An Inquiry into the Human Mind

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[Brackets] enclose editorial explanations. Small ·dots· enclose material that has been added, but can be read as though it were part of the original text. Occasional •bullets, and also indenting of passages that are not quotations, are meant as aids to grasping the structure of a sentence or a thought. Every four-point ellipsis .... indicates the omission of a short passage that seems to present more difficulty than it is worth.

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Chapter 6 (cont'd): Seeing

17. The effect of custom in seeing objects single

From the phenomena of single and double vision that I presented in section 13, it seems that our seeing an object single with two eyes depends on two things—on •the mutual correspondence of certain points of the retinas that I have often described, and •on the two eyes' being directed to the object so accurately that the two images of it fall on corresponding points. We need both of these if we are to see an object single with two eyes; and as far as they depend on custom, so far—and no further—can single vision depend on custom. With regard to the accurate direction of both eyes to the object, I think we have to accept that this is only learned by custom. Nature has wisely ordained the eyes to move in such a way that their axes will always be nearly parallel; but it has left it in our power to vary a little the angle between them, depending on how far away the object is that we are looking at. If we weren't able to do this, objects would appear single at one particular distance only, and would always appear double at distances much less or much greater. Nature's wisdom is conspicuous in giving us this power, and just as conspicuous in making the extent of it exactly adequate to the purpose. The parallelism of the eyes in general is therefore the work of nature, but the precise and accurate direction, which must be varied according to the distance of the object, is the effect of custom. The power that nature has left us of •varying a little the angle between the optic axes is turned into a habit of •giving them always the angle that is right for the distance of the object.

What gives rise to this habit? The answer has to be that *it comes from being found necessary for perfect and clear vision*. A man who has lost the sight of one eye often loses the habit of directing it exactly to the object he is looking at ·with the other eye· because that habit is no longer useful to him. If he regained the sight of his eye, he would regain this habit by finding it useful. No part of the human constitution is more admirable than that whereby, without any design or intention, we acquire habits that are found useful. Children must see imperfectly at first, but by using their eyes they learn to use them in the best way, and to acquire—without intending to—the habits that are necessary for that purpose. Every man becomes most expert in that kind of vision that is most useful to him in his particular profession and way of life. A painter of miniatures or an engraver sees very near objects better than a sailor does, but the sailor sees very distant objects much better than do the painter and the engraver. A person who is short-sighted gets the habit in looking at distant objects of contracting the aperture of his eyes by almost closing his eyelids. Why? Simply because this makes him see the object more clearly. In the same way, the reason why every man acquires the habit of directing both eyes accurately to the object must be because this lets him see it more perfectly and clearly. A question remains to be considered: The *correspondence* between certain points on the retinas that is also necessary for single vision—is it the effect of custom or rather an original property of human eyes?

A strong argument for its being an original property ·rather than acquired through custom· can be drawn from the habit I have just been discussing—the habit of directing the eyes accurately to an object. We get this habit through finding it necessary for perfect and distinct vision. But why

is it necessary for that? Simply for this reason:

> Because of this habit, the two images of the object fall on corresponding points ·of the retinas·, and thus the eyes assist each other in vision, and the object is seen better by both eyes together than it could be by one. But when the eyes are not accurately directed, the two images of an object fall on non-corresponding points of the retinas, and thus the sight of one eye disturbs the sight of the other, and the object is seen less clearly with both eyes than it would be with one.

This makes it reasonable to conclude that this correspondence between certain points on the retinas is prior to the habits we acquire in vision, and consequently is natural and original. We have all acquired the habit of always directing our eyes in a particular manner that causes single vision. Now, if nature has ordained that we should have single vision only when our eyes are thus directed, there's an obvious reason why all mankind should agree in the habit of directing them in that way. If on the other hand single vision were the effect of custom, any other habit of directing the eyes would have done just as well; there would be no explanation of why everyone has this particular habit; and it would seem very strange that no one instance has been found of a person who had acquired the habit of seeing objects single with both eyes while they were directed in any other manner.

In his excellent *System of Optics* the judicious Dr. Smith maintains the contrary opinion, and offers some reasonings and facts in support of it. He agrees with Berkeley in attributing it entirely to custom that we see objects single with two eyes, as well as that we see objects the right way up by upside-down images. I considered Berkeley's reasonings in section 11; now let me make some remarks about what Dr. Smith has said on the subject. I approach him with the respect due to an author to whom the world owes •valuable discoveries of his own and also •discoveries by ·Newton·, the brightest mathematical genius of his age—discoveries which Smith, with great labour, generously rescued from oblivion.

He observes that the question 'Why do we see objects single with two eyes?' is of the same kind as the question 'Why do we hear sounds single with two ears?', and that the same answer must hold for both questions. He means us to infer from this observation that because the second of these phenomena is the effect of custom, the first is so as well.

My humble opinion is that the questions are not so much of the same kind that the same answer must hold for both; and that in any case our hearing single with two ears is *not* the effect of custom.

Two or more visible objects, although perfectly alike and seen at the very same time, can be distinguished by their visible places; but two perfectly similar sounds heard at the same time can't be distinguished, because from the nature of sound the sensations they cause must coalesce into one. Why do we hear sounds single with two ears? I answer: not from custom, but because two sounds that are perfectly alike and simultaneous have nothing by which they can be distinguished. But will this answer fit the other question? I think not.

The object makes an appearance to each eye, as the sound makes an impression on each ear; to that extent the two senses agree. But the visible appearances can be distinguished by place even when they are perfectly alike in every other respect; the sounds can't; and that is a difference between the two senses. Indeed, if the two appearances have the same visible place, they won't be distinguishable as *two* any more than the sounds were, and in that case we'll see the object single. But when they don't have the same visible place, they are perfectly distinguishable and we see the object double. We see the object single only when the

eyes are directed in one particular manner; while we are capable of directing them in many other ways which lead to our seeing the object double.

Dr. Smith rightly attributes to custom the well known tactual illusion in which a button pressed with two opposite sides of two contiguous fingers that are crossed is felt double. I agree with him that the cause of this appearance is that those opposite sides of the fingers have not been accustomed to feeling the same object, but two different objects, at the same time. And I would add this: just as custom produces this phenomenon, so a contrary custom destroys it; for if a man frequently accustoms himself to feel the button between his crossed fingers he will eventually feel it single—as I have found by experience.

