scarcely be true, nor is it conceivable that any portion of time should be [absolutely] imperceptible, or that any should be absolutely unnoticeable; the truth being that it is possible to perceive every instant of time. [This is so]; because, if it is inconceivable that a person should, while perceiving himself or aught else in a continuous time, be at any instant unaware of his own existence; while, obviously, the assumption, that there is in the time-continuum a time so small as to be absolutely imperceptible, carries the implication that a person would, during such time, be unaware of his own existence, as well as of his seeing and perceiving; [this assumption must be false].

Again, if there is any magnitude, whether time or thing, absolutely imperceptible owing to its smallness, it follows that there would not be either a thing which one perceives, or a time in which one perceives it, unless in the sense that in some part of the given time he sees some part of the given thing. For [let there be a line ab, divided into two parts at g, and let this line represent a whole object and a corresponding whole time. Now,] if one sees the whole line, and perceives it during a time which forms one and the same continuum, only in the sense that he does so in some portion of this time, let us suppose the part gb, representing a time in which by supposition he was perceiving nothing, cut off from the whole. Well, then, he perceives in a certain part [viz. in the remainder] of the time, or perceives a part [viz. the remainder] of the line, after the fashion in which one sees the whole earth by seeing some given part of it, or walks in a year by walking in some given part of the year. But [by hypothesis] in the part bg he perceives nothing: therefore, in fact, he is said to perceive the whole object and during the whole time simply because he perceives [some part of the object] in some part of the time ab. But the same argument holds also in the case of ag [the remainder, regarded in its turn as a whole]; for it will be found [on this theory of vacant times and imperceptible magnitudes] that one always perceives only in some part of a given whole time, and perceives only some part of a whole magnitude, and that it is impossible to perceive any [really] whole [object in a really whole time; a conclusion which is absurd, as it would logically annihilate the perception of both Objects and Time].

Therefore we must conclude that all magnitudes are perceptible, but their actual dimensions do not present themselves immediately in their presentation as objects. One sees the sun, or a four-cubit rod at a distance, as a magnitude, but their exact dimensions are not given in their visual presentation: nay, at times an object of sight appears indivisible, but [vision like other special

senses, is fallible respecting ‘common sensibles’, e.g. magnitude, and] nothing that one sees is really indivisible. The reason of this has been previously explained. It is clear then, from the above arguments, that no portion of time is imperceptible.

But we must here return to the question proposed above for discussion, whether it is possible or impossible to perceive several objects coinstantaneously; by ‘coinstantaneously’ I mean perceiving the several objects in a time one and indivisible relatively to one another, i.e. indivisible in a sense consistent with its being all a continuum.

First, then, is it conceivable that one should perceive the different things coinstantaneously, but each with a different part of the Soul? Or [must we object] that, in the first place, to begin with the objects of one and the same sense, e.g. Sight, if we assume it [the Soul qua exercising Sight] to perceive one colour with one part, and another colour with a different part, it will have a plurality of parts the same in species, [as they must be,] since the objects which it thus perceives fall within the same genus?

Should any one [to illustrate how the Soul might have in it two different parts specifically identical, each directed to a set of aistheta the same in genus with that to which the other is directed] urge that, as there are two eyes, so there may be in the Soul something analogous, [the reply is] that of the eyes, doubtless, some one organ is formed, and hence their actualization in perception is one; but if this is so in the Soul, then, in so far as what is formed of both [i.e. of any two specifically identical parts as assumed] is one, the true perceiving subject also will be one, [and the contradictory of the above hypothesis (of different parts of Soul remaining engaged in simultaneous perception with one sense) is what emerges from the analogy]; while if the two parts of Soul remain separate, the analogy of the eyes will fail, [for of these some one is really formed].

Furthermore, [on the supposition of the need of different parts of Soul, co-operating in each sense, to discern different objects coinstantaneously], the senses will be each at the same time one and many, as if we should say that they were each a set of diverse sciences; for neither will an ‘activity’ exist without its proper faculty, nor without activity will there be sensation.

But if the Soul does not, in the way suggested [i.e. with different parts of itself acting simultaneously], perceive in one and the same individual time sensibles of the same sense, a fortiori it is not thus that it perceives sensibles of different senses. For it is, as already stated, more conceivable that it should perceive a plurality of the former together in this way than a plurality of heterogeneous objects.

If then, as is the fact, the Soul with one part perceives Sweet, with another, White, either that which results from these is some one part, or else there is no such one resultant. But there must be such an one, inasmuch as the general faculty of sense-perception is one. What one object, then, does that one faculty [when perceiving an object, e.g. as both White and Sweet] perceive? [None]; for assuredly no one object arises by composition of these [heterogeneous objects, such as White and Sweet]. We must conclude, therefore, that there is, as has been stated before, some one faculty in the soul with which the latter perceives all its percepts, though it perceives each different genus of sensibles through a different organ.

May we not, then, conceive this faculty which perceives White and Sweet to be one qua indivisible [sc. qua combining its different simultaneous objects] in its actualization, but different, when it has become divisible [sc. qua distinguishing its different simultaneous objects] in its actualization?

Or is what occurs in the case of the perceiving Soul conceivably analogous to what holds true in that of the things themselves? For the same numerically one thing is white and sweet, and has many other qualities, [while its numerical oneness is not thereby prejudiced] if the fact is not that the qualities are really separable in the object from one another, but that the being of each quality is different [from that of every other]. In the same way therefore we must assume also, in the case of

the Soul, that the faculty of perception in general is in itself numerically one and the same, but different [differentiated] in its being; different, that is to say, in genus as regards some of its objects, in species as regards others. Hence too, we may conclude that one can perceive [numerically different objects] coinstantaneously with a faculty which is numerically one and the same, but not the same in its relationship [sc. according as the objects to which it is directed are not the same].

That every sensible object is a magnitude, and that nothing which it is possible to perceive is indivisible, may be thus shown. The distance whence an object could not be seen is indeterminate, but that whence it is visible is determinate. We may say the same of the objects of Smelling and Hearing, and of all sensibles not discerned by actual contact. Now, there is, in the interval of distance, some extreme place, the last from which the object is invisible, and the first from which it is visible. This place, beyond which if the object be one cannot perceive it, while if the object be on the hither side one must perceive it, is, I presume, itself necessarily indivisible. Therefore, if any sensible object be indivisible, such object, if set in the said extreme place whence imperceptibility ends and perceptibility begins, will have to be both visible and invisible their objects, whether regarded in general or at the same time; but this is impossible.

This concludes our survey of the characteristics of the organs of Sense-perception and their objects, whether regarded in general or in relation to each organ. Of the remaining subjects, we must first consider that of memory and remembering.

On Memory and Reminiscence

translated by J. I. Beare

1

We have, in the next place, to treat of Memory and Remembering, considering its nature, its cause, and the part of the soul to which this experience, as well as that of Recollecting, belongs. For the persons who possess a retentive memory are not identical with those who excel in power of recollection; indeed, as a rule, slow people have a good memory, whereas those who are quick-witted and clever are better at recollecting.

We must first form a true conception of these objects of memory, a point on which mistakes are often made. Now to remember the future is not possible, but this is an object of opinion or expectation (and indeed there might be actually a science of expectation, like that of divination, in which some believe); nor is there memory of the present, but only sense-perception. For by the latter we know not the future, nor the past, but the present only. But memory relates to the past. No one would say that he remembers the present, when it is present, e.g. a given white object at the moment when he sees it; nor would one say that he remembers an object of scientific contemplation at the moment when he is actually contemplating it, and has it full before his mind; – of the former he would say only that he perceives it, of the latter only that he knows it. But when one has scientific knowledge, or perception, apart from the actualizations of the faculty concerned, he thus ‘remembers’ (that the angles of a triangle are together equal to two right angles); as to the former, that he learned it, or thought it out for himself, as to the latter, that he heard, or saw, it, or had some such sensible experience of it. For whenever one exercises the faculty of remembering, he must say within himself, ‘I formerly heard (or otherwise perceived) this,’ or ‘I formerly had this thought’.

Memory is, therefore, neither Perception nor Conception, but a state or affection of one of these, conditioned by lapse of time. As already observed, there is no such thing as memory of the present while present, for the present is object only of perception, and the future, of expectation, but the object of memory is the past. All memory, therefore, implies a time elapsed; consequently only those animals which perceive time remember, and the organ whereby they perceive time is also that whereby they remember.

The subject of 'presentation' has been already considered in our work On the Soul. Without a presentation intellectual activity is impossible. For there is in such activity an incidental affection identical with one also incidental in geometrical demonstrations. For in the latter case, though we do not for the purpose of the proof make any use of the fact that the quantity in the triangle (for example, which we have drawn) is determinate, we nevertheless draw it determinate in quantity. So likewise when one exerts the intellect (e.g. on the subject of first principles), although the object may not be quantitative, one envisages it as quantitative, though he thinks it in abstraction from quantity; while, on the other hand, if the object of the intellect is essentially of the class of things that are quantitative, but indeterminate, one envisages it as if it had determinate quantity, though subsequently, in thinking it, he abstracts from its determinateness. Why we cannot exercise the intellect on any object absolutely apart from the continuous, or apply it even to non-temporal things unless in connexion with time, is another question. Now, one must cognize magnitude and motion by means of the same faculty by which one cognizes time (i.e. by that which is also the faculty of memory), and the presentation (involved in such cognition) is an affection of the sensus communis; whence this follows, viz. that the cognition of these objects (magnitude, motion time) is effected by the (said sensus communis, i.e. the) primary faculty of perception. Accordingly, memory (not merely of sensible, but) even of intellectual objects involves a presentation: hence we may conclude that it belongs to the faculty of intelligence only incidentally, while directly and essentially it belongs to the primary faculty of sense-perception.

Hence not only human beings and the beings which possess opinion or intelligence, but also certain other animals, possess memory. If memory were a function of (pure) intellect, it would not have been as it is an attribute of many of the lower animals, but probably, in that case, no mortal beings would have had memory; since, even as the case stands, it is not an attribute of them all, just because all have not the faculty of perceiving time. Whenever one actually remembers having seen or heard, or learned, something, he includes in this act (as we have already observed) the consciousness of 'formerly'; and the distinction of 'former' and 'latter' is a distinction in time.

Accordingly if asked, of which among the parts of the soul memory is a function, we reply: manifestly of that part to which 'presentation' appertains; and all objects capable of being presented (viz. aistheta) are immediately and properly objects of memory, while those (viz. noeta) which necessarily involve (but only involve) presentation are objects of memory incidentally.

One might ask how it is possible that though the affection (the presentation) alone is present, and the (related) fact absent, the latter – that which is not present – is remembered. (The question arises), because it is clear that we must conceive that which is generated through sense-perception in the sentient soul, and in the part of the body which is its seat – viz. that affection the state whereof we call memory – to be some such thing as a picture. The process of movement (sensory stimulation) involved the act of perception stamps in, as it were, a sort of impression of the percept, just as persons do who make an impression with a seal. This explains why, in those who are strongly moved owing to passion, or time of life, no mnemonic impression is formed; just as no impression would be formed if the movement of the seal were to impinge on running water; while there are others in whom, owing to the receiving surface being frayed, as happens to (the stucco on) old (chamber) walls, or owing to the hardness of the receiving surface, the requisite impression is

not implanted at all. Hence both very young and very old persons are defective in memory; they are in a state of flux, the former because of their growth, the latter, owing to their decay. In like manner, also, both those who are too quick and those who are too slow have bad memories. The former are too soft, the latter too hard (in the texture of their receiving organs), so that in the case of the former the presented image (though imprinted) does not remain in the soul, while on the latter it is not imprinted at all.

But then, if this truly describes what happens in the genesis of memory, (the question stated above arises:) when one remembers, is it this impressed affection that he remembers, or is it the objective thing from which this was derived? If the former, it would follow that we remember nothing which is absent; if the latter, how is it possible that, though perceiving directly only the impression, we remember that absent thing which we do not perceive? Granted that there is in us something like an impression or picture, why should the perception of the mere impression be memory of something else, instead of being related to this impression alone? For when one actually remembers, this impression is what he contemplates, and this is what he perceives. How then does he remember what is not present? One might as well suppose it possible also to see or hear that which is not present. In reply, we suggest that this very thing is quite conceivable, nay, actually occurs in experience. A picture painted on a panel is at once a picture and a likeness: that is, while one and the same, it is both of these, although the 'being' of both is not the same, and one may contemplate it either as a picture, or as a likeness. Just in the same way we have to conceive that the mnemonic presentation within us is something which by itself is merely an object of contemplation, while, in-relation to something else, it is also a presentation of that other thing. In so far as it is regarded in itself, it is only an object of contemplation, or a presentation; but when considered as relative to something else, e.g. as its likeness, it is also a mnemonic token. Hence, whenever the residual sensory process implied by it is actualized in consciousness, if the soul perceives this in so far as it is something absolute, it appears to occur as a mere thought or presentation; but if the soul perceives it qua related to something else, then, - just as when one contemplates the painting in the picture as being a likeness, and without having (at the moment) seen the actual Koriskos, contemplates it as a likeness of Koriskos, and in that case the experience involved in this contemplation of it (as relative) is different from what one has when he contemplates it simply as a painted figure – (so in the case of memory we have the analogous difference for), of the objects in the soul, the one (the unrelated object) presents itself simply as a thought, but the other (the related object) just because, as in the painting, it is a likeness, presents itself as a mnemonic token.

We can now understand why it is that sometimes, when we have such processes, based on some former act of perception, occurring in the soul, we do not know whether this really implies our having had perceptions corresponding to them, and we doubt whether the case is or is not one of memory. But occasionally it happens that (while thus doubting) we get a sudden idea and recollect that we heard or saw something formerly. This (occurrence of the 'sudden idea') happens whenever, from contemplating a mental object as absolute, one changes his point of view, and regards it as relative to something else.

The opposite (sc. to the case of those who at first do not recognize their phantasms as mnemonic) also occurs, as happened in the cases of Antipheron of Oreus and others suffering from mental derangement; for they were accustomed to speak of their mere phantasms as facts of their past experience, and as if remembering them. This takes place whenever one contemplates what is not a likeness as if it were a likeness.

Mnemonic exercises aim at preserving one's memory of something by repeatedly reminding him of it; which implies nothing else (on the learner's part) than the frequent contemplation of something (viz. the 'mnemonic', whatever it may be) as a likeness, and not as out of relation.

As regards the question, therefore, what memory or remembering is, it has now been shown that it is the state of a presentation, related as a likeness to that of which it is a presentation; and as to the question of which of the faculties within us memory is a function, (it has been shown) that it is a function of the primary faculty of sense-perception, i.e. of that faculty whereby we perceive time.

2

Next comes the subject of Recollection, in dealing with which we must assume as fundamental the truths elicited above in our introductory discussions. For recollection is not the 'recovery' or 'acquisition' of memory; since at the instant when one at first learns (a fact of science) or experiences (a particular fact of sense), he does not thereby 'recover' a memory, inasmuch as none has preceded, nor does he acquire one ab initio. It is only at the instant when the aforesaid state or affection (of the aisthesis or upolepsis) is implanted in the soul that memory exists, and therefore memory is not itself implanted concurrently with the continuous implantation of the (original) sensory experience.

Further: at the very individual and concluding instant when first (the sensory experience or scientific knowledge) has been completely implanted, there is then already established in the person affected the (sensory) affection, or the scientific knowledge (if one ought to apply the term 'scientific knowledge' to the (mnemonic) state or affection; and indeed one may well remember, in the 'incidental' sense, some of the things (i.e. ta katholou) which are properly objects of scientific knowledge); but to remember, strictly and properly speaking, is an activity which will not be immanent until the original experience has undergone lapse of time. For one remembers now what one saw or otherwise experienced formerly; the moment of the original experience and the moment of the memory of it are never identical.