It can be taken for a general rule that things that are produced by custom can be undone or changed by disuse or by a contrary custom. So it's a strong argument that an effect *isn't* due to custom but to the constitution of nature, when a contrary custom is long continued without changing it or weakening it. I take this to be the best rule by which we can settle our present question. I shall therefore mention ·and critically discuss· two facts that Dr. Smith adduces to show that the corresponding points of the retina have been changed by custom; and then I shall cite some facts tending to show that there are corresponding points on the retinas of the eyes *originally*, and that custom produces no change in them. ·Here is the first of Dr Smith's facts·:

> . . . .The Reverend Mr. Foster of Clinchwarton, having been blind for some years from amaurosis, was restored to sight by a treatment with mercury; and when he first began to see again, all objects appeared to him double; but gradually the two appearances came closer together, and eventually he came to see single and as clearly as he did before going blind.

I have three comments on this. **(1)** It doesn't prove any change of the corresponding points on the eyes unless we suppose something that has not been affirmed, namely that when Mr. Foster saw double he was directing his eyes to the object with the same accuracy, and in the same manner, as he did later when he saw single. **(2)** Even if we do suppose this, no explanation can be given of why at first the two appearances should be seen at such-and-such a particular angular distance rather than another; or why this angular distance should gradually decrease until eventually the appearances coincided. How could *custom* produce this effect? **(3)** Every detail of this case can be explained consistently with supposing that Mr. Foster had corresponding points in the retinas of his eyes from the time he began to see, and that custom made no change regarding them. All we need ·for our explanation· is to suppose something that is common in such cases, namely that through some years of blindness he had lost the habit of directing his eyes accurately to an object, and that he gradually recovered this habit when he came to see.

The second fact mentioned by Dr. Smith is taken from Mr. Cheselden's *Anatomy*. It is this:

> A gentleman who had one eye distorted by a blow on the head found every object appear double; but gradually the most familiar ones became single, and eventually all objects became so, all without any improvement in the distortion ·of his eye·.

Notice that it isn't said that the two appearances gradually came closer to one another and eventually united into one, without any improvement in the distortion. This would indeed have been a decisive proof of a change in the corresponding points of the retinas, though not one that could be explained in terms of custom. But it isn't said ·that this is what happened; so it probably *isn't* what happened, because·

such a remarkable detail would have been mentioned by Mr. Cheselden, as it was by the person who reported on Mr Foster's case. So we can take it for granted that one of the appearances gradually *vanished*, without approaching the other. I can see several ways in which this might happen. **(1)** The sight of the distorted eye might gradually grow weaker because of the injury, so that the appearances presented by that eye would gradually vanish. **(2)** A small and unnoticed change in the manner of directing the eyes, might occasion his not seeing the object with the distorted eye. . . . **(3)** By acquiring the habit of directing one and the same eye always to the object, the faint and oblique appearance presented by the other eye might, when it became familiar, be so little attended to that it wasn't perceived. One of these causes, or more of them acting together, could produce the effect mentioned without any change of the corresponding points of the eyes.

For these reasons, the facts mentioned by Dr. Smith, although challenging and interesting, seem not to be decisive.

The following facts ought to be put in the opposite scale. **(1)** In the famous case of the young gentleman couched [see the explanation on page 53] by Mr. Cheselden, after having had cataracts on both eyes until he was thirteen years of age, it seems that he saw objects single from the time he began to see with both eyes. Mr. Cheselden's words are:

> And now being lately couched of his other eye, he says that objects at first appeared large to this eye, but not as large as they did at first to the other eye; and looking at the same object with both eyes, he thought it looked about twice as large as when seen with only the first couched eye—but not double, so far as we can discover.

(2) The three young gentlemen mentioned in section 16, who (as far as I know) had squinted since infancy, as soon as they learned to direct both eyes to an object, saw it single. In these four cases it seems clear that the centres of the retinas corresponded *originally*, before custom could produce any such effect; for Mr. Cheselden's young gentleman had never been accustomed to see at all before he was couched, and the other three had never been accustomed to direct the axes of both eyes to the object.

(3) From the facts adduced in section 13, it appears that from the time we are capable of observing the phenomena of single and double vision, custom makes no change in them.

I have occupied myself with making such observations for more than thirty years; and in every case where I saw the object double at first, I see it double to this day, despite knowing from constant experience that it is single. In other cases where I know there are two objects there appears only one, after thousands of trials.

Let a man look at a familiar object through a polyhedron or multiplying glass every hour of his life, the number of visible appearances will be the same at last as at first; it doesn't make the least difference how often this is tried or for how long.

Effects produced by habit must vary according to the frequency of the acts by which the habit is acquired; but the phenomena of single and double vision are so invariable and uniform in all men, are so exactly regulated by mathematical rules, that I think we have good reason to conclude that they are effects not of custom but of fixed and unchanging laws of nature.

18. Dr. Porterfield's account of single and double vision

Bishop Berkeley and Dr. Smith seem to attribute too much to custom in vision; Dr. Porterfield too little. This ingenious writer thinks that by an original law of our nature, lying deeper than custom and experience, *we perceive visible objects in their true place*— not only in their true direction but also at their true distance from the eye—and that's his basis for his explanation of why we see objects single with two eyes:- Having the power to perceive the object with each eye •in its true place, we must perceive it with both eyes •in the same place, and so we must perceive it single.

He realizes that this principle, though it accounts for our •seeing objects single with two eyes, doesn't at all account for our •seeing objects double. Other writers on this subject take it to be a sufficient cause for •double vision that we have two eyes, and only find difficulty in assigning a cause for •single vision; but Dr. Porterfield's principle ·reverses this and· throws all the difficulty on the other side.

To explain double vision, therefore, he advances another principle, without saying whether he takes it to be an original law of our nature or the effect of custom. This is it:

> Our natural perception of the distance of objects from the eye doesn't apply to all the objects within the field of vision, but only to the object we directly look at; and objects off to the side, whatever their real distance from us may be, are seen at the same distance as the object we look at, as though they were all on the surface of a sphere with the eye at its centre.

Thus, •single vision is accounted for by our •seeing the true distance of an object that we look at; and •double vision by •a false appearance of distance in objects that we don't directly look at.

I agree with this learned and ingenious author that it is by a natural and original principle that we see visible objects in a certain direction from the eye, and I honour him as the person who first made this discovery; but I can't assent to either of those principles by which he explains single and double vision, for the following ·five· reasons.