Again, (even when time has elapsed, and one can be said really to have acquired memory, this is not necessarily recollection, for firstly) it is obviously possible, without any present act of recollection, to remember as a continued consequence of the original perception or other experience; whereas when (after an interval of obliviscence) one recovers some scientific knowledge which he had before, or some perception, or some other experience, the state of which we above declared to be memory, it is then, and then only, that this recovery may amount to a recollection of any of the things aforesaid. But, (though as observed above, remembering does not necessarily imply recollecting), recollecting always implies remembering, and actualized memory follows (upon the successful act of recollecting).

But secondly, even the assertion that recollection is the reinstatement in consciousness of something which was there before but had disappeared requires qualification. This assertion may be true, but it may also be false; for the same person may twice learn (from some teacher), or twice discover (i.e. excogitate), the same fact. Accordingly, the act of recollecting ought (in its definition) to be distinguished from these acts; i.e. recollecting must imply in those who recollect the presence of some spring over and above that from which they originally learn.

Acts of recollection, as they occur in experience, are due to the fact that one movement has by nature another that succeeds it in regular order.

If this order be necessary, whenever a subject experiences the former of two movements thus connected, it will (invariably) experience the latter; if, however, the order be not necessary, but customary, only in the majority of cases will the subject experience the latter of the two movements. But it is a fact that there are some movements, by a single experience of which persons take the impress of custom more deeply than they do by experiencing others many times; hence

upon seeing some things but once we remember them better than others which we may have been frequently.

Whenever therefore, we are recollecting, we are experiencing certain of the antecedent movements until finally we experience the one after which customarily comes that which we seek. This explains why we hunt up the series (of kineseis) having started in thought either from a present intuition or some other, and from something either similar, or contrary, to what we seek, or else from that which is contiguous with it. Such is the empirical ground of the process of recollection; for the mnemonic movements involved in these starting-points are in some cases identical, in others, again, simultaneous, with those of the idea we seek, while in others they comprise a portion of them, so that the remnant which one experienced after that portion (and which still requires to be excited in memory) is comparatively small.

Thus, then, it is that persons seek to recollect, and thus, too, it is that they recollect even without the effort of seeking to do so, viz. when the movement implied in recollection has supervened on some other which is its condition. For, as a rule, it is when antecedent movements of the classes here described have first been excited, that the particular movement implied in recollection follows. We need not examine a series of which the beginning and end lie far apart, in order to see how (by recollection) we remember; one in which they lie near one another will serve equally well. For it is clear that the method is in each case the same, that is, one hunts up the objective series, without any previous search or previous recollection. For (there is, besides the natural order, viz. the order of the pralmata, or events of the primary experience, also a customary order, and) by the effect of custom the mnemonic movements tend to succeed one another in a certain order. Accordingly, therefore, when one wishes to recollect, this is what he will do: he will try to obtain a beginning of movement whose sequel shall be the movement which he desires to reawaken. This explains why attempts at recollection succeed soonest and best when they start from a beginning (of some objective series). For, in order of succession, the mnemonic movements are to one another as the objective facts (from which they are derived). Accordingly, things arranged in a fixed order, like the successive demonstrations in geometry, are easy to remember (or recollect) while badly arranged subjects are remembered with difficulty.

Recollecting differs also in this respect from relearning, that one who recollects will be able, somehow, to move, solely by his own effort, to the term next after the starting-point. When one cannot do this of himself, but only by external assistance, he no longer remembers (i.e. he has totally forgotten, and therefore of course cannot recollect). It often happens that, though a person cannot recollect at the moment, yet by seeking he can do so, and discovers what he seeks. This he succeeds in doing by setting up many movements, until finally he excites one of a kind which will have for its sequel the fact he wishes to recollect. For remembering (which is the condicio sine qua non of recollecting) is the existence, potentially, in the mind of a movement capable of stimulating it to the desired movement, and this, as has been said, in such a way that the person should be moved (prompted to recollection) from within himself, i.e. in consequence of movements wholly contained within himself.

But one must get hold of a starting-point. This explains why it is that persons are supposed to recollect sometimes by starting from mnemonic loci. The cause is that they pass swiftly in thought from one point to another, e.g. from milk to white, from white to mist, and thence to moist, from which one remembers Autumn (the ‘season of mists’), if this be the season he is trying to recollect. It seems true in general that the middle point also among all things is a good mnemonic starting-point from which to reach any of them. For if one does not recollect before, he will do so when he has come to this, or, if not, nothing can help him; as, e.g. if one were to have in mind the numerical series denoted by the symbols A, B, G, D, E, Z, I, H, O. For, if he does not remember

what he wants at E, then at E he remembers O; because from E movement in either direction is possible, to D or to Z. But, if it is not for one of these that he is searching, he will remember (what he is searching for) when he has come to G if he is searching for H or I. But if (it is) not (for H or I that he is searching, but for one of the terms that remain), he will remember by going to A, and so in all cases (in which one starts from a middle point). The cause of one's sometimes recollecting and sometimes not, though starting from the same point, is, that from the same starting-point a movement can be made in several directions, as, for instance, from G to I or to D. If, then, the mind has not (when starting from E) moved in an old path (i.e. one in which it moved first having the objective experience, and that, therefore, in which un-'ethized' phusis would have it again move), it tends to move to the more customary; for (the mind having, by chance or otherwise, missed moving in the 'old' way) Custom now assumes the role of Nature. Hence the rapidity with which we recollect what we frequently think about. For as regular sequence of events is in accordance with nature, so, too, regular sequence is observed in the actualization of kinesis (in consciousness), and here frequency tends to produce (the regularity of) nature. And since in the realm of nature occurrences take place which are even contrary to nature, or fortuitous, the same happens a fortiori in the sphere swayed by custom, since in this sphere natural law is not similarly established. Hence it is that (from the same starting-point) the mind receives an impulse to move sometimes in the required direction, and at other times otherwise, (doing the latter) particularly when something else somehow deflects the mind from the right direction and attracts it to itself. This last consideration explains too how it happens that, when we want to remember a name, we remember one somewhat like it, indeed, but blunder in reference to (i.e. in pronouncing) the one we intended.

Thus, then, recollection takes place.

But the point of capital importance is that (for the purpose of recollection) one should cognize, determinately or indeterminately, the time-relation (of that which he wishes to recollect). There is, let it be taken as a fact, something by which one distinguishes a greater and a smaller time; and it is reasonable to think that one does this in a way analogous to that in which one discerns (spacial) magnitudes. For it is not by the mind's reaching out towards them, as some say a visual ray from the eye does (in seeing), that one thinks of large things at a distance in space (for even if they are not there, one may similarly think them); but one does so by a proportionate mental movement. For there are in the mind the like figures and movements (i.e. 'like' to those of objects and events). Therefore, when one thinks the greater objects, in what will his thinking those differ from his thinking the smaller? (In nothing,) because all the internal though smaller are as it were proportional to the external. Now, as we may assume within a person something proportional to the forms (of distant magnitudes), so, too, we may doubtless assume also something else proportional to their distances. As, therefore, if one has (psychically) the movement in AB, BE, he constructs in thought (i.e. knows objectively) GD, since AG and GD bear equal ratios respectively (to AB and BE), (so he who recollects also proceeds). Why then does he construct GD rather than ZH? Is it not because as AG is to AB, so is O to I? These movements therefore (sc. in AB, BE, and in O:I) he has simultaneously. But if he wishes to construct to thought ZH, he has in mind BE in like manner as before (when constructing GD), but now, instead of (the movements of the ratio) O:I, he has in mind (those of the ratio K:L; for K:L::ZA:BA. (See diagram.)

When, therefore, the 'movement' corresponding to the object and that corresponding to its time concur, then one actually remembers. If one supposes (himself to move in these different but concurrent ways) without really doing so, he supposes himself to remember.

For one may be mistaken, and think that he remembers when he really does not. But it is not possible, conversely, that when one actually remembers he should not suppose himself to remember, but should remember unconsciously. For remembering, as we have conceived it,

essentially implies consciousness of itself. If, however, the movement corresponding to the objective fact takes place without that corresponding to the time, or, if the latter takes place without the former, one does not remember.

The movement answering to the time is of two kinds. Sometimes in remembering a fact one has no determinate time-notion of it, no such notion as that e.g. he did something or other on the day before yesterday; while in other cases he has a determinate notion of the time. Still, even though one does not remember with actual determination of the time, he genuinely remembers, none the less. Persons are wont to say that they remember (something), but yet do not know when (it occurred, as happens) whenever they do not know determinately the exact length of time implied in the 'when'.

It has been already stated that those who have a good memory are not identical with those who are quick at recollecting. But the act of recollecting differs from that of remembering, not only chronologically, but also in this, that many also of the other animals (as well as man) have memory, but, of all that we are acquainted with, none, we venture to say, except man, shares in the faculty of recollection. The cause of this is that recollection is, as it were a mode of inference. For he who endeavours to recollect infers that he formerly saw, or heard, or had some such experience, and the process (by which he succeeds in recollecting) is, as it were, a sort of investigation. But to investigate in this way belongs naturally to those animals alone which are also endowed with the faculty of deliberation; (which proves what was said above), for deliberation is a form of inference. That the affection is corporeal, i.e. that recollection is a searching for an 'image' in a corporeal substrate, is proved by the fact that in some persons, when, despite the most strenuous application of thought, they have been unable to recollect, it (viz. the anamnesis = the effort at recollection) excites a feeling of discomfort, which, even though they abandon the effort at recollection, persists in them none the less; and especially in persons of melancholic temperament. For these are most powerfully moved by presentations. The reason why the effort of recollection is not under the control of their will is that, as those who throw a stone cannot stop it at their will when thrown, so he who tries to recollect and 'hunts' (after an idea) sets up a process in a material part, (that) in which resides the affection. Those who have moisture around that part which is the centre of sense-perception suffer most discomfort of this kind. For when once the moisture has been set in motion it is not easily brought to rest, until the idea which was sought for has again presented itself, and thus the movement has found a straight course. For a similar reason bursts of anger or fits of terror, when once they have excited such motions, are not at once allayed, even though the angry or terrified persons (by efforts of will) set up counter motions, but the passions continue to move them on, in the same direction as at first, in opposition to such counter motions. The affection resembles also that in the case of words, tunes, or sayings, whenever one of them has become inveterate on the lips. People give them up and resolve to avoid them; yet again they find themselves humming the forbidden air, or using the prohibited word. Those whose upper parts are abnormally large, as. is the case with dwarfs, have abnormally weak memory, as compared with their opposites, because of the great weight which they have resting upon the organ of perception, and because their mnemonic movements are, from the very first, not able to keep true to a course, but are dispersed, and because, in the effort at recollection, these movements do not easily find a direct onward path. Infants and very old persons have bad memories, owing to the amount of movement going on within them; for the latter are in process of rapid decay, the former in process of vigorous growth; and we may add that children, until considerably advanced in years, are dwarf-like in their bodily structure. Such then is our theory as regards memory and remembering their nature, and the particular organ of the soul by which animals remember; also as regards recollection, its formal definition, and the manner and causes of its performance.

On Sleep And Sleeplessness
translated by J. I. Beare

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With regard to sleep and waking, we must consider what they are: whether they are peculiar to soul or to body, or common to both; and if common, to what part of soul or body they appertain: further, from what cause it arises that they are attributes of animals, and whether all animals share in them both, or some partake of the one only, others of the other only, or some partake of neither and some of both.

Further, in addition to these questions, we must also inquire what the dream is, and from what cause sleepers sometimes dream, and sometimes do not; or whether the truth is that sleepers always dream but do not always remember (their dream); and if this occurs, what its explanation is.

Again, [we must inquire] whether it is possible or not to foresee the future (in dreams), and if it be possible, in what manner; further, whether, supposing it possible, it extends only to things to be accomplished by the agency of Man, or to those also of which the cause lies in supra-human agency, and which result from the workings of Nature, or of Spontaneity.

First, then, this much is clear, that waking and sleep appertain to the same part of an animal, inasmuch as they are opposites, and sleep is evidently a privation of waking. For contraries, in natural as well as in all other matters, are seen always to present themselves in the same subject, and to be affections of the same: examples are – health and sickness, beauty and ugliness, strength and weakness, sight and blindness, hearing and deafness. This is also clear from the following considerations. The criterion by which we know the waking person to be awake is identical with that by which we know the sleeper to be asleep; for we assume that one who is exercising sense-perception is awake, and that every one who is awake perceives either some external movement or else some movement in his own consciousness. If waking, then, consists in nothing else than the exercise of sense-perception, the inference is clear, that the organ, in virtue of which animals perceive, is that by which they wake, when they are awake, or sleep, when they are awake, or sleep, when they are asleep.

But since the exercise of sense-perception does not belong to soul or body exclusively, then (since the subject of actuality is in every case identical with that of potentiality, and what is called sense-perception, as actuality, is a movement of the soul through the body) it is clear that its affection is not an affection of soul exclusively, and that a soulless body has not the potentiality of perception. [Thus sleep and waking are not attributes of pure intelligence, on the one hand, or of inanimate bodies, on the other.]

Now, whereas we have already elsewhere distinguished what are called the parts of the soul, and whereas the nutrient is, in all living bodies, capable of existing without the other parts, while none of the others can exist without the nutrient; it is clear that sleep and waking are not affections of such living things as partake only of growth and decay, e.g. not of plants, because these have not the faculty of sense-perception, whether or not this be capable of separate existence; in its potentiality, indeed, and in its relationships, it is separable.

Likewise it is clear that [of those which either sleep or wake] there is no animal which is always awake or always asleep, but that both these affections belong [alternately] to the same animals. For if there be an animal not endued with sense-perception, it is impossible that this should either sleep

or wake; since both these are affections of the activity of the primary faculty of sense-perception. But it is equally impossible also that either of these two affections should perpetually attach itself to the same animal, e.g. that some species of animal should be always asleep or always awake, without intermission; for all organs which have a natural function must lose power when they work beyond the natural time-limit of their working period; for instance, the eyes [must lose power] from [too long continued] seeing, and must give it up; and so it is with the hand and every other member which has a function. Now, if sense-perception is the function of a special organ, this also, if it continues perceiving beyond the appointed time-limit of its continuous working period, will lose its power, and will do its work no longer. Accordingly, if the waking period is determined by this fact, that in it sense-perception is free; if in the case of some contraries one of the two must be present, while in the case of others this is not necessary; if waking is the contrary of sleeping, and one of these two must be present to every animal: it must follow that the state of sleeping is necessary. Finally, if such affection is Sleep, and this is a state of powerlessness arising from excess of waking, and excess of waking is in its origin sometimes morbid, sometimes not, so that the powerlessness or dissolution of activity will be so or not; it is inevitable that every creature which wakes must also be capable of sleeping, since it is impossible that it should continue actualizing its powers perpetually.

So, also, it is impossible for any animal to continue always sleeping. For sleep is an affection of the organ of sense-perception – a sort of tie or inhibition of function imposed on it, so that every creature that sleeps must needs have the organ of sense-perception. Now, that alone which is capable of sense-perception in actuality has the faculty of sense-perception; but to realize this faculty, in the proper and unqualified sense, is impossible while one is asleep. All sleep, therefore, must be susceptible of awakening. Accordingly, almost all other animals are clearly observed to partake in sleep, whether they are aquatic, aerial, or terrestrial, since fishes of all kinds, and molluscs, as well as all others which have eyes, have been seen sleeping. ‘Hard-eyed’ creatures and insects manifestly assume the posture of sleep; but the sleep of all such creatures is of brief duration, so that often it might well baffle one’s observation to decide whether they sleep or not. Of testaceous animals, on the contrary, no direct sensible evidence is as yet forthcoming to determine whether they sleep, but if the above reasoning be convincing to any one, he who follows it will admit this [viz. that they do so.]