(1) Our having a natural and original perception of the distance of objects from the eye seems to be contrary to a well attested fact; for the young gentleman couched by Mr. Cheselden imagined at first that everything he saw *touched his eye*, just as what he felt touched his hand.

(2) Our perception of the distance of objects from the eye, whether it is from nature or from custom, isn't as accurate and determinate as it would have to be to produce single vision. A mistake of the twentieth or thirtieth part of the distance of a small object such as a pin ought, according to Dr. Porterfield's hypothesis, to make it appear double. Very few can judge the distance of a visible object with *that* sort of accuracy; yet we never find double vision produced by mistaking the distance of the object. Even when looking with the naked eye, we often mistake the distance of an object by a half or more; why do we see such objects single? When I move my spectacles from my eyes towards a small object two or three feet away, the object seems to come nearer and eventually appears to be at about half its real distance ·from my eyes·, but I see it single at that apparent distance just as well as when I see it with the naked eye at its real distance. And when we look at an object with a binocular telescope properly fitted to the eyes, we see it single while it appears fifteen or twenty times nearer than it is. So there are few cases where the distance of an object from the eye is seen as accurately as is necessary for single vision, on Dr Porterfield's hypothesis. This seems to be a conclusive argument against his explanation of single vision.

We also find that false judgments or fallacious appearances of the distance of an object do *not* produce double vision. This seems to be a conclusive argument against Dr Porterfield's account of double vision.

(3) Our perception of objects' distances from ourselves seems to be wholly the effect of experience. I think this has been proved by Bishop Berkeley and by Dr. Smith; and when I come to set out the means of judging distance by sight, you will see that they are all provided by experience.

(4) Supposing that by a law of our nature the •distance of objects from the eye *were* perceived most accurately, as well as their •direction, it still wouldn't follow that we must see the object single. Let us now consider what help such a law of nature would give us in answering the question of whether the objects of the two eyes are in the very same place and consequently are not two but one.

Suppose then two straight lines, one from the centre of one eye to its object and the other from the centre of the other eye to its object. This law of nature ·of Dr Porterfield's· gives us •the direction and •the length of each of these straight lines, and that is all that it gives. These are geometrical data, and we can learn from geometry what questions they can answer. Well, then, *can* they tell us whether the two straight lines terminate at one point? No indeed! In order to determine *that* we need answers to three other questions:

> Are the two straight lines in one plane?
> What angle do they make?
> How far apart are the centres of the eyes?

When these things are known, we must apply the rules of trigonometry in order to learn whether the objects of the two eyes are in the very same place and consequently whether they are two or one.

(5) The false appearance of distance which is offered as explaining double vision •can't be the effect of custom, for constant experience contradicts it; and it •doesn't have the features of a law of nature, because it doesn't serve any good purpose, or indeed any purpose at all except to deceive us. But why should we look for *arguments* about what does or doesn't appear to us? The question is,

> At what distance do the objects now in my field of vision appear? Do they all appear at one distance, as if placed on the concave surface of a sphere with the eye at its centre?

Surely every man can know this with certainty; and if you will just attend to the testimony of your eyes you needn't ask a philosopher how visible objects appear to you. It is indeed true that when I look up to a star in the heavens the other stars that appear at the same time do appear in •this manner. But this phenomenon doesn't favour Dr. Porterfield's hypothesis, for the stars and heavenly bodies don't appear at their true distances when we look directly at them any more when we see them off to the side; and if this phenomenon is an argument for Dr. Porterfield's second principle, it must destroy the first.

I shall explain the true cause of this phenomenon later, so I set it aside for the present. Take another case: I sit in my room and direct my eyes to the door, which appears to be about sixteen feet away; at the same time I see many other objects faintly and off to the side of my field of vision—the floor, the rug, the table that I write on, papers, ink-stand, candle etc. Do all these objects appear to be sixteen feet away? On the closest attention I find that they do not.

19. Dr. Briggs's theory and Sir Isaac Newton's conjecture on this subject

I'm afraid that you will now be tired of the subject of single and double vision—as I am! The topic has become complex and confused, as a result of two equal causes: •the multitude of theories advanced by famous authors, and •the multitude of facts observed without sufficient skill in optics or reported without attention to the most important and decisive details.

In order to bring it to some sort of conclusion, I have in section 13 given a fuller and more orderly account than anyone had previously given of the phenomena of single and double vision in those whose sight is perfect, and have brought them under one general principle which appears to be a law of vision in human eyes that are perfect and in their natural state.

In section 14 I have given reason to think that this law of vision, although excellently adapted to the way human eyes are constructed and placed, can't serve the purposes of vision in some other animals, and therefore very probably isn't common to all animals. [Reid then returns for a page or so to squinting, which was the topic of sections 15 and 16, omitted from this version.]

In section 17 I have tried to show that the correspondence and working-together of certain points of the two retinas, under which I have brought *all* the phenomena of single and double vision, is not (as Dr. Smith thought) the effect of custom, nor is it changed by custom; it is a natural and original property of human eyes; and—in section 18—that it is not due to an original and natural perception of the true distance of objects from the eye, as Dr. Porterfield thought. After this recapitulation, which is intended to ease things for you, I shall embark on some more theories on this subject.

The theory of Dr. Briggs, first published in English in the *Philosophical Transactions* and afterwards in Latin under the title *Nova visionis theoria*—with a preface consisting of a letter from Sir Isaac Newton to the author—amounts to this:

> The fibres of the optic nerves running from •corresponding points of the retinas to the *thalami* of the optic nerves ·in the brain· have the same length, the same tension, and a similar situation, so they will have the same tone; and therefore their vibrations caused by the impact of the rays of light will be like a musical unison, and will present one and the same image to the mind; but the fibres passing from •parts of the retinas that don't correspond will have different tensions and tones, will have discordant vibrations, and will therefore present different images to the mind.

I shan't discuss this theory in detail. It is enough to make the general point that it is a system of conjectures about things of which we are entirely ignorant, and that all such theories in philosophy deserve to be laughed at rather than seriously refuted.