That, therefore, all animals sleep may be gathered from these considerations. For an animal is defined as such by its possessing sense-perception; and we assert that sleep is, in a certain way, an inhibition of function, or, as it were, a tie, imposed on sense-perception, while its loosening or remission constitutes the being awake. But no plant can partake in either of these affections, for without sense-perception there is neither sleeping nor waking. But creatures which have sense-perception have likewise the feeling of pain and pleasure, while those which have these have appetite as well; but plants have none of these affections. A mark of this is that the nutrient part does its own work better when (the animal) is asleep than when it is awake. Nutrition and growth are then especially promoted, a fact which implies that creatures do not need sense-perception to assist these processes.

2

We must now proceed to inquire into the cause why one sleeps and wakes, and into the particular nature of the sense-perception, or sense-perceptions, if there be several, on which these affections depend. Since, then, some animals possess all the modes of sense-perception, and some not all, not, for example, sight, while all possess touch and taste, except such animals as are imperfectly

developed, a class of which we have already treated in our work on the soul; and since an animal when asleep is unable to exercise, in the simple sense any particular sensory faculty whatever, it follows that in the state called sleep the same affection must extend to all the special senses; because, if it attaches itself to one of them but not to another, then an animal while asleep may perceive with the latter; but this is impossible.

Now, since every sense has something peculiar, and also something common; peculiar, as, e.g. seeing is to the sense of sight, hearing to the auditory sense, and so on with the other senses severally; while all are accompanied by a common power, in virtue whereof a person perceives that he sees or hears (for, assuredly, it is not by the special sense of sight that one sees that he sees; and it is not by mere taste, or sight, or both together that one discerns, and has the faculty of discerning, that sweet things are different from white things, but by a faculty connected in common with all the organs of sense; for there is one sensory function, and the controlling sensory faculty is one, though differing as a faculty of perception in relation to each genus of sensibles, e.g. sound or colour); and since this [common sensory activity] subsists in association chiefly with the faculty of touch (for this can exist apart from all the other organs of sense, but none of them can exist apart from it – a subject of which we have treated in our speculations concerning the Soul); it is therefore evident that waking and sleeping are an affection of this [common and controlling organ of sense-perception]. This explains why they belong to all animals, for touch [with which this common organ is chiefly connected], alone, [is common] to all [animals].

For if sleeping were caused by the special senses having each and all undergone some affection, it would be strange that these senses, for which it is neither necessary nor in a manner possible to realize their powers simultaneously, should necessarily all go idle and become motionless simultaneously. For the contrary experience, viz. that they should not go to rest altogether, would have been more reasonably anticipated. But, according to the explanation just given, all is quite clear regarding those also. For, when the sense organ which controls all the others, and to which all the others are tributary, has been in some way affected, that these others should be all affected at the same time is inevitable, whereas, if one of the tributaries becomes powerless, that the controlling organ should also become powerless need in no wise follow.

It is indeed evident from many considerations that sleep does not consist in the mere fact that the special senses do not function or that one does not employ them; and that it does not consist merely in an inability to exercise the sense-perceptions; for such is what happens in cases of swooning. A swoon means just such impotence of perception, and certain other cases of unconsciousness also are of this nature. Moreover, persons who have the bloodvessels in the neck compressed become insensible. But sleep supervenes when such incapacity of exercise has neither arisen in some casual organ of sense, nor from some chance cause, but when, as has been just stated, it has its seat in the primary organ with which one perceives objects in general. For when this has become powerless all the other sensory organs also must lack power to perceive; but when one of them has become powerless, it is not necessary for this also to lose its power.

We must next state the cause to which it is due, and its quality as an affection. Now, since there are several types of cause (for we assign equally the ‘final’, the ‘efficient’, the ‘material’, and the ‘formal’ as causes), in the first place, then, as we assert that Nature operates for the sake of an end, and that this end is a good; and that to every creature which is endowed by nature with the power to move, but cannot with pleasure to itself move always and continuously, rest is necessary and beneficial; and since, taught by experience, men apply to sleep this metaphorical term, calling it a ‘rest’ [from the strain of movement implied in sense-perception]: we conclude that its end is the conservation of animals. But the waking state is for an animal its highest end, since the exercise of sense-perception or of thought is the highest end for all beings to which either of these appertains;

inasmuch as these are best, and the highest end is what is best: whence it follows that sleep belongs of necessity to each animal. I use the term ‘necessity’ in its conditional sense, meaning that if an animal is to exist and have its own proper nature, it must have certain endowments; and, if these are to belong to it, certain others likewise must belong to it [as their condition.]

The next question to be discussed is that of the kind of movement or action, taking place within their bodies, from which the affection of waking or sleeping arises in animals. Now, we must assume that the causes of this affection in all other animals are identical with, or analogous to, those which operate in sanguineous animals; and that the causes operating in sanguineous animals generally are identical with those operating in man. Hence we must consider the entire subject in the light of these instances [afforded by sanguineous animals, especially man]. Now, it has been definitely settled already in another work that sense-perception in animals originates ill the same part of the organism in which movement originates. This locus of origination is one of three determinate loci, viz. that which lies midway between the head and the abdomen. This is sanguineous animals is the region of the heart; for all sanguineous animals have a heart; and from this it is that both motion and the controlling sense-perception originate. Now, as regards movement, it is obvious that that of breathing and of the cooling process generally takes its rise there; and it is with a view to the conservation of the [due amount of] heat in this part that nature has formed as she has both the animals which respire, and those which cool themselves by moisture. Of this [cooling process] per se we shall treat hereafter. In bloodless animals, and insects, and such as do not respire, the ‘connatural spirit’ is seen alternately puffed up and subsiding in the part which is in them analogous [to the region of the heart in sanguineous animals]. This is clearly observable in the holoptera [insects with undivided wings] as wasps and bees; also in flies and such creatures. And since to move anything, or do anything, is impossible without strength, and holding the breath produces strength – in creatures which inhale, the holding of that breath which comes from without, but, in creatures which do not respire, of that which is connatural (which explains why winged insects of the class holoptera, when they move, are perceived to make a humming noise, due to the friction of the connatural spirit colliding with the diaphragm); and since movement is, in every animal, attended with some sense-perception, either internal or external, in the primary organ of sense, [we conclude] accordingly that if sleeping and waking are affections of this organ, the place in which, or the organ in which, sleep and waking originate, is self-evident [being that in which movement and sense-perception originate, viz. the heart].

Some persons move in their sleep, and perform many acts like waking acts, but not without a phantasm or an exercise of sense-perception; for a dream is in a certain way a sense-impression. But of them we have to speak later on. Why it is that persons when aroused remember their dreams, but do not remember these acts which are like waking acts, has been already explained in the work ‘Of Problems’.

3

The point for consideration next in order to the preceding is: – What are the processes in which the affection of waking and sleeping originates, and whence do they arise? Now, since it is when it has sense-perception that an animal must first take food and receive growth, and in all cases food in its ultimate form is, in sanguineous animals, the natural substance blood, or, in bloodless animals, that which is analogous to this; and since the veins are the place of the blood, while the origin of these is the heart – an assertion which is proved by anatomy – it is manifest that, when the external nutriment enters the parts fitted for its reception, the evaporation arising from it enters into the veins, and there, undergoing a change, is converted into blood, and makes its way to their source

[the heart]. We have treated of all this when discussing the subject of nutrition, but must here recapitulate what was there said, in order that we may obtain a scientific view of the beginnings of the process, and come to know what exactly happens to the primary organ of sense-perception to account for the occurrence of waking and sleep. For sleep, as has been shown, is not any given impotence of the perceptive faculty; for unconsciousness, a certain form of asphyxia, and swooning, all produce such impotence. Moreover it is an established fact that some persons in a profound trance have still had the imaginative faculty in play. This last point, indeed, gives rise to a difficulty; for if it is conceivable that one who had swooned should in this state fall asleep, the phantasm also which then presented itself to his mind might be regarded as a dream. Persons, too, who have fallen into a deep trance, and have come to be regarded as dead, say many things while in this condition. The same view, however, is to be taken of all these cases, [i.e. that they are not cases of sleeping or dreaming].

As we observed above, sleep is not co-extensive with any and every impotence of the perceptive faculty, but this affection is one which arises from the evaporation attendant upon the process of nutrition. The matter evaporated must be driven onwards to a certain point, then turn back, and change its current to and fro, like a tide-race in a narrow strait. Now, in every animal the hot naturally tends to move [and carry other things] upwards, but when it has reached the parts above [becoming cool], it turns back again, and moves downwards in a mass. This explains why fits of drowsiness are especially apt to come on after meals; for the matter, both the liquid and the corporeal, which is borne upwards in a mass, is then of considerable quantity. When, therefore, this comes to a stand it weighs a person down and causes him to nod, but when it has actually sunk downwards, and by its return has repulsed the hot, sleep comes on, and the animal so affected is presently asleep. A confirmation of this appears from considering the things which induce sleep; they all, whether potable or edible, for instance poppy, mandragora, wine, darnel, produce a heaviness in the head; and persons borne down [by sleepiness] and nodding [drowsily] all seem affected in this way, i.e. they are unable to lift up the head or the eye-lids. And it is after meals especially that sleep comes on like this, for the evaporation from the foods eaten is then copious. It also follows certain forms of fatigue; for fatigue operates as a solvent, and the dissolved matter acts, if not cold, like food prior to digestion. Moreover, some kinds of illness have this same effect; those arising from moist and hot secretions, as happens with fever-patients and in cases of lethargy. Extreme youth also has this effect; infants, for example, sleep a great deal, because of the food being all borne upwards – a mark whereof appears in the disproportionately large size of the upper parts compared with the lower during infancy, which is due to the fact that growth predominates in the direction of the former. Hence also they are subject to epileptic seizures; for sleep is like epilepsy, and, in a sense, actually is a seizure of this sort. Accordingly, the beginning of this malady takes place with many during sleep, and their subsequent habitual seizures occur in sleep, not in waking hours. For when the spirit [evaporation] moves upwards in a volume, on its return downwards it distends the veins, and forcibly compresses the passage through which respiration is effected. This explains why wines are not good for infants or for wet nurses (for it makes no difference, doubtless, whether the infants themselves, or their nurses, drink them), but such persons should drink them [if at all] diluted with water and in small quantity. For wine is spirituous, and of all wines the dark more so than any other. The upper parts, in infants, are so filled with nutriment that within five months [after birth] they do not even turn the neck [sc. to raise the head]; for in them, as in persons deeply intoxicated, there is ever a large quantity of moisture ascending. It is reasonable, too, to think that this affection is the cause of the embryo’s remaining at rest in the womb at first. Also, as a general rule, persons whose veins are inconspicuous, as well as those who are dwarf-like, or have abnormally large heads, are addicted to sleep. For in the former the veins

are narrow, so that it is not easy for the moisture to flow down through them; while in the case of dwarfs and those whose heads are abnormally large, the impetus of the evaporation upwards is excessive. Those [on the contrary] whose veins are large are, thanks to the easy flow through the veins, not addicted to sleep, unless, indeed, they labour under some other affection which counteracts [this easy flow]. Nor are the 'atrabilious' addicted to sleep, for in them the inward region is cooled so that the quantity of evaporation in their case is not great. For this reason they have large appetites, though spare and lean; for their bodily condition is as if they derived no benefit from what they eat. The dark bile, too, being itself naturally cold, cools also the nutrient tract, and the other parts wheresoever such secretion is potentially present [i.e. tends to be formed]. Hence it is plain from what has been said that sleep is a sort of concentration, or natural recoil, of the hot matter inwards [towards its centre], due to the cause above mentioned. Hence restless movement is a marked feature in the case of a person when drowsy. But where it [the heat in the upper and outer parts] begins to fail, he grows cool, and owing to this cooling process his eye-lids droop. Accordingly [in sleep] the upper and outward parts are cool, but the inward and lower, i.e. the parts at the feet and in the interior of the body, are hot.

Yet one might found a difficulty on the facts that sleep is most oppressive in its onset after meals, and that wine, and other such things, though they possess heating properties, are productive of sleep, for it is not probable that sleep should be a process of cooling while the things that cause sleeping are themselves hot. Is the explanation of this, then, to be found in the fact that, as the stomach when empty is hot, while replenishment cools it by the movement it occasions, so the passages and tracts in the head are cooled as the 'evaporation' ascends thither? Or, as those who have hot water poured on them feel a sudden shiver of cold, just so in the case before us, may it be that, when the hot substance ascends, the cold rallying to meet it cools [the aforesaid parts] deprives their native heat of all its power, and compels it to retire? Moreover, when much food is taken, which [i.e. the nutrient evaporation from which] the hot substance carries upwards, this latter, like a fire when fresh logs are laid upon it, is itself cooled, until the food has been digested.

For, as has been observed elsewhere, sleep comes on when the corporeal element [in the 'evaporation'] conveyed upwards by the hot, along the veins, to the head. But when that which has been thus carried up can no longer ascend, but is too great in quantity [to do so], it forces the hot back again and flows downwards. Hence it is that men sink down [as they do in sleep] when the heat which tends to keep them erect (man alone, among animals, being naturally erect) is withdrawn; and this, when it befalls them, causes unconsciousness, and afterwards phantasy.

Or are the solutions thus proposed barely conceivable accounts of the refrigeration which takes place, while, as a matter of fact, the region of the brain is, as stated elsewhere, the main determinant of the matter? For the brain, or in creatures without a brain that which corresponds to it, is of all parts of the body the coolest. Therefore, as moisture turned into vapour by the sun's heat is, when it has ascended to the upper regions, cooled by the coldness of the latter, and becoming condensed, is carried downwards, and turned into water once more; just so the excrementitious evaporation, when carried up by the heat to the region of the brain, is condensed into a 'phlegm' (which explains why catarrhs are seen to proceed from the head); while that evaporation which is nutrient and not unwholesome, becoming condensed, descends and cools the hot. The tenuity or narrowness of the veins about the brain itself contributes to its being kept cool, and to its not readily admitting the evaporation. This, then, is a sufficient explanation of the cooling which takes place, despite the fact that the evaporation is exceedingly hot.

A person awakes from sleep when digestion is completed: when the heat, which had been previously forced together in large quantity within a small compass from out the surrounding part, has once more prevailed, and when a separation has been effected between the more corporeal and

the purer blood. The finest and purest blood is that contained in the head, while the thickest and most turbid is that in the lower parts. The source of all the blood is, as has been stated both here and elsewhere, the heart. Now of the chambers in the heart the central communicates with each of the two others. Each of the latter again acts as receiver from each, respectively, of the two vessels, called the ‘great’ and the ‘aorta’. It is in the central chamber that the [above-mentioned] separation takes place. To go into these matters in detail would, however, be more properly the business of a different treatise from the present. Owing to the fact that the blood formed after the assimilation of food is especially in need of separation, sleep [then especially] occurs [and lasts] until the purest part of this blood has been separated off into the upper parts of the body, and the most turbid into the lower parts. When this has taken place animals awake from sleep, being released from the heaviness consequent on taking food. We have now stated the cause of sleeping, viz. that it consists in the recoil by the corporeal element, upborne by the connatural heat, in a mass upon the primary sense-organ; we have also stated what sleep is, having shown that it is a seizure of the primary sense-organ, rendering it unable to actualize its powers; arising of necessity (for it is impossible for an animal to exist if the conditions which render it an animal be not fulfilled), i.e. for the sake of its conservation; since remission of movement tends to the conservation of animals.

On Dreams
translated by J. I. Beare

1
We must, in the next place, investigate the subject of the dream, and first inquire to which of the faculties of the soul it presents itself, i.e. whether the affection is one which pertains to the faculty of intelligence or to that of sense-perception; for these are the only faculties within us by which we acquire knowledge.