From the first dawn of philosophy right down to this day it has been believed that the optic nerves are intended to carry the images of visible objects from the back of the eye to the mind, and that the nerves belonging to the organs of the other senses have a similar role. But how do we know this? We *conjecture* it and then, taking this conjecture for a truth, we think about how the nerves might best serve this purpose. For many ages the system of the nerves was taken to be •a hydraulic engine consisting of a bundle of pipes that carry to and fro a liquid called 'animal spirits'. Around the time of Dr. Briggs, the nervous system was thought rather to be •a stringed instrument, composed of vibrating chords each of which had its own particular tension and tone. But some, just as plausibly, conceived it to be a •wind instrument that

played its part by the vibrations of an elastic ether [= '*extremely* fine gas'] in the fibres of the nerves.

These, I think, are all the engines into which the nervous system has been moulded by philosophers for conveying the images of sensible things from the sense-organ to the sensorium [= 'sensory part of the brain']. And nothing that we *know* gets in the way of anyone's freely choosing the theory that he thinks is best for the purpose, for none of them can claim to be better supported by facts and experiments than are the others. Indeed, they all seem to be such clumsy devices for carrying images that a man would be tempted to invent a new one! Well, in the dark a blind man can guess as well one who sees, so I venture to offer another conjecture about the nervous system—one that will serve the purpose as well as those I have mentioned, and has the virtue of simplicity. ·It is offered in a spirit of instructive fun·. I shall state it for the special case of the nerves relating to vision.

> Why can't the optic nerves be made up of empty tubes opening their mouths wide enough to receive the •rays of light that form the image on the retinas, and gently conveying •them—safely and in their proper order—to the very seat of the soul where they flash in her face?

It is easy for an ingenious philosopher to fit the calibre of these empty tubes to the diameter particles of light so that nothing larger will get in. And if there is a risk that the rays will lose their way, an expedient can be found to prevent this: simply give the tubes of the nervous system a peristaltic motion like that of the alimentary canal.

This hypothesis has a special advantage ·over the other three I have mentioned·. All philosophers believe that the. . . .likenesses of things are conveyed by the nerves to the soul, but none of their hypotheses show *how* this could be done. For how can the likenesses of sound, taste, smell, colour, shape and all sensible qualities be made out of the vibrations of musical chords, or the undulations of animal spirits or of ether? We ought not to suppose means that are inadequate to the end. Isn't it just as philosophical, and more intelligible, to conceive that the soul receives her likenesses by a kind of nervous *swallowing*, as the stomach receives its food? I might add that to account for muscular motion we need only to continue this peristaltic motion of the nervous tubes from the sensorium to the ends of the nerves that serve the muscles.

Thus nature will be in harmony with herself: sensation will be the conveying of idea-food to the mind, and muscular motion will be the expulsion of the waste products. For who can deny that the likenesses of things conveyed by sensation can after appropriate digestion be excreted by muscular motion?. . . . I hope that in time this hypothesis may be developed into a system as philosophical as that of animal spirits or the vibration of the nervous fibres!

To be serious now: in the operations of nature I regard the theories of a philosopher that are unsupported by facts with as little respect as I do the dreams of a sleeping man or the ravings of a madman. We laugh at the Indian philosopher who explained the support of the earth by inventing the hypothesis of a huge elephant, and to support the elephant a huge tortoise. If we are honest about it, we'll admit that we don't know any more about how the nerves operate than he did about how the earth is supported; and that our hypothesis about animal spirits, or about the tension and vibrations of the nerves, are as likely to be true as is his hypothesis about the support of the earth. His elephant was a hypothesis, and our hypotheses are elephants! Every theory in philosophy that is built on pure conjecture is an elephant; and every theory that is supported partly by fact and partly by conjecture is like the statue of Nebuchadnezzar with feet partly of iron and partly of clay.

The great Newton set philosophers an example that always *ought to be* but rarely *has been* followed, by distinguishing his •conjectures from his •conclusions and putting the former by themselves in the modest form of questions. This is fair and legal; but any other kind of philosophical traffic in conjectures ought to be regarded as contraband and illicit. Indeed *his* conjectures often have more foundation in fact and more plausibility than the dogmatic theories of most other philosophers; so we shouldn't overlook the conjecture he has offered concerning the cause of our seeing objects single with two eyes, in the 15th query in his *Optics*:

> When an object is seen with both eyes, isn't what happens the following? The likenesses of the object are united at the place where the optic nerves meet before they come into the brain,
>
> •the fibres on the right side of both nerves uniting there, and then going on into the brain in the nerve on the right side of the head, and
>
> •the fibres on the left side of both nerves uniting in the same place, and then going on into the brain in the nerve on the left side of the head;
>
> and these two nerves meet in the brain in such a way that their fibres make just one likeness or picture,
>
> •half of which on the right side of the sensorium comes from the right side of both eyes through the right side of both optic nerves to the place where the nerves meet and from there on the right side of the head into the brain, and
>
> •the other half on the left side of the sensorium comes in the same way from the left side of both eyes.
>
> For the optic nerves of animals that look in the same direction with both eyes—such as men, dogs, sheep, oxen etc.—meet before they come into the brain; but the optic nerves of animals that don't look in the same direction with both eyes—such as fishes and the chameleon—do not meet, if I am rightly informed.

Let me divide this question into two, which are of very different kinds, one being purely anatomical, the other relating to the carrying of likenesses or pictures of visible objects to the sensorium.

The first question is this:

> Do the fibres coming from corresponding points of the two retinas unite at the place where the optic nerves meet, and continue united from there to the brain; so that the right optic nerve after the meeting of the two nerves is composed of the fibres coming from the right sides of the two retinas, and the left of the fibres coming from the left sides of the two retinas?

This is undoubtedly a challenging and reasonable question; because if we could find anatomical grounds for answering it in the affirmative, it would lead us a step forward in discovering the cause of the correspondence and working-together that there is between certain points of the two retinas. For although we don't *know* what the particular function of the optic nerves is, it is *probable* that vision requires some impression that is had on them and passed along their fibres; and whatever such impressions *are*, we can say that if two fibres are united into one, an impression made on one of them is likely to have the same effect as would the same impression made on both. Anatomists think that when two parts of the body work together this is sufficiently explained by their being served by branches of the same nerve; so we should look on it as an important discovery in anatomy if it were found that a single nerve sent branches to the corresponding points of the retinas.