If, then, the exercise of the faculty of sight is actual seeing, that of the auditory faculty, hearing, and, in general that of the faculty of sense-perception, perceiving; and if there are some perceptions common to the senses, such as figure, magnitude, motion, &c., while there are others, as colour, sound, taste, peculiar [each to its own sense]; and further, if all creatures, when the eyes are closed in sleep, are unable to see, and the analogous statement is true of the other senses, so that manifestly we perceive nothing when asleep; we may conclude that it is not by sense-perception we perceive a dream.

But neither is it by opinion that we do so. For [in dreams] we not only assert, e.g. that some object approaching is a man or a horse [which would be an exercise of opinion], but that the object is white or beautiful, points on which opinion without sense-perception asserts nothing either truly or falsely. It is, however, a fact that the soul makes such assertions in sleep. We seem to see equally well that the approaching figure is a man, and that it is white. [In dreams], too, we think something else, over and above the dream presentation, just as we do in waking moments when we perceive something; for we often also reason about that which we perceive. So, too, in sleep we sometimes have thoughts other than the mere phantasms immediately before our minds. This would be manifest to any one who should attend and try, immediately on arising from sleep, to remember [his dreaming experience]. There are cases of persons who have seen such dreams, those, for example, who believe themselves to be mentally arranging a given list of subjects according to the mnemonic rule. They frequently find themselves engaged in something else besides the dream, viz.

in setting a phantasm which they envisage into its mnemonic position. Hence it is plain that not every ‘phantasm’ in sleep is a mere dream-image, and that the further thinking which we perform then is due to an exercise of the faculty of opinion.

So much at least is plain on all these points, viz. that the faculty by which, in waking hours, we are subject to illusion when affected by disease, is identical with that which produces illusory effects in sleep. So, even when persons are in excellent health, and know the facts of the case perfectly well, the sun, nevertheless, appears to them to be only a foot wide. Now, whether the presentative faculty of the soul be identical with, or different from, the faculty of sense-perception, in either case the illusion does not occur without our actually seeing or [otherwise] perceiving something. Even to see wrongly or to hear wrongly can happen only to one who sees or hears something real, though not exactly what he supposes. But we have assumed that in sleep one neither sees, nor hears, nor exercises any sense whatever. Perhaps we may regard it as true that the dreamer sees nothing, yet as false that his faculty of sense-perception is unaffected, the fact being that the sense of seeing and the other senses may possibly be then in a certain way affected, while each of these affections, as duly as when he is awake, gives its impulse in a certain manner to his [primary] faculty of sense, though not in precisely the same manner as when he is awake. Sometimes, too, opinion says [to dreamers] just as to those who are awake, that the object seen is an illusion; at other times it is inhibited, and becomes a mere follower of the phantasm.

It is plain therefore that this affection, which we name ‘dreaming’, is no mere exercise of opinion or intelligence, but yet is not an affection of the faculty of perception in the simple sense. If it were the latter it would be possible [when asleep] to hear and see in the simple sense.

How then, and in what manner, it takes place, is what we have to examine. Let us assume, what is indeed clear enough, that the affection [of dreaming] pertains to sense-perception as surely as sleep itself does. For sleep does not pertain to one organ in animals and dreaming to another; both pertain to the same organ.

But since we have, in our work On the Soul, treated of presentation, and the faculty of presentation is identical with that of sense-perception, though the essential notion of a faculty of presentation is different from that of a faculty of sense-perception; and since presentation is the movement set up by a sensory faculty when actually discharging its function, while a dream appears to be a presentation (for a presentation which occurs in sleep – whether simply or in some particular way – is what we call a dream): it manifestly follows that dreaming is an activity of the faculty of sense-perception, but belongs to this faculty qua presentative.

2

We can best obtain a scientific view of the nature of the dream and the manner in which it originates by regarding it in the light of the circumstances attending sleep. The objects of sense-perception corresponding to each sensory organ produce sense-perception in us, and the affection due to their operation is present in the organs of sense not only when the perceptions are actualized, but even when they have departed.

What happens in these cases may be compared with what happens in the case of projectiles moving in space. For in the case of these the movement continues even when that which set up the movement is no longer in contact [with the things that are moved]. For that which set them in motion moves a certain portion of air, and this, in turn, being moved excites motion in another portion; and so, accordingly, it is in this way that [the bodies], whether in air or in liquids, continue moving, until they come to a standstill.

This we must likewise assume to happen in the case of qualitative change; for that part which [for example] has been heated by something hot, heats [in turn] the part next to it, and this propagates the affection continuously onwards until the process has come round to its oint of origination. This must also happen in the organ wherein the exercise of sense-perception takes place, since sense-perception, as realized in actual perceiving, is a mode of qualitative change. This explains why the affection continues in the sensory organs, both in their deeper and in their more superficial parts, not merely while they are actually engaged in perceiving, but even after they have ceased to do so. That they do this, indeed, is obvious in cases where we continue for some time engaged in a particular form of perception, for then, when we shift the scene of our perceptive activity, the previous affection remains; for instance, when we have turned our gaze from sunlight into darkness. For the result of this is that one sees nothing, owing to the excited by the light still subsisting in our eyes. Also, when we have looked steadily for a long while at one colour, e.g. at white or green, that to which we next transfer our gaze appears to be of the same colour. Again if, after having looked at the sun or some other brilliant object, we close the eyes, then, if we watch carefully, it appears in a right line with the direction of vision (whatever this may be), at first in its own colour; then it changes to crimson, next to purple, until it becomes black and disappears. And also when persons turn away from looking at objects in motion, e.g. rivers, and especially those which flow very rapidly, they find that the visual stimulations still present themselves, for the things really at rest are then seen moving: persons become very deaf after hearing loud noises, and after smelling very strong odours their power of smelling is impaired; and similarly in other cases. These phenomena manifestly take place in the way above described.

That the sensory organs are acutely sensitive to even a slight qualitative difference [in their objects] is shown by what happens in the case of mirrors; a subject to which, even taking it independently, one might devote close consideration and inquiry. At the same time it becomes plain from them that as the eye [in seeing] is affected [by the object seen], so also it produces a certain effect upon it. If a woman chances during her menstrual period to look into a highly polished mirror, the surface of it will grow cloudy with a blood-coloured haze. It is very hard to remove this stain from a new mirror, but easier to remove from an older mirror. As we have said before, the cause of this lies in the fact that in the act of sight there occurs not only a passion in the sense organ acted on by the polished surface, but the organ, as an agent, also produces an action, as is proper to a brilliant object. For sight is the property of an organ possessing brilliance and colour. The eyes, therefore, have their proper action as have other parts of the body. Because it is natural to the eye to be filled with blood-vessels, a woman’s eyes, during the period of menstrual flux and inflammation, will undergo a change, although her husband will not note this since his seed is of the same nature as that of his wife. The surrounding atmosphere, through which operates the action of sight, and which surrounds the mirror also, will undergo a change of the same sort that occurred shortly before in the woman’s eyes, and hence the surface of the mirror is likewise affected. And as in the case of a garment, the cleaner it is the more quickly it is soiled, so the same holds true in the case of the mirror. For anything that is clean will show quite clearly a stain that it chances to receive, and the cleanest object shows up even the slightest stain. A bronze mirror, because of its shininess, is especially sensitive to any sort of contact (the movement of the surrounding air acts upon it like a rubbing or pressing or wiping); on that account, therefore, what is clean will show up clearly the slightest touch on its surface. It is hard to cleanse smudges off new mirrors because the stain penetrates deeply and is suffused to all parts; it penetrates deeply because the mirror is not a dense medium, and is suffused widely because of the smoothness of the object. On the other hand, in the case of old mirrors, stains do not remain because they do not penetrate deeply, but only smudge the surface.

From this therefore it is plain that stimulatory motion is set up even by slight differences, and that sense-perception is quick to respond to it; and further that the organ which perceives colour is not only affected by its object, but also reacts upon it. Further evidence to the same point is afforded by what takes place in wines, and in the manufacture of unguents. For both oil, when prepared, and wine become rapidly infected by the odours of the things near them; they not only acquire the odours of the things thrown into or mixed with them, but also those of the things which are placed, or which grow, near the vessels containing them.

In order to answer our original question, let us now, therefore, assume one proposition, which is clear from what precedes, viz. that even when the external object of perception has departed, the impressions it has made persist, and are themselves objects of perception: and [let us assume], besides, that we are easily deceived respecting the operations of sense-perception when we are excited by emotions, and different persons according to their different emotions; for example, the coward when excited by fear, the amorous person by amorous desire; so that, with but little resemblance to go upon, the former thinks he sees his foes approaching, the latter, that he sees the object of his desire; and the more deeply one is under the influence of the emotion, the less similarity is required to give rise to these illusory impressions. Thus too, both in fits of anger, and also in all states of appetite, all men become easily deceived, and more so the more their emotions are excited. This is the reason too why persons in the delirium of fever sometimes think they see animals on their chamber walls, an illusion arising from the faint resemblance to animals of the markings thereon when put together in patterns; and this sometimes corresponds with the emotional states of the sufferers, in such a way that, if the latter be not very ill, they know well enough that it is an illusion; but if the illness is more severe they actually move according to the appearances. The cause of these occurrences is that the faculty in virtue of which the controlling sense judges is not identical with that in virtue of which presentations come before the mind. A proof of this is, that the sun presents itself as only a foot in diameter, though often something else gainsays the presentation. Again, when the fingers are crossed, the one object [placed between them] is felt [by the touch] as two; but yet we deny that it is two; for sight is more authoritative than touch. Yet, if touch stood alone, we should actually have pronounced the one object to be two. The ground of such false judgements is that any appearances whatever present themselves, not only when its object stimulates a sense, but also when the sense by itself alone is stimulated, provided only it be stimulated in the same manner as it is by the object. For example, to persons sailing past the land seems to move, when it is really the eye that is being moved by something else [the moving ship.]

3

From this it is manifest that the stimulatory movements based upon sensory impressions, whether the latter are derived from external objects or from causes within the body, present themselves not only when persons are awake, but also then, when this affection which is called sleep has come upon them, with even greater impressiveness. For by day, while the senses and the intellect are working together, they (i.e. such movements) are extruded from consciousness or obscured, just as a smaller is beside a larger fire, or as small beside great pains or pleasures, though, as soon as the latter have ceased, even those which are trifling emerge into notice. But by night [i.e. in sleep] owing to the inaction of the particular senses, and their powerlessness to realize themselves, which arises from the reflux of the hot from the exterior parts to the interior, they [i.e. the above ‘movements’] are borne in to the head quarters of sense-perception, and there display themselves as the disturbance (of waking life) subsides. We must suppose that, like the little eddies which are

being ever formed in rivers, so the sensory movements are each a continuous process, often remaining like what they were when first started, but often, too, broken into other forms by collisions with obstacles. This [last mentioned point], moreover, gives the reason why no dreams occur in sleep immediately after meals, or to sleepers who are extremely young, e.g. to infants. The internal movement in such cases is excessive, owing to the heat generated from the food. Hence, just as in a liquid, if one vehemently disturbs it, sometimes no reflected image appears, while at other times one appears, indeed, but utterly distorted, so as to seem quite unlike its original; while, when once the motion has ceased, the reflected images are clear and plain; in the same manner during sleep the phantasms, or residuary movements, which are based upon the sensory impressions, become sometimes quite obliterated by the above described motion when too violent; while at other times the sights are indeed seen, but confused and weird, and the dreams [which then appear] are unhealthy, like those of persons who are atrabilious, or feverish, or intoxicated with wine. For all such affections, being spirituous, cause much commotion and disturbance. In sanguineous animals, in proportion as the blood becomes calm, and as its purer are separated from its less pure elements, the fact that the movement, based on impressions derived from each of the organs of sense, is preserved in its integrity, renders the dreams healthy, causes a [clear] image to present itself, and makes the dreamer think, owing to the effects borne in from the organ of sight, that he actually sees, and owing to those which come from the organ of hearing, that he really hears; and so on with those also which proceed from the other sensory organs. For it is owing to the fact that the movement which reaches the primary organ of sense comes from them, that one even when awake believes himself to see, or hear, or otherwise perceive; just as it is from a belief that the organ of sight is being stimulated, though in reality not so stimulated, that we sometimes erroneously declare ourselves to see, or that, from the fact that touch announces two movements, we think that the one object is two. For, as a rule, the governing sense affirms the report of each particular sense, unless another particular sense, more authoritative, makes a contradictory report. In every case an appearance presents itself, but what appears does not in every case seem real, unless when the deciding faculty is inhibited, or does not move with its proper motion. Moreover, as we said that different men are subject to illusions, each according to the different emotion present in him, so it is that the sleeper, owing to sleep, and to the movements then going on in his sensory organs, as well as to the other facts of the sensory process, [is liable to illusion], so that the dream presentation, though but little like it, appears as some actual given thing. For when one is asleep, in proportion as most of the blood sinks inwards to its fountain [the heart], the internal [sensory] movements, some potential, others actual accompany it inwards. They are so related [in general] that, if anything move the blood, some one sensory movement will emerge from it, while if this perishes another will take its place; while to one another also they are related in the same way as the artificial frogs in water which severally rise [in fixed succesion] to the surface in the order in which the salt [which keeps them down] becomes dissolved. The residuary movements are like these: they are within the soul potentially, but actualize themselves only when the impediment to their doing so has been relaxed; and according as they are thus set free, they begin to move in the blood which remains in the sensory organs, and which is now but scanty, while they possess verisimilitude after the manner of cloud-shapes, which in their rapid metamorphoses one compares now to human beings and a moment afterwards to centaurs. Each of them is however, as has been said, the remnant of a sensory impression taken when sense was actualizing itself; and when this, the true impression, has departed, its remnant is still immanent, and it is correct to say of it, that though not actually Koriskos, it is like Koriskos. For when the person was actually perceiving, his controlling and judging sensory faculty did not call it Koriskos, but, prompted by this [impression], called the genuine person yonder Koriskos. Accordingly, this sensory impulse, which, when

actually perceiving, it [the controlling faculty] describes (unless completely inhibited by the blood), it now [in dreams] when quasi-perceiving, receives from the movements persisting in the sense-organs, and mistakes it – an impulse that is merely like the true [objective] impression – for the true impression itself, while the effect of sleep is so great that it causes this mistake to pass unnoticed. Accordingly, just as if a finger be inserted beneath the eyeball without being observed, one object will not only present two visual images, but will create an opinion of its being two objects; while if it [the finger] be observed, the presentation will be the same, but the same opinion will not be formed of it; exactly so it is in states of sleep: if the sleeper perceives that he is asleep, and is conscious of the sleeping state during which the perception comes before his mind, it presents itself still, but something within him speaks to this effect: 'the image of Koriskos presents itself, but the real Koriskos is not present'; for often, when one is asleep, there is something in consciousness which declares that what then presents itself is but a dream. If, however, he is not aware of being asleep, there is nothing which will contradict the testimony of the bare presentation. That what we here urge is true, i.e. that there are such presentative movements in the sensory organs, any one may convince himself, if he attends to and tries to remember the affections we experience when sinking into slumber or when being awakened. He will sometimes, in the moment of awakening, surprise the images which present themselves to him in sleep, and find that they are really but movements lurking in the organs of sense. And indeed some very young persons, if it is dark, though looking with wide open eyes, see multitudes of phantom figures moving before them, so that they often cover up their heads in terror.

From all this, then, the conclusion to be drawn is, that the dream is a sort of presentation, and, more particularly, one which occurs in sleep; since the phantoms just mentioned are not dreams, nor is any other a dream which presents itself when the sense-perceptions are in a state of freedom. Nor is every presentation which occurs in sleep necessarily a dream. For in the first place, some persons [when asleep] actually, in a certain way, perceive sounds, light, savour, and contact; feebly, however, and, as it were, remotely. For there have been cases in which persons while asleep, but with the eyes partly open, saw faintly in their sleep (as they supposed) the light of a lamp, and afterwards, on being awakened, straightway recognized it as the actual light of a real lamp; while, in other cases, persons who faintly heard the crowing of cocks or the barking of dogs identified these clearly with the real sounds as soon as they awoke. Some persons, too, return answers to questions put to them in sleep. For it is quite possible that, of waking or sleeping, while the one is present in the ordinary sense, the other also should be present in a certain way. But none of these occurrences should be called a dream. Nor should the true thoughts, as distinct from the mere presentations, which occur in sleep [be called dreams]. The dream proper is a presentation based on the movement of sense impressions, when such presentation occurs during sleep, taking sleep in the strict sense of the term.

There are cases of persons who in their whole lives have never had a dream, while others dream when considerably advanced in years, having never dreamed before. The cause of their not having dreams appears somewhat like that which operates in the case of infants, and [that which operates] immediately after meals. It is intelligible enough that no dream-presentation should occur to persons whose natural constitution is such that in them copious evaporation is borne upwards, which, when borne back downwards, causes a large quantity of motion. But it is not surprising that, as age advances, a dream should at length appear to them. Indeed, it is inevitable that, as a change is wrought in them in proportion to age or emotional experience, this reversal [from non-dreaming to dreaming] should occur also.

On Prophesying by Dreams
translated by J. I. Beare

1

As to the divination which takes place in sleep, and is said to be based on dreams, we cannot lightly either dismiss it with contempt or give it implicit confidence. The fact that all persons, or many, suppose dreams to possess a special significance, tends to inspire us with belief in it [such divination], as founded on the testimony of experience; and indeed that divination in dreams should, as regards some subjects, be genuine, is not incredible, for it has a show of reason; from which one might form a like opinion also respecting all other dreams. Yet the fact of our seeing no probable cause to account for such divination tends to inspire us with distrust. For, in addition to its further unreasonableness, it is absurd to combine the idea that the sender of such dreams should be God with the fact that those to whom he sends them are not the best and wisest, but merely commonplace persons. If, however, we abstract from the causality of God, none of the other causes assigned appears probable. For that certain persons should have foresight in dreams concerning things destined to take place at the Pillars of Hercules, or on the banks of the Borysthenes, seems to be something to discover the explanation of which surpasses the wit of man. Well then, the dreams in question must be regarded either as causes, or as tokens, of the events, or else as coincidences; either as all, or some, of these, or as one only. I use the word ‘cause’ in the sense in which the moon is [the cause] of an eclipse of the sun, or in which fatigue is [a cause] of fever; ‘token’ [in the sense in which] the entrance of a star [into the shadow] is a token of the eclipse, or [in which] roughness of the tongue [is a token] of fever; while by ‘coincidence’ I mean, for example, the occurrence of an eclipse of the sun while some one is taking a walk; for the walking is neither a token nor a cause of the eclipse, nor the eclipse [a cause or token] of the walking. For this reason no coincidence takes place according to a universal or general rule. Are we then to say that some dreams are causes, others tokens, e.g. of events taking place in the bodily organism? At all events, even scientific physicians tell us that one should pay diligent attention to dreams, and to hold this view is reasonable also for those who are not practitioners, but speculative philosophers. For the movements which occur in the daytime [within the body] are, unless very great and violent, lost sight of in contrast with the waking movements, which are more impressive. In sleep the opposite takes place, for then even trifling movements seem considerable. This is plain in what often happens during sleep; for example, dreamers fancy that they are affected by thunder and lightning, when in fact there are only faint ringings in their ears; or that they are enjoying honey or other sweet savours, when only a tiny drop of phlegm is flowing down [the oesophagus]; or that they are walking through fire, and feeling intense heat, when there is only a slight warmth affecting certain parts of the body. When they are awakened, these things appear to them in this their true character. But since the beginnings of all events are small, so, it is clear, are those also of the diseases or other affections about to occur in our bodies. In conclusion, it is manifest that these beginnings must be more evident in sleeping than in waking moments.

Nay, indeed, it is not improbable that some of the presentations which come before the mind in sleep may even be causes of the actions cognate to each of them. For as when we are about to act [in waking hours], or are engaged in any course of action, or have already performed certain actions, we often find ourselves concerned with these actions, or performing them, in a vivid dream; the cause whereof is that the dream-movement has had a way paved for it from the original movements set up in the daytime; exactly so, but conversely, it must happen that the movements set up first in

sleep should also prove to be starting-points of actions to be performed in the daytime, since the recurrence by day of the thought of these actions also has had its way paved for it in the images before the mind at night. Thus then it is quite conceivable that some dreams may be tokens and causes [of future events].

Most [so-called prophetic] dreams are, however, to be classed as mere coincidences, especially all such as are extravagant, and those in the fulfilment of which the dreamers have no initiative, such as in the case of a sea-fight, or of things taking place far away. As regards these it is natural that the fact should stand as it does whenever a person, on mentioning something, finds the very thing mentioned come to pass. Why, indeed, should this not happen also in sleep? The probability is, rather, that many such things should happen. As, then, one's mentioning a particular person is neither token nor cause of this person's presenting himself, so, in the parallel instance, the dream is, to him who has seen it, neither token nor cause of its [so-called] fulfilment, but a mere coincidence. Hence the fact that many dreams have no 'fulfilment', for coincidence do not occur according to any universal or general law.

2

On the whole, forasmuch as certain of the lower animals also dream, it may be concluded that dreams are not sent by God, nor are they designed for this purpose [to reveal the future]. They have a divine aspect, however, for Nature [their cause] is divinely planned, though not itself divine. A special proof [of their not being sent by God] is this: the power of foreseeing the future and of having vivid dreams is found in persons of inferior type, which implies that God does not send their dreams; but merely that all those whose physical temperament is, as it were, garrulous and excitable, see sights of all descriptions; for, inasmuch as they experience many movements of every kind, they just chance to have visions resembling objective facts, their luck in these matters being merely like that of persons who play at even and odd. For the principle which is expressed in the gambler's maxim: 'If you make many throws your luck must change,' holds in their case also. That many dreams have no fulfilment is not strange, for it is so too with many bodily toms and weather-signs, e.g. those of train or wind. For if another movement occurs more influential than that from which, while [the event to which it pointed was] still future, the given token was derived, the event [to which such token pointed] does not take place. So, of the things which ought to be accomplished by human agency, many, though well-planned are by the operation of other principles more powerful [than man's agency] brought to nought. For, speaking generally, that which was about to happen is not in every case what now is happening, nor is that which shall hereafter he identical with that which is now going to be. Still, however, we must hold that the beginnings from which, as we said, no consummation follows, are real beginnings, and these constitute natural tokens of certain events, even though the events do not come to pass.

As for [prophetic] dreams which involve not such beginnings [sc. of future events] as we have here described, but such as are extravagant in times, or places, or magnitudes; or those involving beginnings which are not extravagant in any of these respects, while yet the persons who see the dream hold not in their own hands the beginnings [of the event to which it points]: unless the foresight which such dreams give is the result of pure coincidence, the following would be a better explanation of it than that proposed by Democritus, who alleges 'images' and 'emanations' as its cause. As, when something has caused motion in water or air, this [the portion of water or air], and, though the cause has ceased to operate, such motion propagates itself to a certain point, though there the prime movement is not present; just so it may well be that a movement and a consequent sense-perception should reach sleeping souls from the objects from which Democritus represents

‘images’ and ‘emanations’ coming; that such movements, in whatever way they arrive, should be more perceptible at night [than by day], because when proceeding thus in the daytime they are more liable to dissolution (since at night the air is less disturbed, there being then less wind); and that they shall be perceived within the body owing to sleep, since persons are more sensitive even to slight sensory movements when asleep than when awake. It is these movements then that cause ‘presentations’, as a result of which sleepers foresee the future even relatively to such events as those referred to above. These considerations also explain why this experience befalls commonplace persons and not the most intelligent. For it would have regularly occurred both in the daytime and to the wise had it been God who sent it; but, as we have explained the matter, it is quite natural that commonplace persons should be those who have foresight [in dreams]. For the mind of such persons is not given to thinking, but, as it were, derelict, or totally vacant, and, when once set moving, is borne passively on in the direction taken by that which moves it. With regard to the fact that some persons who are liable to derangement have this foresight, its explanation is that their normal mental movements do not impede [the alien movements], but are beaten off by the latter. Therefore it is that they have an especially keen perception of the alien movements.

That certain persons in particular should have vivid dreams, e.g. that familiar friends should thus have foresight in a special degree respecting one another, is due to the fact that such friends are most solicitous on one another’s behalf. For as acquaintances in particular recognize and perceive one another a long way off, so also they do as regards the sensory movements respecting one another; for sensory movements which refer to persons familiarly known are themselves more familiar. Atrabilious persons, owing to their impetuosity, are, when they, as it were, shoot from a distance, expert at hitting; while, owing to their mutability, the series of movements deploys quickly before their minds. For even as the insane recite, or con over in thought, the poems of Philaegides, e.g. the Aphrodite, whose parts succeed in order of similitude, just so do they [the ‘atrabilious’] go on and on stringing sensory movements together. Moreover, owing to their aforesaid impetuosity, one movement within them is not liable to be knocked out of its course by some other movement.

The most skilful interpreter of dreams is he who has the faculty of observing resemblances. Any one may interpret dreams which are vivid and plain. But, speaking of ‘resemblances’, I mean that dream presentations are analogous to the forms reflected in water, as indeed we have already stated. In the latter case, if the motion in the water be great, the reflexion has no resemblance to its original, nor do the forms resemble the real objects. Skilful, indeed, would he be in interpreting such reflexions who could rapidly discern, and at a glance comprehend, the scattered and distorted fragments of such forms, so as to perceive that one of them represents a man, or a horse, Or anything whatever. Accordingly, in the other case also, in a similar way, some such thing as this [blurred image] is all that a dream amounts to; for the internal movement effaces the clearness of the dream.

The questions, therefore, which we proposed as to the nature of sleep and the dream, and the cause to which each of them is due, and also as to divination as a result of dreams, in every form of it, have now been discussed.

On Longevity and Shortness of Life
translated by G. R. T. Ross

1

The reasons for some animals being long-lived and others short-lived, and, in a word, causes of the length and brevity of life call for investigation.

The necessary beginning to our inquiry is a statement of the difficulties about these points. For it is not clear whether in animals and plants universally it is a single or diverse cause that makes some to be long-lived, others short-lived. Plants too have in some cases a long life, while in others it lasts but for a year.

Further, in a natural structure are longevity and a sound constitution coincident, or is shortness of life independent of unhealthiness? Perhaps in the case of certain maladies a diseased state of the body and shortness of life are interchangeable, while in the case of others ill-health is perfectly compatible with long life.

Of sleep and waking we have already treated; about life and death we shall speak later on, and likewise about health and disease, in so far as it belongs to the science of nature to do so. But at present we have to investigate the causes of some creatures being long-lived, and others short-lived. We find this distinction affecting not only entire genera opposed as wholes to one another, but applying also to contrasted sets of individuals within the same species. As an instance of the difference applying to the genus I give man and horse (for mankind has a longer life than the horse), while within the species there is the difference between man and man; for of men also some are long-lived, others short-lived, differing from each other in respect of the different regions in which they dwell. Races inhabiting warm countries have longer life, those living in a cold climate live a shorter time. Likewise there are similar differences among individuals occupying the same locality.

2

In order to find premisses for our argument, we must answer the question, What is that which, in natural objects, makes them easily destroyed, or the reverse? Since fire and water, and whatsoever is akin thereto, do not possess identical powers they are reciprocal causes of generation and decay. Hence it is natural to infer that everything else arising from them and composed of them should share in the same nature, in all cases where things are not, like a house, a composite unity formed by the synthesis of many things.

In other matters a different account must be given; for in many things their mode of dissolution is something peculiar to themselves, e.g. in knowledge and health and disease. These pass away even though the medium in which they are found is not destroyed but continues to exist; for example, take the termination of ignorance, which is recollection or learning, while knowledge passes away into forgetfulness, or error. But accidentally the disintegration of a natural object is accompanied by the destruction of the non-physical reality; for, when the animal dies, the health or knowledge resident in it passes away too. Hence from these considerations we may draw a conclusion about the soul too; for, if the inherence of soul in body is not a matter of nature but like that of knowledge in the soul, there would be another mode of dissolution pertaining to it besides that which occurs when the body is destroyed. But since evidently it does not admit of this dual dissolution, the soul must stand in a different case in respect of its union with the body.

3

Perhaps one might reasonably raise the question whether there is any place where what is corruptible becomes incorruptible, as fire does in the upper regions where it meets with no opposite. Opposites destroy each other, and hence accidentally, by their destruction, whatsoever is attributed to them is destroyed. But no opposite in a real substance is accidentally destroyed, because real substance is not predicated of any subject. Hence a thing which has no opposite, or which is situated where it has no opposite, cannot be destroyed. For what will that be which can destroy it, if destruction comes only through contraries, but no contrary to it exists either absolutely or in the particular place where it is? But perhaps this is in one sense true, in another sense not true, for it is impossible that anything containing matter should not have in any sense an opposite. Heat and straightness can be present in every part of a thing, but it is impossible that the thing should be nothing but hot or white or straight; for, if that were so, attributes would have an independent existence. Hence if, in all cases, whenever the active and the passive exist together, the one acts and the other is acted on, it is impossible that no change should occur. Further, this is so if a waste product is an opposite, and waste must always be produced; for opposition is always the source of change, and refuse is what remains of the previous opposite. But, after expelling everything of a nature actually opposed, would an object in this case also be imperishable? No, it would be destroyed by the environment.

If then that is so, what we have said sufficiently accounts for the change; but, if not, we must assume that something of actually opposite character is in the changing object, and refuse is produced.

Hence accidentally a lesser flame is consumed by a greater one, for the nutriment, to wit the smoke, which the former takes a long period to expend, is used up by the big flame quickly.

Hence [too] all things are at all times in a state of transition and are coming into being and passing away. The environment acts on them either favourably or antagonistically, and, owing to this, things that change their situation become more or less enduring than their nature warrants, but never are they eternal when they contain contrary qualities; for their matter is an immediate source of contrariety, so that if it involves locality they show change of situation, if quantity, increase and diminution, while if it involves qualitative affection we find alteration of character.

4

We find that a superior immunity from decay attaches neither to the largest animals (the horse has shorter life than man) nor to those that are small (for most insects live but for a year). Nor are plants as a whole less liable to perish than animals (many plants are annuals), nor have sanguineous animals the pre-eminence (for the bee is longer-lived than certain sanguineous animals). Neither is it the bloodless animals that live longest (for molluscs live only a year, though bloodless), nor terrestrial organisms (there are both plants and terrestrial animals of which a single year is the period), nor the occupants of the sea (for there we find the crustaceans and the molluscs, which are short-lived).

Speaking generally, the longest-lived things occur among the plants, e.g. the date-palm. Next in order we find them among the sanguineous animals rather than among the bloodless, and among those with feet rather than among the denizens of the water. Hence, taking these two characters together, the longest-lived animals fall among sanguineous animals which have feet, e.g. man and elephant. As a matter of fact also it is a general rule that the larger live longer than the smaller, for the other long-lived animals too happen to be of a large size, as are also those I have mentioned.

5

The following considerations may enable us to understand the reasons for all these facts. We must remember that an animal is by nature humid and warm, and to live is to be of such a constitution, while old age is dry and cold, and so is a corpse. This is plain to observation. But the material constituting the bodies of all things consists of the following – the hot and the cold, the dry and the moist. Hence when they age they must become dry, and therefore the fluid in them requires to be not easily dried up. Thus we explain why fat things are not liable to decay. The reason is that they contain air; now air relatively to the other elements is fire, and fire never becomes corrupted.

Again the humid element in animals must not be small in quantity, for a small quantity is easily dried up. This is why both plants and animals that are large are, as a general rule, longer-lived than the rest, as was said before; it is to be expected that the larger should contain more moisture. But it is not merely this that makes them longer lived; for the cause is twofold, to wit, the quality as well as the quantity of the fluid. Hence the moisture must be not only great in amount but also warm, in order to be neither easily congealed nor easily dried up.