But has any such discovery been made? No, not in a single case. as far as I can learn. And in several cases the contrary seems to have been discovered. Dr. Porterfield has passed on detailed reports. . . .of two cases where the optic nerves, after touching one another as usual, appeared to be reflected back to the same side from which they came, without any mixing of their fibres. Each of these persons had lost an eye some time before his death, and the optic nerve belonging to that eye had shrunk so that it could be distinguished from the other at the place where they met. Another case that Dr Porterfield reports from the same source is still more remarkable; for in it the optic nerves didn't touch at all; and yet those who had known the person best when he was alive declared (when asked about this) that he never complained of any defect in his sight, or of seeing objects double. . . . Other writers also affirm that they have encountered cases where the optic nerves didn't touch.

These observations were made before Sir Isaac Newton put his question; I don't know whether he was ignorant of them, or whether he suspected some inaccuracy in them and wanted the matter to be looked into more carefully. But from a report by the most accurate Winslow it doesn't seem that later observations have been more favourable to Newton's conjecture. [Reid then quotes a passage implying that sometimes there is a partial cross-over of fibres and sometimes not.]

When I consider this conjecture of Sir Isaac Newton's •on its own merits, it seems more ingenious and more plausible than anything else that has been offered on the subject; and I admire Newton's caution and modesty in proposing it only as something to be looked into. But when I consider it •in the light of the observations of anatomists that contradict it, I am naturally led to the thought all we'll get from trusting to the *conjectures* of men of the greatest genius in the operations of nature is a chance to go wrong in an ingenious manner! The second part of Newton's question is:

> Are the two likenesses of objects from the two eyes united into one likeness or picture at the place where the optic nerves meet, half of this picture being carried from there to the sensorium by the right optic nerve, and the other half by the left? And are these two halves put together again at the sensorium in such a way as to make one likeness or picture?

Here it seems natural to put my previous question: What reason do we have to believe that pictures of objects are carried *at all* to the sensorium, whether by the optic nerves or by any other nerves? Isn't it possible that this great philosopher, like many lesser ones, was first led into this opinion by education, and then retained it because he never thought of calling it into question? I admit that this was my own situation for much of my life. But then something happened that started me thinking seriously about what *reason* I had to believe it, and I couldn't find any. It seems to be a mere hypothesis, as much as the Indian philosopher's elephant. I am not conscious of any pictures of external objects in my sensorium, any more than in my stomach; the things that I perceive by my senses appear to be external to me and not in any part of my brain; and my sensations - properly so-called—in no way resemble external objects. The conclusion from everything I have said about our seeing objects single with two eyes is this: •By an original property of human eyes, objects painted at the centres of the two retinas or at points similarly situated in relation to the centres, appear in the same visible place; •the most plausible attempts to explain this property of the eyes have been unsuccessful; and therefore •it must be either a primary law of our constitution or a consequence of some more general law that isn't yet discovered.

I have now finished what I intended to say about •the visible appearance of things to the eye and about •the laws of our constitution by which those appearances are presented to us. But I noted at the start of this chapter that the visible appearances of objects serve only as signs of their distance, size, shape, and other tangible qualities. The •visible appearance is presented to the mind by •nature, according to laws of our constitution that I have explained. But the •thing signified by that appearance is presented to the mind by •custom.

When someone speaks to us in a familiar language we hear certain sounds, and that is the only effect that his discourse has on us *by nature*; but by *custom* we understand the meaning of these sounds, and so we fix our attention not on the sounds but on the things signified by them. Similarly, by nature we see only the visible appearance of objects, but we learn by custom to interpret these appearances and to understand their meaning. And when we have learned this visual language and it has become familiar to us, we attend only to the things signified and find it very difficult to attend to the signs by which they are presented. The mind passes from one to the other so rapidly, and so familiarly, that no trace of the sign is left in our memory, and we seem to perceive the signified thing immediately and without the intervention of any sign.

When I look at the apple-tree that stands before my window, I perceive, at the first glance its distance and size, the roughness of its trunk, the lay-out of its branches, the shapes of its leaves and fruit. I seem to perceive all these things immediately. The visible *appearance* that presented them all to the mind has entirely escaped me; even when it stands before me I can't attend to it without great difficulty and laborious abstraction. Yet it is certain that this visible appearance is *all* that is presented to my eye by nature, and that I learned by custom to infer all the rest from it. If this were the first time I had ever seen anything, I wouldn't perceive either the distance or tangible shape of the tree, and it would have required the practice of seeing for many months to change that original perception that nature gave me by my eyes into what I now have by custom.

The objects that we see naturally and originally, as I pointed out earlier, have length and breadth but no thickness and no distance from the eye. Custom, by a kind of sleight of hand, gradually withdraws these original and proper objects of *sight* and substitutes in their place objects of *touch*, which have length, breadth, thickness and a determinate distance from the eye. My next topic is: *how* this change is brought about, and what forces in the human mind are involved in it.

20. Perception in general

•Sensation and •the perception of external objects by the senses have commonly been considered as one and the same thing, though really they are very different in their natures. The purposes of common life give us no need to distinguish them, and the accepted opinions of philosophers tend rather to run them together; but ·they *are* distinct from one another, and· if we don't attend carefully to their distinctness we can't possibly get a sound conception of how our senses operate. The simplest operations of the mind aren't capable of being logically *defined*; all we can do is to *describe* them, so as to lead those of you who are conscious of them in yourselves to attend to them and reflect on them; and it is often very difficult to describe them so as to produce this result.

The same form of words is used to denote •sensation and •perception, which makes us apt to look on them as things of the same nature. Thus:

I feel a pain. I see a tree.

The first denotes a sensation, the second a perception. The grammatical analysis of the two expressions is the same, for both consist of an active verb and an object. But if we attend to the things signified by these expressions we shall find that in the first the distinction between the act and the object is not real but grammatical; in the second the distinction is not just grammatical but real.

The form of the expression 'I feel pain' might seem to imply that the feeling is something distinct from the pain felt, but in reality they are not distinct. Just as 'thinking a thought' is an expression that can't signify anything more than 'thinking' does, so 'feeling a pain' signifies no more than 'being pained'. What I have just said about pain is true of every other mere sensation. It is difficult to give examples because very few of our sensations have names; and when a sensation does have a name it will also be the name of something *else* that is associated with the sensation. But when we attend to the sensation by itself, and separate it from other things that are linked with it in the imagination, it appears •to be something that can't exist except in a sentient mind, and •not to be distinct from the act of the mind by which it is felt.