It is for this reason also that man lives longer than some animals which are larger; for animals live longer though there is a deficiency in the amount of their moisture, if the ratio of its qualitative superiority exceeds that of its quantitative deficiency.

In some creatures the warm element is their fatty substance, which prevents at once desiccation and congelation; but in others it assumes a different flavour. Further, that which is designed to be not easily destroyed should not yield waste products. Anything of such a nature causes death either by disease or naturally, for the potency of the waste product works adversely and destroys now the entire constitution, now a particular member.

This is why salacious animals and those abounding in seed age quickly; the seed is a residue, and further, by being lost, it produces dryness. Hence the mule lives longer than either the horse or the ass from which it sprang, and females live longer than males if the males are salacious. Accordingly cock-sparrows have a shorter life than the females. Again males subject to great toil are short-lived and age more quickly owing to the labour; toil produces dryness and old age is dry. But by natural constitution and as a general rule males live longer than females, and the reason is that the male is an animal with more warmth than the female.

The same kind of animals are longer-lived in warm than in cold climates for the same reason, on account of which they are of larger size. The size of animals of cold constitution illustrates this particularly well, and hence snakes and lizards and scaly reptiles are of great size in warm localities, as also are testacea in the Red Sea: the warm humidity there is the cause equally of their augmented size and of their life. But in cold countries the humidity in animals is more of a watery nature, and hence is readily congealed. Consequently it happens that animals with little or no blood are in northerly regions either entirely absent (both the land animals with feet and the water creatures whose home is the sea) or, when they do occur, they are smaller and have shorter life; for the frost prevents growth.

Both plants and animals perish if not fed, for in that case they consume themselves; just as a large flame consumes and burns up a small one by using up its nutriment, so the natural warmth which is the primary cause of digestion consumes the material in which it is located.

Water animals have a shorter life than terrestrial creatures, not strictly because they are humid, but because they are watery, and watery moisture is easily destroyed, since it is cold and readily congealed. For the same reason bloodless animals perish readily unless protected by great size, for

there is neither fatness nor sweetness about them. In animals fat is sweet, and hence bees are longer-lived than other animals of larger size.

6

It is amongst the plants that we find the longest life – more than among the animals, for, in the first place, they are less watery and hence less easily frozen. Further they have an oiliness and a viscosity which makes them retain their moisture in a form not easily dried up, even though they are dry and earthy.

But we must discover the reason why trees are of an enduring constitution, for it is peculiar to them and is not found in any animals except the insects.

Plants continually renew themselves and hence last for a long time. New shoots continually come and the others grow old, and with the roots the same thing happens. But both processes do not occur together. Rather it happens that at one time the trunk and the branches alone die and new ones grow up beside them, and it is only when this has taken place that the fresh roots spring from the surviving part. Thus it continues, one part dying and the other growing, and hence also it lives a long time.

There is a similarity, as has been already said, between plants and insects, for they live, though divided, and two or more may be derived from a single one. Insects, however, though managing to live, are not able to do so long, for they do not possess organs; nor can the principle resident in each of the separated parts create organs. In the case of a plant, however, it can do so; every part of a plant contains potentially both root and stem. Hence it is from this source that issues that continued growth when one part is renewed and the other grows old; it is practically a case of longevity. The taking of slips furnishes a similar instance, for we might say that, in a way, when we take a slip the same thing happens; the shoot cut off is part of the plant. Thus in taking slips this perpetuation of life occurs though their connexion with the plant is severed, but in the former case it is the continuity that is operative. The reason is that the life principle potentially belonging to them is present in every part.

Identical phenomena are found both in plants and in animals. For in animals the males are, in general, the longer-lived. They have their upper parts larger than the lower (the male is more of the dwarf type of build than the female), and it is in the upper part that warmth resides, in the lower cold. In plants also those with great heads are longer-lived, and such are those that are not annual but of the tree-type, for the roots are the head and upper part of a plant, and among the annuals growth occurs in the direction of their lower parts and the fruit.

These matters however will be specially investigated in the work On Plants. But this is our account of the reasons for the duration of life and for short life in animals. It remains for us to discuss youth and age, and life and death. To come to a definite understanding about these matters would complete our course of study on animals.

On Youth and Old Age, On Breathing, On Life and Death
translated by G. R. T. Ross

1

We must now treat of youth and old age and life and death. We must probably also at the same time state the causes of respiration as well, since in some cases living and the reverse depend on this.

We have elsewhere given a precise account of the soul, and while it is clear that its essential reality cannot be corporeal, yet manifestly it must exist in some bodily part which must be one of those possessing control over the members. Let us for the present set aside the other divisions or faculties of the soul (whichever of the two be the correct name). But as to being what is called an animal and a living thing, we find that in all beings endowed with both characteristics (viz. being an animal and being alive) there must be a single identical part in virtue of which they live and are called animals; for an animal qua animal cannot avoid being alive. But a thing need not, though alive, be animal, for plants live without having sensation, and it is by sensation that we distinguish animal from what is not animal.

This organ, then, must be numerically one and the same and yet possess multiple and disparate aspects, for being animal and living are not identical. Since then the organs of special sensation have one common organ in which the senses when functioning must meet, and this must be situated midway between what is called before and behind (we call ‘before’ the direction from which sensation comes, ‘behind’ the opposite), further, since in all living things the body is divided into upper and lower (they all have upper and lower parts, so that this is true of plants as well), clearly the nutritive principle must be situated midway between these regions. That part where food enters we call upper, considering it by itself and not relatively to the surrounding universe, while downward is that part by which the primary excrement is discharged.

Plants are the reverse of animals in this respect. To man in particular among the animals, on account of his erect stature, belongs the characteristic of having his upper parts pointing upwards in the sense in which that applies to the universe, while in the others these are in an intermediate position. But in plants, owing to their being stationary and drawing their sustenance from the ground, the upper part must always be down; for there is a correspondence between the roots in a plant and what is called the mouth in animals, by means of which they take in their food, whether the source of supply be the earth or each other’s bodies.

2

All perfectly formed animals are to be divided into three parts, one that by which food is taken in, one that by which excrement is discharged, and the third the region intermediate between them. In the largest animals this latter is called the chest and in the others something corresponding; in some also it is more distinctly marked off than in others. All those also that are capable of progression have additional members subservient to this purpose, by means of which they bear the whole trunk, to wit legs and feet and whatever parts are possessed of the same powers. Now it is evident both by observation and by inference that the source of the nutritive soul is in the midst of the three parts. For many animals, when either part – the head or the receptacle of the food – is cut off, retain life in that member to which the middle remains attached. This can be seen to occur in many insects, e.g. wasps and bees, and many animals also besides insects can, though divided, continue to live by means of the part connected with nutrition.

While this member is indeed in actuality single, yet potentially it is multiple, for these animals have a constitution similar to that of Plants; plants when cut into sections continue to live, and a number of trees can be derived from one single source. A separate account will be given of the reason why some plants cannot live when divided, while others can be propagated by the taking of slips. In this respect, however, plants and insects are alike.

It is true that the nutritive soul, in beings possessing it, while actually single must be potentially plural. And it is too with the principle of sensation, for evidently the divided segments of these animals have sensation. They are unable, however, to preserve their constitution, as plants can, not possessing the organs on which the continuance of life depends, for some lack the means for seizing, others for receiving their food; or again they may be destitute of other organs as well.

Divisible animals are like a number of animals grown together, but animals of superior construction behave differently because their constitution is a unity of the highest possible kind. Hence some of the organs on division display slight sensitiveness because they retain some psychical susceptibility; the animals continue to move after the vitals have been abstracted: tortoises, for example, do so even after the heart has been removed.

3

The same phenomenon is evident both in plants and in animals, and in plants we note it both in their propagation by seed and in grafts and cuttings. Genesis from seeds always starts from the middle. All seeds are bivalvular, and the place of junction is situated at the point of attachment (to the plant), an intermediate part belonging to both halves. It is from this part that both root and stem of growing things emerge; the starting-point is in a central position between them. In the case of grafts and cuttings this is particularly true of the buds; for the bud is in a way the starting-point of the branch, but at the same time it is in a central position. Hence it is either this that is cut off, or into this that the new shoot is inserted, when we wish either a new branch or a new root to spring from it; which proves that the point of origin in growth is intermediate between stem and root.

Likewise in sanguineous animals the heart is the first organ developed; this is evident from what has been observed in those cases where observation of their growth is possible. Hence in bloodless animals also what corresponds to the heart must develop first. We have already asserted in our treatise on The Parts of Animals that it is from the heart that the veins issue, and that in sanguineous animals the blood is the final nutriment from which the members are formed. Hence it is clear that there is one function in nutrition which the mouth has the faculty of performing, and a different one appertaining to the stomach. But it is the heart that has supreme control, exercising an additional and completing function. Hence in sanguineous animals the source both of the sensitive and of the nutritive soul must be in the heart, for the functions relative to nutrition exercised by the other parts are ancillary to the activity of the heart. It is the part of the dominating organ to achieve the final result, as of the physician’s efforts to be directed towards health, and not to be occupied with subordinate offices.

Certainly, however, all saguineous animals have the supreme organ of the sensefaculties in the heart, for it is here that we must look for the common sensorium belonging to all the sense-organs. These in two cases, taste and touch, can be clearly seen to extend to the heart, and hence the others also must lead to it, for in it the other organs may possibly initiate changes, whereas with the upper region of the body taste and touch have no connexion. Apart from these considerations, if the life is always located in this part, evidently the principle of sensation must be situated there too, for it is qua animal that an animal is said to be a living thing, and it is called animal because endowed with sensation. Elsewhere in other works we have stated the reasons why some of the sense-organs are,

as is evident, connected with the heart, while others are situated in the head. (It is this fact that causes some people to think that it is in virtue of the brain that the function of perception belongs to animals.)

4

Thus if, on the one hand, we look to the observed facts, what we have said makes it clear that the source of the sensitive soul, together with that connected with growth and nutrition, is situated in this organ and in the central one of the three divisions of the body. But it follows by deduction also; for we see that in every case, when several results are open to her, Nature always brings to pass the best. Now if both principles are located in the midst of the substance, the two parts of the body, viz. that which elaborates and that which receives the nutriment in its final form will best perform their appropriate function; for the soul will then be close to each, and the central situation which it will, as such, occupy is the position of a dominating power.

Further, that which employs an instrument and the instrument it employs must be distinct (and must be spatially diverse too, if possible, as in capacity), just as the flute and that which plays it – the hand – are diverse. Thus if animal is defined by the possession of sensitive soul, this soul must in the sanguineous animals be in the heart, and, in the bloodless ones, in the corresponding part of their body. But in animals all the members and the whole body possess some connate warmth of constitution, and hence when alive they are observed to be warm, but when dead and deprived of life they are the opposite. Indeed, the source of this warmth must be in the heart in sanguineous animals, and in the case of bloodless animals in the corresponding organ, for, though all parts of the body by means of their natural heat elaborate and concoct the nutriment, the governing organ takes the chief share in this process. Hence, though the other members become cold, life remains; but when the warmth here is quenched, death always ensues, because the source of heat in all the other members depends on this, and the soul is, as it were, set aglow with fire in this part, which in sanguineous animals is the heart and in the bloodless order the analogous member. Hence, of necessity, life must be coincident with the maintenance of heat, and what we call death is its destruction.

5

However, it is to be noticed that there are two ways in which fire ceases to exist; it may go out either by exhaustion or by extinction. That which is self-caused we call exhaustion, that due to its opposites extinction. [The former is that due to old age, the latter to violence.] But either of these ways in which fire ceases to be may be brought about by the same cause, for, when there is a deficiency of nutriment and the warmth can obtain no maintenance, the fire fails; and the reason is that the opposite, checking digestion, prevents the fire from being fed. But in other cases the result is exhaustion, when the heat accumulates excessively owing to lack of respiration and of refrigeration. For in this case what happens is that the heat, accumulating in great quantity, quickly uses up its nutriment and consumes it all before more is sent up by evaporation. Hence not only is a smaller fire readily put out by a large one, but of itself the candle flame is consumed when inserted in a large blaze just as is the case with any other combustible. The reason is that the nutriment in the flame is seized by the larger one before fresh fuel can be added, for fire is ever coming into being and rushing just like a river, but so speedily as to elude observation.

Clearly therefore, if the bodily heat must be conserved (as is necessary if life is to continue), there must be some way of cooling the heat resident in the source of warmth. Take as an illustration what

occurs when coals are confined in a brazier. If they are kept covered up continuously by the so-called ‘choker’, they are quickly extinguished, but, if the lid is in rapid alternation lifted up and put on again they remain glowing for a long time. Banking up a fire also keeps it in, for the ashes, being porous, do not prevent the passage of air, and again they enable it to resist extinction by the surrounding air by means of the supply of heat which it possesses. However, we have stated in The Problems the reasons why these operations, namely banking up and covering up a fire, have the opposite effects (in the one case the fire goes out, in the other it continues alive for a considerable time).

6

Everything living has soul, and it, as we have said, cannot exist without the presence of heat in the constitution. In plants the natural heat is sufficiently well kept alive by the aid which their nutriment and the surrounding air supply. For the food has a cooling effect [as it enters, just as it has in man] when first it is taken in, whereas abstinence from food produces heat and thirst. The air, if it be motionless, becomes hot, but by the entry of food a motion is set up which lasts until digestion is completed and so cools it. If the surrounding air is excessively cold owing to the time of year, there being severe frost, plants shrivel, or if, in the extreme heats of summer the moisture drawn from the ground cannot produce its cooling effect, the heat comes to an end by exhaustion. Trees suffering at such seasons are said to be blighted or star-stricken. Hence the practice of laying beneath the roots stones of certain species or water in pots, for the purpose of cooling the roots of the plants.

Some animals pass their life in the water, others in the air, and therefore these media furnish the source and means of refrigeration, water in the one case, air in the other. We must proceed – and it will require further application on our part – to give an account of the way and manner in which this refrigeration occurs.

7

A few of the previous physical philosophers have spoken of respiration. The reason, however, why it exists in animals they have either not declared or, when they have, their statements are not correct and show a comparative lack of acquaintance with the facts. Moreover they assert that all animals respire – which is untrue. Hence these points must first claim our attention, in order that we may not be thought to make unsubstantiated charges against authors no longer alive.

First then, it is evident that all animals with lungs breathe, but in some cases breathing animals have a bloodless and spongy lung, and then there is less need for respiration. These animals can remain under water for a time, which relatively to their bodily strength, is considerable. All oviparous animals, e.g. the frog-tribe, have a spongy lung. Also hemydes and tortoises can remain for a long time immersed in water; for their lung, containing little blood, has not much heat. Hence, when once it is inflated, it itself, by means of its motion, produces a cooling effect and enables the animal to remain immersed for a long time. Suffocation, however, always ensues if the animal is forced to hold its breath for too long a time, for none of this class take in water in the way fishes do. On the other hand, animals which have the lung charged with blood have greater need of respiration on account of the amount of their heat, while none at all of the others which do not possess lungs breathe.

8

Democritus of Abdera and certain others who have treated of respiration, while saying nothing definite about the lungless animals, nevertheless seem to speak as if all breathed. But Anaxagoras and Diogenes both maintain that all breathe, and state the manner in which fishes and oysters respire. Anaxagoras says that when fishes discharge water through their gills, air is formed in the mouth, for there can be no vacuum, and that it is by drawing in this that they respire. Diogenes' statement is that, when they discharge water through their gills, they suck the air out of the water surrounding the mouth by means of the vacuum formed in the mouth, for he believes there is air in the water.

But these theories are untenable. Firstly, they state only what is the common element in both operations and so leave out the half of the matter. For what goes by the name of respiration consists, on the one hand, of inhalation, and, on the other, of the exhalation of breath; but, about the latter they say nothing, nor do they describe how such animals emit their breath. Indeed, explanation is for them impossible for, when the creatures respire, they must discharge their breath by the same passage as that by which they draw it in, and this must happen in alternation. Hence, as a result, they must take the water into their mouth at the same time as they breathe out. But the air and the water must meet and obstruct each other. Further, when they discharge the water they must emit their breath by the mouth or the gills, and the result will be that they will breathe in and breathe out at the same time, for it is at that moment that respiration is said to occur. But it is impossible that they should do both at the same time. Hence, if respiring creatures must both exhale and inhale the air, and if none of these animals can breathe out, evidently none can respire at all.

9

Further, the assertion that they draw in air out of the mouth or out of the water by means of the mouth is an impossibility, for, not having a lung, they have no windpipe; rather the stomach is closely juxtaposed to the mouth, so that they must do the sucking with the stomach. But in that case the other animals would do so also, which is not the truth; and the water-animals also would be seen to do it when out of the water, whereas quite evidently they do not. Further, in all animals that respire and draw breath there is to be observed a certain motion in the part of the body which draws in the air, but in the fishes this does not occur. Fishes do not appear to move any of the parts in the region of the stomach, except the gills alone, and these move both when they are in the water and when they are thrown on to dry land and gasp. Moreover, always when respiring animals are killed by being suffocated in water, bubbles are formed of the air which is forcibly discharged, as happens, e.g. when one forces a tortoise or a frog or any other animal of a similar class to stay beneath water. But with fishes this result never occurs, in whatsoever way we try to obtain it, since they do not contain air drawn from an external source. Again, the manner of respiration said to exist in them might occur in the case of men also when they are under water. For if fishes draw in air out of the surrounding water by means of their mouth why should not men too and other animals do so also; they should also, in the same way as fishes, draw in air out of the mouth. If in the former case it were possible, so also should it be in the latter. But, since in the one it is not so, neither does it occur in the other. Furthermore, why do fishes, if they respire, die in the air and gasp (as can be seen) as in suffocation? It is not want of food that produces this effect upon them, and the reason given by Diogenes is foolish, for he says that in air they take in too much air and hence die, but in the water they take in a moderate amount. But that should be a possible occurrence with land animals also; as facts are, however, no land animal seems to be suffocated by excessive respiration. Again, if all animals breathe, insects must do so also. many of them seem to live though divided not

merely into two, but into several parts, e.g. the class called Scolopendra. But how can they, when thus divided, breathe, and what is the organ they employ? The main reason why these writers have not given a good account of these facts is that they have no acquaintance with the internal organs, and that they did not accept the doctrine that there is a final cause for whatever Nature does. If they had asked for what purpose respiration exists in animals, and had considered this with reference to the organs, e.g. the gills and the lungs, they would have discovered the reason more speedily.

10

Democritus, however, does teach that in the breathing animals there is a certain result produced by respiration; he asserts that it prevents the soul from being extruded from the body. Nevertheless, he by no means asserts that it is for this purpose that Nature so contrives it, for he, like the other physical philosophers, altogether fails to attain to any such explanation. His statement is that the soul and the hot element are identical, being the primary forms among the spherical particles. Hence, when these are being crushed together by the surrounding atmosphere thrusting them out, respiration, according to his account, comes in to succour them. For in the air there are many of those particles which he calls mind and soul. Hence, when we breathe and the air enters, these enter along with it, and by their action cancel the pressure, thus preventing the expulsion of the soul which resides in the animal.

This explains why life and death are bound up with the taking in and letting out of the breath; for death occurs when the compression by the surrounding air gains the upper hand, and, the animal being unable to respire, the air from outside can no longer enter and counteract the compression. Death is the departure of those forms owing to the expulsive pressure exerted by the surrounding air. Death, however, occurs not by haphazard but, when natural, owing to old age, and, when unnatural, to violence.

But the reason for this and why all must die Democritus has by no means made clear. And yet, since evidently death occurs at one time of life and not at another, he should have said whether the cause is external or internal. Neither does he assign the cause of the beginning of respiration, nor say whether it is internal or external. Indeed, it is not the case that the external mind superintends the reinforcement; rather the origin of breathing and of the respiratory motion must be within: it is not due to pressure from around. It is absurd also that what surrounds should compress and at the same time by entering dilate. This then is practically his theory, and how he puts it.

But if we must consider that our previous account is true, and that respiration does not occur in every animal, we must deem that this explains death not universally, but only in respiring animals. Yet neither is it a good account of these even, as may clearly be seen from the facts and phenomena of which we all have experience. For in hot weather we grow warmer, and, having more need of respiration, we always breathe faster. But, when the air around is cold and contracts and solidifies the body, retardation of the breathing results. Yet this was just the time when the external air should enter and annul the expulsive movement, whereas it is the opposite that occurs. For when the breath is not let out and the heat accumulates too much then we need to respire, and to respire we must draw in the breath. When hot, people breathe rapidly, because they must do so in order to cool themselves, just when the theory of Democritus would make them add fire to fire.

11

The theory found in the Timaeus, of the passing round of the breath by pushing, by no means determines how, in the case of the animals other than land-animals, their heat is preserved, and

whether it is due to the same or a different cause. For if respiration occurs only in land-animals we should be told what is the reason of that. Likewise, if it is found in others also, but in a different form, this form of respiration, if they all can breathe, must also be described.
Further, the method of explaining involves a fiction. It is said that when the hot air issues from the mouth it pushes the surrounding air, which being carried on enters the very place whence the internal warmth issued, through the interstices of the porous flesh; and this reciprocal replacement is due to the fact that a vacuum cannot exist. But when it has become hot the air passes out again by the same route, and pushes back inwards through the mouth the air that had been discharged in a warm condition. It is said that it is this action which goes on continuously when the breath is taken in and let out.
But according to this way of thinking it will follow that we breathe out before we breathe in. But the opposite is the case, as evidence shows, for though these two functions go on in alternation, yet the last act when life comes to a close is the letting out of the breath, and hence its admission must have been the beginning of the process.
Once more, those who give this kind of explanation by no means state the final cause of the presence in animals of this function (to wit the admission and emission of the breath), but treat it as though it were a contingent accompaniment of life. Yet it evidently has control over life and death, for it results synchronously that when respiring animals are unable to breathe they perish. Again, it is absurd that the passage of the hot air out through the mouth and back again should be quite perceptible, while we were not able to detect the thoracic influx and the return outwards once more of the heated breath. It is also nonsense that respiration should consist in the entrance of heat, for the evidence is to the contrary effect; what is breathed out is hot, and what is breathed in is cold. When it is hot we pant in breathing, for, because what enters does not adequately perform its cooling function, we have as a consequence to draw the breath frequently.

12
It is certain, however, that we must not entertain the notion that it is for purposes of nutrition that respiration is designed, and believe that the internal fire is fed by the breath; respiration, as it were, adding fuel to the fire, while the feeding of the flame results in the outward passage of the breath. To combat this doctrine I shall repeat what I said in opposition to the previous theories. This, or something analogous to it, should occur in the other animals also (on this theory), for all possess vital heat. Further, how are we to describe this fictitious process of the generation of heat from the breath? Observation shows rather that it is a product of the food. A consequence also of this theory is that the nutriment would enter and the refuse be discharged by the same channel, but this does not appear to occur in the other instances.

13
Empedocles also gives an account of respiration without, however, making clear what its purpose is, or whether or not it is universal in animals. Also when dealing with respiration by means of the nostrils he imagines he is dealing with what is the primary kind of respiration. Even the breath which passes through the nostrils passes through the windpipe out of the chest as well, and without the latter the nostrils cannot act. Again, when animals are bereft of respiration through the nostrils, no detrimental result ensues, but, when prevented from breathing through the windpipe, they die. Nature employs respiration through the nostrils as a secondary function in certain animals in order

to enable them to smell. But the reason why it exists in some only is that though almost all animals are endowed with the sense of smell, the sense-organ is not the same in all.

A more precise account has been given about this elsewhere. Empedocles, however, explains the passage inwards and outwards of the breath, by the theory that there are certain blood-vessels, which, while containing blood, are not filled by it, but have passages leading to the outer air, the calibre of which is fine in contrast to the size of the solid particles, but large relatively to those in the air. Hence, since it is the nature of the blood to move upwards and downwards, when it moves down the air rushes in and inspiration occurs; when the blood rises, the air is forced out and the outward motion of the breath results. He compares this process to what occurs in a clepsydra.

Thus all things outwards breathe and in; – their flesh has tubes
Bloodless, that stretch towards the body's outmost edge,
Which, at their mouths, full many frequent channels pierce,
Cleaving the extreme nostrils through; thus, while the gore
Lies hid, for air is cut a thoroughfare most plain.
And thence, whenever shrinks away the tender blood,
Enters the blustering wind with swelling billow wild.
But when the blood leaps up, backward it breathes. As when
With water-clock of polished bronze a maiden sporting,
Sets on her comely hand the narrow of the tube
And dips it in the frail-formed water's silvery sheen;
Not then the flood the vessel enters, but the air,
Until she frees the crowded stream. But then indeed
Upon the escape runs in the water meet.
So also when within the vessel's deeps the water
Remains, the opening by the hand of flesh being closed,
The outer air that entrance craves restrains the flood
At the gates of the sounding narrow,
upon the surface pressing,
Until the maid withdraws her hand. But then in contrariwise
Once more the air comes in and water meet flows out.
Thus to the to the subtle blood, surging throughout the limbs,
Whene'er it shrinks away into the far recesses
Admits a stream of air rushing with swelling wave,
But, when it backward leaps, in like bulk air flows out.

This then is what he says of respiration. But, as we said, all animals that evidently respire do so by means of the windpipe, when they breathe either through the mouth or through the nostrils. Hence, if it is of this kind of respiration that he is talking, we must ask how it tallies with the explanation given. But the facts seem to be quite opposed. The chest is raised in the manner of a forge-bellows when the breath is drawn in – it is quite reasonable that it should be heat which raises up and that the blood should occupy the hot region – but it collapses and sinks down, like the bellows once more, when the breath is let out. The difference is that in a bellows it is not by the same channel that the air is taken in and let out, but in breathing it is.

But, if Empedocles is accounting only for respiration through the nostrils, he is much in error, for that does not involve the nostrils alone, but passes by the channel beside the uvula where the extremity of the roof of the mouth is, some of the air going this way through the apertures of the nostrils and some through the mouth, both when it enters and when it passes out. Such then is the

nature and magnitude of the difficulties besetting the theories of other writers concerning respiration.

14

We have already stated that life and the presence of soul involve a certain heat. Not even the digesting process to which is due the nutrition of animals occurs apart from soul and warmth, for it is to fire that in all cases elaboration is due. It is for this reason, precisely, that the primary nutritive soul also must be located in that part of the body and in that division of this region which is the immediate vehicle of this principle. The region in question is intermediate between that where food enters and that where excrement is discharged. In bloodless animals it has no name, but in the sanguineous class this organ is called the heart. The blood constitutes the nutriment from which the organs of the animal are directly formed. Likewise the bloodvessels must have the same originating source, since the one exists for the other's behoof – as a vessel or receptacle for it. In sanguineous animals the heart is the starting-point of the veins; they do not traverse it, but are found to stretch out from it, as dissections enable us to see.

Now the other psychical faculties cannot exist apart from the power of nutrition (the reason has already been stated in the treatise On the Soul), and this depends on the natural fire, by the union with which Nature has set it aglow. But fire, as we have already stated, is destroyed in two ways, either by extinction or by exhaustion. It suffers extinction from its opposites. Hence it can be extinguished by the surrounding cold both when in mass and (though more speedily) when scattered. Now this way of perishing is due to violence equally in living and in lifeless objects, for the division of an animal by instruments and consequent congelation by excess of cold cause death. But exhaustion is due to excess of heat; if there is too much heat close at hand and the thing burning does not have a fresh supply of fuel added to it, it goes out by exhaustion, not by the action of cold. Hence, if it is going to continue it must be cooled, for cold is a preventive against this form of extinction.

15

Some animals occupy the water, others live on land, and, that being so, in the case of those which are very small and bloodless the refrigeration due to the surrounding water or air is sufficient to prevent destruction from this cause. Having little heat, they require little cold to combat it. Hence too such animals are almost all short-lived, for, being small, they have less scope for deflection towards either extreme. But some insects are longer-lived though bloodless, like all the others), and these have a deep indentation beneath the waist, in order to secure cooling through the membrane, which there is thinner. They are warmer animals and hence require more refrigeration, and such are bees (some of which live as long as seven years) and all that make a humming noise, like wasps, cockchafers, and crickets. They make a sound as if of panting by means of air, for, in the middle section itself, the air which exists internally and is involved in their construction, causing a rising and falling movement, produces friction against the membrane. The way in which they move this region is like the motion due to the lungs in animals that breathe the outer air, or to the gills in fishes. What occurs is comparable to the suffocation of a respiring animal by holding its mouth, for then the lung causes a heaving motion of this kind. In the case of these animals this internal motion is not sufficient for refrigeration, but in insects it is. It is by friction against the membrane that they produce the humming sound, as we said, in the way that children do by blowing through the holes of a reed covered by a fine membrane. It is thus that the singing crickets too produce their song;

they possess greater warmth and are indented at the waist, but the songless variety have no fissure there.
Animals also which are sanguineous and possess a lung, though that contains little blood and is spongy, can in some cases, owing to the latter fact, live a long time without breathing; for the lung, containing little blood or fluid, can rise a long way: its own motion can for a long time produce sufficient refrigeration. But at last it ceases to suffice, and the animal dies of suffocation if it does not respire – as we have already said. For of exhaustion that kind which is destruction due to lack of refrigeration is called suffocation, and whatsoever is thus destroyed is said to be suffocated.
We have already stated that among animals insects do not respire, and the fact is open to observation in the case of even small creatures like flies and bees, for they can swim about in a fluid for a long time if it is not too hot or too cold. Yet animals with little strength tend to breathe more frequently. These, however, die of what is called suffocation when the stomach becomes filled and the heat in the central segment is destroyed. This explains also why they revive after being among ashes for a time.
Again among water-animals those that are bloodless remain alive longer in air than those that have blood and admit the sea-water, as, for example, fishes. Since it is a small quantity of heat they possess, the air is for a long time adequate for the purposes of refrigeration in such animals as the crustacea and the polyps. It does not however suffice, owing to their want of heat, to keep them finally in life, for most fishes also live though among earth, yet in a motionless state, and are to be found by digging. For all animals that have no lung at all or have a bloodless one require less refrigeration.

16

Concerning the bloodless animals we have declared that in some cases it is the surrounding air, in others fluid, that aids the maintenance of life. But in the case of animals possessing blood and heart, all which have a lung admit the air and produce the cooling effect by breathing in and out. All animals have a lung that are viviparous and are so internally, not externally merely (the Selachia are viviparous, but not internally), and of the oviparous class those that have wings, e.g. birds, and those with scales, e.g. tortoises, lizards, and snakes. The former class have a lung charged with blood, but in the most part of the latter it is spongy. Hence they employ respiration more sparingly as already said. The function is found also in all that frequent and pass their life in the water, e.g. the class of water-snakes and frogs and crocodiles and hemydes, both sea – and land-tortoises, and seals.
All these and similar animals both bring forth on land and sleep on shore or, when they do so in the water, keep the head above the surface in order to respire. But all with gills produce refrigeration by taking in water; the Selachia and all other footless animals have gills. Fish are footless, and the limbs they have get their name (pterugion) from their similarity to wings (pterux). But of those with feet one only, so far as observed, has gills. It is called the tadpole.
No animal yet has been seen to possess both lungs and gills, and the reason for this is that the lung is designed for the purpose of refrigeration by means of the air (it seems to have derived its name (pneumon) from its function as a receptacle of the breath (pneuma)), while gills are relevant to refrigeration by water. Now for one purpose one organ is adapted and one single means of refrigeration is sufficient in every case. Hence, since we see that Nature does nothing in vain, and if there were two organs one would be purposeless, this is the reason why some animals have gills, others lungs, but none possess both.