Perception, as I here understand it, always has an •object distinct from the •act by which it is perceived—an object that can exist whether or not it is perceived. I perceive a tree that grows just outside my window: there is here an •object that is perceived, and an •act of the mind by which it is perceived; and these two are not only distinguishable but are extremely unalike in their natures. The object is made up of a trunk, branches and leaves; but the act of the mind by which it is perceived has no trunk, branches or leaves! I am conscious of this act of ·my· mind and I can reflect on it; but it is too simple to admit of an analysis ·or definition·, and I can't find proper words to describe it. I find nothing that resembles it so much as the •memory of the tree or the •imagining of it; yet both of these differ essentially from •perception, and they also differ from one another. It is useless for a philosopher ·such as Hume· to assure me that •imagining the tree, •remembering it, and •perceiving it are all one, and differ only in degree of liveliness. I know better, for I am as well acquainted with all three of those as I am with the rooms in my own house. I also know this: •perceiving an object implies both •conceiving of its form and •believing in its present existence. I know, moreover, that this belief isn't the effect of arguments and reasoning; it is the immediate effect of my constitution.

I am aware that this belief that I have in perception stands exposed to the big guns of scepticism. But they don't have much effect on it. The sceptic asks me:

> Why do you believe in the existence of the external object that you perceive?

Reply: This belief, sir, is not made by me; it came from the mint of nature; it bears her image and official stamp, and, if it isn't right that's not my fault; I took it on trust, without suspicion.

> Sceptic: Reason is the only judge of truth, and you ought to rid yourself of every opinion and every belief that isn't based on reason.

Reply: Why, sir, should I trust the faculty of •reason more than that of •perception? They came out of the same workshop and were made by the same craftsman; and if he puts one piece of false ware into my hands, what's to stop him from putting another? Perhaps the sceptic will agree to distrust reason rather than give any credence to perception. He may argue like this:

> Since you concede that the object that you perceive and the act of your mind by which you perceive it are quite different things, either can exist without the

> other: just as the object can exist without being perceived, so *the perception can exist without an object*. There is nothing so shameful in a philosopher as to be deceived and deluded; and therefore you ought to resolve firmly to withhold assent, and to get rid of all this belief in external objects, which may be all delusion.

For my part, I will never attempt to get rid of it. The sober part of mankind won't be much concerned to know my reasons, but if they can be of use to any sceptic, here they are. **(1)** It isn't in my power ·to get rid of my belief in external objects·, so why should I waste time *trying* to do so? It would be enjoyable to fly to the moon, and to make a visit to Jupiter and Saturn; but when I know that nature has bound me down by the law of gravitation to this planet that I inhabit, I rest content and quietly allow myself to be carried along in its orbit. Well, my belief is carried along by perception as irresistibly as my body is carried along by the earth. And the greatest sceptic will find that this holds for him too. He may struggle hard to disbelieve the information of his senses, like a man struggling to swim against a current; but ah! it is useless. It is useless for him to strain every nerve, and to wrestle with nature and with every object that impinges on his senses. For after all this effort, when his strength is exhausted in the forlorn attempt, he will be carried down the current with the common herd of believers.

(2) I think that it wouldn't be prudent to throw off this belief, even if I could. If nature intended to deceive me and lead me astray by false appearances, and I by my great cunning and profound logic discovered this, prudence would dictate to me that I should put up with this indignity as quietly as I could and not call nature an impostor to her face, for fear that she would get even with me in some other way. What do I gain by resenting this injury? 'You ought at least not to believe what she says.' This indeed seems reasonable if she intends to lead me astray. But what is the consequence? I resolve not to believe my senses. I break my nose against a post that comes in my way; I step into a canal; and after twenty such wise and rational actions I am arrested and dumped into a mad-house. Now, I admit that I would rather be one of the •credulous fools whom nature leads astray than one of the •wise and rational philosophers who resolve to withhold assent at all this expense. If a man pretends to be a sceptic with regard to what his senses tell him, yet prudently keeps out of harm's way as other men do, he must excuse my suspicion that either he is a hypocrite or he is deceiving himself. For if the scales of his belief were so evenly poised as to lean no more to one side than to its opposite, his actions couldn't possibly be directed by any rules of ordinary prudence.

(3) Although those two reasons are perhaps two more than enough, I shall offer a third. For a considerable part of my life I completely trusted what nature told me through my senses, before I had learned enough logic to be able to *start* a doubt about this. And now when I think back on my past, I don't find that I have been led astray by this belief. I find that without it I would have perished by a thousand accidents. I find that without it I would have been no wiser now than when I was born. I wouldn't even have been able to acquire the logic that suggests these sceptical doubts with regard to my senses. So I regard this instructive belief as one of nature's best gifts. I thank ·God·, the author of my being, who gave it to me before the eyes of my reason were opened and still gives it to me as a guide in matters where reason leaves me in the dark. And now I follow the direction of my senses not merely from instinct but also from confidence and trust in a reliable and kindly guide—trust based on my experience of his paternal care and goodness.

In all this I deal with the author of my being in just the way I have thought it reasonable to deal with my parents and teachers. I instinctively believed whatever they told me, long before I had the idea of a lie or thought of the possibility of their deceiving me. Afterwards, I found on reflection that they had acted like fair and honest people who wished me well. I found that if I hadn't believed what they told me before I could give any reason for doing so, I would even today have been little better than an imbecile. And although my natural credulity has sometimes led to my being imposed on by deceivers, it has been of infinite advantage to me on the whole; and so I consider my credulity as another good gift of nature. And the trust that I used to give •instinctively I continue to give •thoughtfully to those of whose integrity and truthfulness I have had experience.

People don't generally realise how much similarity there is between •the testimony of nature given by our senses and •testimony of men given by language. Our trust in both is at first an effect purely of instinct. When we grow up and begin to reason about them, our trust in human testimony is restrained and weakened by our experience of being deceived. But our trust in the testimony of our senses is established and confirmed by the uniformity and constancy of the laws of nature.

Our perceptions are of two kinds: some are •natural and original, others are •acquired and the result of experience. When I perceive that

> this is the taste of cider and that of brandy,
> this is the smell of an apple and that of an orange,
> this is the noise of thunder and that the ringing of bells,
> this is the sound of a coach passing and that the voice of a friend,

these perceptions and others like them are not original; they are acquired. But the perception that I have by touch of the hardness and softness of bodies, of their extension, shape and motion, isn't acquired; it is original. With all our senses there are many more acquired perceptions than original ones—and especially in the case of *sight*. By this sense we perceive •originally

> only the visible shape and colour of bodies, and their visible place;

but we •learn to perceive by the eye

> almost everything that we can perceive by touch.

The •original perceptions of this sense serve only as signs to introduce the •acquired ones. The signs by which objects are presented to us in perception are the language in which nature speaks to man; it is in many ways like the language in which men speak to one another, and especially in this: both ·languages· are partly •natural and original and •partly acquired by custom. Our original or natural perceptions are analogous to the •natural language of man to man, which I discussed in chapter 4, and our acquired perceptions are analogous to •artificial language which, in our mother tongue, is acquired in much the same way as our acquired perceptions, as I shall explain ·in section 24·.

It is not only healthy adults who acquire by habit many perceptions that they didn't have originally—the same is true for children, idiots, and lower animals. [In Reid's day, 'idiot' meant 'person who is seriously mentally defective'.] Almost every employment in life has perceptions of this kind that are special to it. The shepherd knows every sheep in his flock the way we know our acquaintances, and can pick them out of another flock one by one. The butcher knows by sight the weight and quality of his cattle and sheep before they are killed. The farmer perceives by his eye roughly how much hay there is in a haystack, or how much corn in a heap. The sailor sees from a great distance what a ship's build and carrying capacity are, and how far away it is. Every man

accustomed to writing tells his acquaintances apart by their hand-writing, as he does by their faces. And the painter distinguishes in paintings the styles of all the great masters. In short, acquired perception varies greatly from person to person, because of the variety in the objects to which the perceptions are directed and the different ways people go about perceiving them.

•Perception ought to be distinguished not only from •sensation but also from the knowledge of the objects of sense that is acquired by •reasoning. There is no reasoning *in* perception, as I have already observed. The belief that is implied *in* perception is an effect ·not of reasoning but· of instinct. But there are many facts concerning sensible objects that we can *infer from* what we perceive, and such •conclusions of reason ought to be distinguished from •what is merely perceived. When I look at the moon, I perceive it to be sometimes circular, sometimes crescent-shaped and sometimes in between. This is simple perception, and is the same in the philosopher as in the clown; but from these various appearances of the moon's illuminated part I infer that it is really spherical in shape. This conclusion isn't obtained by simple perception but by reasoning. •Simple perception relates to •the conclusions of reason drawn from our perceptions in the same way as •the axioms in mathematics relate to •the propositions ·inferred from them·. I can't demonstrate that

> two quantities that are equal to the same quantity are equal to each other;

neither can I demonstrate that

> the tree that I perceive exists.

But by the constitution of my nature my belief is irresistibly carried along by my grasp of the axiom; and by the constitution of my nature my belief is just as irresistibly carried along by my perception of the tree. All reasoning is from principles. The first principles of mathematical reasoning are mathematical axioms and definitions, and the first principles of all our reasoning about existing things are our perceptions. The first principles of *every* kind of reasoning are given us by nature, and have as much authority as does the faculty of reason—which is also a gift of nature. The conclusions of reason are all built on first principles, and can't have any foundation but that. So it is quite proper that such principles refused to be tried by reason, and laugh at the artillery of the logician when it is aimed at them.

When a long train of reasoning is needed to demonstrate a mathematical proposition, it is easily distinguished from an axiom, and they seem to be things of a very different nature. But some propositions lie so near to axioms that it is hard to decide whether they should be •held as •axioms or rather •demonstrated as •propositions. The same thing holds with regard to perception and the conclusions drawn from it. Some of these conclusions follow our perceptions so easily, and are so immediately connected with them, that it is hard to ascertain the boundary dividing them from one another.

Perception, whether original or acquired, doesn't involve any use of reason; and it is something that adults have in common with children, idiots, and lower animals. The •more obvious conclusions inferred by reason from our perceptions constitute what we call 'common understanding', which is what men steer by in the common affairs of life, and what distinguishes them from idiots. The •more remote conclusions that are inferred by reason from our perceptions constitute what we commonly call 'science' concerning the various parts of nature— whether in agriculture, medicine, mechanics or any part of natural philosophy. When I see a garden in good order, containing a great variety of plants of the best kinds and in the most flourishing condition, I

immediately infer from these signs that the gardener has worked hard and skillfully. When a farmer gets up in the morning and sees that the neighbouring brook overflows his field, he infers that a great deal of rain has fallen in the night. Seeing his fence broken and his corn trodden down, he infers that some of his own or his neighbour's cattle have broken loose. Seeing that his stable door is broken open and some of the horses gone, he infers that a thief has taken them. He traces the prints of his horses' feet in the soft ground, and from them he discovers which road the thief has taken. These are instances of *common understanding*, which is so close to perception that it's hard to draw the line between them. Similarly, *the science of nature* is so close to common understanding that we can't see where the latter ends and the former begins. I perceive that:

> Bodies lighter than water float in water while those that are heavier sink.

From this ·item of common understanding· I infer ·something that is closer to the science of nature, namely· that

> If a body immersed in water stays wherever it is put, whether at the top or bottom, it weighs exactly the same as water. If it stays put only when part of it is above the water, it is lighter than water; and the bigger the proportion of it that is above water the lighter the body is. If it had no gravity at all, it would have no effect on the water and would stand wholly above it.

Thus every man has by •common understanding a rule by which he judges of the specific gravity of bodies immersed in water; and a step or two more leads him into •the science of hydrostatics.

The whole of what we know about nature, i.e. about existing things, can be compared to a tree: perception is the root of this tree of knowledge, common understanding is its trunk, and the sciences are its branches.

21. Nature's way of bringing about sense-perception

Although there is no reasoning in perception, nature ordains that certain means and instruments shall intervene between the object and our perception of it; and these means and instruments limit and regulate our perceptions. **(1)** If the object isn't in contact with the organ of sense, some medium—·i.e. some intervening things or stuff·—must pass from the object to the organ. Thus,

> in vision the rays of light,
> in hearing the vibrations of elastic air,
> in smelling the effluvia of the body that is smelled,

must pass from the object to the organ; otherwise we have no perception. **(2)** There must be some action or effect [Reid's word is 'impression'] on the organ of sense, either by the immediate application of the object or by the medium that goes between the object and the organ. **(3)** The nerves that go from the brain to the organ must receive some effect by means of the effect that was made on the organ; and probably by means of the nerves some effect must be made on the brain. **(4)** The effect made on the organ, nerves and brain is followed by a sensation. **(5)** Lastly, this sensation is followed by the perception of the object.