17

Every animal in order to exist requires nutriment, in order to prevent itself from dying, refrigeration; and so Nature employs the same organ for both purposes. For, as in some cases the tongue serves both for discerning tastes and for speech, so in animals with lungs the mouth is employed both in working up the food and in the passage of the breath outwards and inwards. In lungless and non-respiring animals it is employed in working up the food, while in those of them that require refrigeration it is the gills that are created for this purpose.

We shall state further on how it is that these organs have the faculty of producing refrigeration. But to prevent their food from impeding these operations there is a similar contrivance in the respiring animals and in those that admit water. At the moment of respiration they do not take in food, for otherwise suffocation results owing to the food, whether liquid or dry, slipping in through the windpipe and lying on the lung. The windpipe is situated before the oesophagus, through which food passes into what is called the stomach, but in quadrupeds which are sanguineous there is, as it were, a lid over the windpipe – the epiglottis. In birds and oviparous quadrupeds this covering is absent, but its office is discharged by a contraction of the windpipe. The latter class contract the windpipe when swallowing their food; the former close down the epiglottis. When the food has passed, the epiglottis is in the one case raised, and in the other the windpipe is expanded, and the air enters to effect refrigeration. In animals with gills the water is first discharged through them and then the food passes in through the mouth; they have no windpipe and hence can take no harm from liquid lodging in this organ, only from its entering the stomach. For these reasons the expulsion of water and the seizing of their food is rapid, and their teeth are sharp and in almost all cases arranged in a saw-like fashion, for they are debarred from chewing their food.

18

Among water-animals the cetaceans may give rise to some perplexity, though they too can be rationally explained.

Examples of such animals are dolphins and whales, and all others that have a blowhole. They have no feet, yet possess a lung though admitting the sea-water. The reason for possessing a lung is that which we have now stated [refrigeration]; the admission of water is not for the purpose of refrigeration. That is effected by respiration, for they have a lung. Hence they sleep with their head out of the water, and dolphins, at any rate, snore. Further, if they are entangled in nets they soon die of suffocation owing to lack of respiration, and hence they can be seen to come to the surface owing to the necessity of breathing. But, since they have to feed in the water, they must admit it, and it is in order to discharge this that they all have a blow-hole; after admitting the water they expel it through the blow-hole as the fishes do through the gills. The position of the blow-hole is an indication of this, for it leads to none of the organs which are charged with blood; but it lies before the brain and thence discharges water.

It is for the very same reason that molluscs and crustaceans admit water – I mean such animals as Carabi and Carcini. For none of these is refrigeration a necessity, for in every case they have little heat and are bloodless, and hence are sufficiently cooled by the surrounding water. But in feeding they admit water, and hence must expel it in order to prevent its being swallowed simultaneously with the food. Thus crustaceans, like the Carcini and Carabi, discharge water through the folds beside their shaggy parts, while cuttlefish and the polyps employ for this purpose the hollow above the head. There is, however, a more precise account of these in the History of Animals.

Thus it has been explained that the cause of the admission of the water is refrigeration, and the fact that animals constituted for a life in water must feed in it.

19

An account must next be given of refrigeration and the manner in which it occurs in respiring animals and those possessed of gills. We have already said that all animals with lungs respire. The reason why some creatures have this organ, and why those having it need respiration, is that the higher animals have a greater proportion of heat, for at the same time they must have been assigned a higher soul and they have a higher nature than plants. Hence too those with most blood and most warmth in the lung are of greater size, and animal in which the blood in the lung is purest and most plentiful is the most erect, namely man; and the reason why he alone has his upper part directed to the upper part of the universe is that he possesses such a lung. Hence this organ as much as any other must be assigned to the essence of the animal both in man and in other cases.

This then is the purpose of refrigeration. As for the constraining and efficient cause, we must believe that it created animals like this, just as it created many others also not of this constitution. For some have a greater proportion of earth in their composition, like plants, and others, e.g. aquatic animals, contain a larger amount of water; while winged and terrestrial animals have an excess of air and fire respectively. It is always in the region proper to the element preponderating in the scheme of their constitution that things exist.

20

Empedocles is then in error when he says that those animals which have the most warmth and fire live in the water to counterbalance the excess of heat in their constitution, in order that, since they are deficient in cold and fluid, they may be kept in life by the contrary character of the region they occupy; for water has less heat than air. But it is wholly absurd that the water-animals should in every case originate on dry land, and afterwards change their place of abode to the water; for they are almost all footless. He, however, when describing their original structure says that, though originating on dry land, they have abandoned it and migrated to the water. But again it is evident that they are not warmer than land-animals, for in some cases they have no blood at all, in others little.

The question, however, as to what sorts of animals should be called warm and what cold, has in each special case received consideration. Though in one respect there is reason in the explanation which Empedocles aims at establishing, yet his account is not correct. Excess in a bodily state is cured by a situation or season of opposite character, but the constitution is best maintained by an environment akin to it. There is a difference between the material of which any animal is constituted and the states and dispositions of that material. For example, if nature were to constitute a thing of wax or of ice, she would not preserve it by putting it in a hot place, for the opposing quality would quickly destroy it, seeing that heat dissolves that which cold congeals. Again, a thing composed of salt or nitre would not be taken and placed in water, for fluid dissolves that of which the consistency is due to the hot and the dry.

Hence if the fluid and the dry supply the material for all bodies, it is reasonable that things the composition of which is due to the fluid and the cold should have liquid for their medium [and, if they are cold, they will exist in the cold], while that which is due to the dry will be found in the dry. Thus trees grow not in water but on dry land. But the same theory would relegate them to the water,

on account of their excess of dryness, just as it does the things that are excessively fiery. They would migrate thither not on account of its cold but owing to its fluidity.
Thus the natural character of the material of objects is of the same nature as the region in which they exist; the liquid is found in liquid, the dry on land, the warm in air. With regard, however, to states of body, a cold situation has, on the other hand, a beneficial effect on excess of heat, and a warm environment on excess of cold, for the region reduces to a mean the excess in the bodily condition. The regions appropriate to each material and the revolutions of the seasons which all experience supply the means which must be sought in order to correct such excesses; but, while states of the body can be opposed in character to the environment, the material of which it is composed can never be so. This, then, is a sufficient explanation of why it is not owing to the heat in their constitution that some animals are aquatic, others terrestrial, as Empedocles maintains, and of why some possess lungs and others do not.

21
The explanation of the admission of air and respiration in those animals in which a lung is found, and especially in those in which it is full of blood, is to be found in the fact that it is of a spongy nature and full of tubes, and that it is the most fully charged with blood of all the visceral organs. All animals with a full-blooded lung require rapid refrigeration because there is little scope for deviation from the normal amount of their vital fire; the air also must penetrate all through it on account of the large quantity of blood and heat it contains. But both these operations can be easily performed by air, for, being of a subtle nature, it penetrates everywhere and that rapidly, and so performs its cooling function; but water has the opposite characteristics.
The reason why animals with a full-blooded lung respire most is hence manifest; the more heat there is, the greater is the need for refrigeration, and at the same time breath can easily pass to the source of heat in the heart.

22
In order to understand the way in which the heart is connected with the lung by means of passages, we must consult both dissections and the account in the History of Animals. The universal cause of the need which the animal has for refrigeration, is the union of the soul with fire that takes place in the heart. Respiration is the means of effecting refrigeration, of which those animals make use that possess a lung as well as a heart. But when they, as for example the fishes, which on account of their aquatic nature have no lung, possess the latter organ without the former, the cooling is effected through the gills by means of water. For ocular evidence as to how the heart is situated relatively to the gills we must employ dissections, and for precise details we must refer to Natural History. As a summarizing statement, however, and for present purposes, the following is the account of the matter.
It might appear that the heart has not the same position in terrestrial animals and fishes, but the position really is identical, for the apex of the heart is in the direction in which they incline their heads. But it is towards the mouth in fishes that the apex of the heart points, seeing that they do not incline their heads in the same direction as land-animals do. Now from the extremity of the heart a tube of a sinewy, arterial character runs to the centre where the gills all join. This then is the largest of those ducts, but on either side of the heart others also issue and run to the extremity of each gill, and by means of the ceaseless flow of water through the gills, effect the cooling which passes to the heart.

In similar fashion as the fish move their gills, respiring animals with rapid action raise and let fall the chest according as the breath is admitted or expelled. If air is limited in amount and unchanged they are suffocated, for either medium, owing to contact with the blood, rapidly becomes hot. The heat of the blood counteracts the refrigeration and, when respiring animals can no longer move the lung aquatic animals their gills, whether owing to discase or old age, their death ensues.

23

To be born and to die are common to all animals, but there are specifically diverse ways in which these phenomena occur; of destruction there are different types, though yet something is common to them all. There is violent death and again natural death, and the former occurs when the cause of death is external, the latter when it is internal, and involved from the beginning in the constitution of the organ, and not an affection derived from a foreign source. In the case of plants the name given to this is withering, in animals senility. Death and decay pertain to all things that are not imperfectly developed; to the imperfect also they may be ascribed in nearly the same but not an identical sense. Under the imperfect I class eggs and seeds of plants as they are before the root appears.

It is always to some lack of heat that death is due, and in perfect creatures the cause is its failure in the organ containing the source of the creature's essential nature. This member is situate, as has been said, at the junction of the upper and lower parts; in plants it is intermediate between the root and the stem, in sanguineous animals it is the heart, and in those that are bloodless the corresponding part of their body. But some of these animals have potentially many sources of life, though in actuality they possess only one. This is why some insects live when divided, and why, even among sanguineous animals, all whose vitality is not intense live for a long time after the heart has been removed. Tortoises, for example, do so and make movements with their feet, so long as the shell is left, a fact to be explained by the natural inferiority of their constitution, as it is in insects also.

The source of life is lost to its possessors when the heat with which it is bound up is no longer tempered by cooling, for, as I have often remarked, it is consumed by itself. Hence when, owing to lapse of time, the lung in the one class and the gills in the other get dried up, these organs become hard and earthy and incapable of movement, and cannot be expanded or contracted. Finally things come to a climax, and the fire goes out from exhaustion.

Hence a small disturbance will speedily cause death in old age. Little heat remains, for the most of it has been breathed away in the long period of life preceding, and hence any increase of strain on the organ quickly causes extinction. It is just as though the heart contained a tiny feeble flame which the slightest movement puts out. Hence in old age death is painless, for no violent disturbance is required to cause death, and there is an entire absence of feeling when the soul's connexion is severed. All diseases which harden the lung by forming tumours or waste residues, or by excess of morbid heat, as happens in fevers, accelerate the breathing owing to the inability of the lung to move far either upwards or downwards. Finally, when motion is no longer possible, the breath is given out and death ensues.

24

Generation is the initial participation, mediated by warm substance, in the nutritive soul, and life is the maintenance of this participation. Youth is the period of the growth of the primary organ of refrigeration, old age of its decay, while the intervening time is the prime of life.

A violent death or dissolution consists in the extinction or exhaustion of the vital heat (for either of these may cause dissolution), while natural death is the exhaustion of the heat owing to lapse of time, and occurring at the end of life. In plants this is to wither, in animals to die. Death, in old age, is the exhaustion due to inability on the part of the organ, owing to old age, to produce refrigeration. This then is our account of generation and life and death, and the reason for their occurrence in animals.

25

It is hence also clear why respiring animals are suffocated in water and fishes in air. For it is by water in the latter class, by air in the former that refrigeration is effected, and either of these means of performing the function is removed by a change of environment.

There is also to be explained in either case the cause of the cause of the motion of the gills and of the lungs, the rise and fall of which effects the admission and expulsion of the breath or of water. The following, moreover, is the manner of the constitution of the organ.

26

In connexion with the heart there are three phenomena, which, though apparently of the same nature, are really not so, namely palpitation, pulsation, and respiration.

Palpitation is the rushing together of the hot substance in the heart owing to the chilling influence of residual or waste products. It occurs, for example, in the ailment known as ‘spasms’ and in other diseases. It occurs also in fear, for when one is afraid the upper parts become cold, and the hot substance, fleeing away, by its concentration in the heart produces palpitation. It is crushed into so small a space that sometimes life is extinguished, and the animals die of the fright and morbid disturbance.

The beating of the heart, which, as can be seen, goes on continuously, is similar to the throbbing of an abscess. That, however, is accompanied by pain, because the change produced in the blood is unnatural, and it goes on until the matter formed by concoction is discharged. There is a similarity between this phenomenon and that of boiling; for boiling is due to the volatilization of fluid by heat and the expansion consequent on increase of bulk. But in an abscess, if there is no evaporation through the walls, the process terminates in suppuration due to the thickening of the liquid, while in boiling it ends in the escape of the fluid out of the containing vessel.

In the heart the beating is produced by the heat expanding the fluid, of which the food furnishes a constant supply. It occurs when the fluid rises to the outer wall of the heart, and it goes on continuously; for there is a constant flow of the fluid that goes to constitute the blood, it being in the heart that the blood receives its primary elaboration. That this is so we can perceive in the initial stages of generation, for the heart can be seen to contain blood before the veins become distinct. This explains why pulsation in youth exceeds that in older people, for in the young the formation of vapour is more abundant.

All the veins pulse, and do so simultaneously with each other, owing to their connexion with the heart. The heart always beats, and hence they also beat continuously and simultaneously with each other and with it.

Palpitation, then, is the recoil of the heart against the compression due to cold; and pulsation is the volatilization of the heated fluid.

27

Respiration takes place when the hot substance which is the seat of the nutritive principle increases. For it, like the rest of the body, requires nutrition, and more so than the members, for it is through it that they are nourished. But when it increases it necessarily causes the organ to rise. This organ we must to be constructed like the bellows in a smithy, for both heart and lungs conform pretty well to this shape. Such a structure must be double, for the nutritive principle must be situated in the centre of the natural force.

Thus on increase of bulk expansion results, which necessarily causes the surrounding parts to rise. Now this can be seen to occur when people respire; they raise their chest because the motive principle of the organ described resident within the chest causes an identical expansion of this organ. When it dilates the outer air must rush in as into a bellows, and, being cold, by its chilling influence reduces by extinction the excess of the fire. But, as the increase of bulk causes the organ to dilate, so diminution causes contraction, and when it collapses the air which entered must pass out again. When it enters the air is cold, but on issuing it is warm owing to its contact with the heat resident in this organ, and this is specially the case in those animals that possess a full-blooded lung. The numerous canal-like ducts in the lung, into which it passes, have each a blood-vessel lying alongside, so that the whole lung is thought to be full of blood. The inward passage of the air is called respiration, the outward expiration, and this double movement goes on continuously just so long as the animal lives and keeps this organ in continuous motion; it is for this reason that life is bound up with the passage of the breath outwards and inwards.

It is in the same way that the motion of the gills in fishes takes place. When the hot substance in the blood throughout the members rises, the gills rise too, and let the water pass through, but when it is chilled and retreats through its channels to the heart, they contract and eject the water. Continually as the heat in the heart rises, continually on being chilled it returns thither again. Hence, as in respiring animals life and death are bound up with respiration, so in the other animals class they depend on the admission of water.

Our discussion of life and death and kindred topics is now practically complete. But health and discase also claim the attention of the scientist, and not mercly of the physician, in so far as an account of their causes is concerned. The extent to which these two differ and investigate diverse provinces must not escape us, since facts show that their inquiries are, to a certain extent, at least conterminous. For physicians of culture and refinement make some mention of natural science, and claim to derive their principles from it, while the most accomplished investigators into nature generally push their studies so far as to conclude with an account of medical principles.