Thus our perception of objects is the result of a sequence of operations, some of which affect only the body, others affect the mind. We don't know much about the nature of some of these operations; we don't know *anything* about how they are connected to one another or how they contribute to the perception that results from them all together; but by the laws of our constitution this *is* how we perceive objects—and our only way of doing so.

There may be other beings who can perceive external objects without rays of light or vibrations of air or effluvia

of bodies, without effects on bodily organs, even without sensations. But *we* are so built by ·God·, the author of nature, that we could be surrounded by external objects and yet perceive none of them. Our capacity for perceiving an object lies dormant until it is roused and stimulated by a certain corresponding sensation. And this sensation isn't always available, for it enters into the mind only as a result of a certain corresponding effect that the object has on the sense-organ.

Let us track down, as far as we can, this correspondence of effects, sensations and perceptions, starting with what comes first, namely the effect on the bodily organ. But, alas! we don't know what these effects are, let alone how they cause sensations in the mind.

We know that one body can act on another by •pressure, by •impact, by •attraction, by •repulsion and probably in many other ways that we don't know and don't have names for. But in which of these ways

> objects that we perceive act on the sense-organs,
> these organs act on the nerves, and
> the nerves act on the brain,

we don't know. Can anyone tell me how in vision the rays of light act on the retinas, how the retinas acts on the optic nerve and how the optic nerve acts on the brain? No-one can. When I feel the pain of the gout in my toe, I know that there is some unusual effect made on that part of my body. But what kind of effect? Are the small vessels swollen by some intrusive. . . .fluid? Are the fibres abnormally stretched? Are they torn apart by force, or eaten away by some acid? I can't answer any of these questions. All that I •feel is *pain*, which is an effect on the mind, not on the body; and all that I •perceive through this sensation is that *something wrong in my toe leads to this pain*. But because I don't know the natural state of my toe when it is not in pain, I also don't know what change or disorder in its parts leads to this painful sensation. Similarly with every other ·kind of· sensation, there is doubtless some effect on the sense-organ but we don't know what it is. It is too subtle to be discovered by our senses, and we can make a thousand conjectures about it without coming near to the truth. If we understood the structure of our sense-organs in such detail that we could learn what effects external objects have on them, this knowledge wouldn't add anything to our perception of the object; for those who know least about what happens in perception perceive as clearly as the greatest experts. ·For perception to occur·, it is necessary •that the effect be made on our organs, but not •that it be known. Nature carries on this part of the process of perception without our being aware of it or helping it along.

But we can't be unaware of the next step in this process, the sensation of the mind that always immediately follows the effect made on the body. It is essential to a sensation to be *felt*, and it can't *be* anything more than we *feel it to be*. We can know our sensations perfectly, if we will just get the habit of attending to them. But how are the sensations of the mind produced by impressions on the body? Of this we are absolutely ignorant, having no way of knowing how the body acts on the mind, or the mind on the body. When we consider the nature and attributes of body and of mind they seem to be so different, and so unalike, that we can't find any handle by which either can lay hold of the other. There is a deep and dark gulf between them that our understanding can't pass, and *how* they correspond and interrelate is absolutely unknown.

Experience teaches us that certain effects on the body are constantly followed by certain sensations of the mind, and that in the other direction certain states of the mind are constantly followed by certain motions in the body; but we

don't see the chain that connects these events. For all we know, their connection may be purely a matter of a *choice* by ·God· our maker. Perhaps the same sensations could have been connected with other effects or with other bodily organs. Perhaps we might have been made in such a way as to taste with our fingers, smell with our ears, and hear through the nose. Perhaps we could have been made in such a way that we could have all the sensations and perceptions that we do in fact have, without any effect at all being made on our bodily organs.

Be all that as it may, if nature had given us nothing more than effects on the body and corresponding sensations in our minds, that would have made us sentient beings but not percipient ones—·beings that *sense* but not ones that *perceive*·. In that case we would never have been able to form a •conception of any external object, far less a •belief in its existence. Our sensations don't at all resemble external objects, and we can't discover through our reason any necessary connection between the existence of the sensation and the existence of the object.

Perhaps we could have been made with a constitution such that we had our present ·actual· perceptions connected with different sensations. Perhaps we could have had the perception of external objects without any effects on the sense-organs and without any sensations. Or, lastly, the perceptions we have could have been *immediately* connected with the effects on our organs, without any sensations coming into the process. This last seems really to be the case in one instance, namely in our perception of the visible shape of bodies, as I noted in section 8.

So nature's way of bringing about sense-perception can be thought of as a kind of drama, in which some things are performed off-stage, and others are represented to the mind in a succession of different scenes. The •effect that the object has on the organ (either by immediate contact or through some intervening medium) and the •effect on the nerves and the brain happen off-stage, and the mind sees nothing of either of them. But by the laws of the drama every such effect is followed by *sensation*, which is the first scene that is shown to the mind; and this scene is quickly followed by another, which is the *perception* of the object.

In this drama, nature is the actor and we are spectators. We know nothing of the stage-machinery by means of which every different effect on the organ, nerves and brain exhibits its corresponding sensation; or of the machinery by means of which each sensation exhibits its corresponding perception. We are inspired with the sensation, and with the corresponding perception, by means unknown. And because the mind

> •passes immediately from the sensation to the conception of and belief in the object that we have in perception

in the same way that it

> •passes from signs to the things signified by them,

I have called our sensations 'signs of external objects', finding no terms that express better the function that nature has assigned to sensations in perception and the relation they have to their corresponding objects.

There is no need for a sign to resemble what it signifies, and indeed no sensation can resemble any external object. But two things *are* needed for us to know things by means of signs.

(1) A real connection must be established, either by the course of nature or by the will and decision of men, between the sign and the thing signified. When they are connected by the course of nature it is a natural sign; when by human decision it is an artificial sign. Thus smoke is a natural sign of fire, certain facial expressions are natural signs of anger;

but our spoken or written words are artificial signs of our thoughts and purposes.

(2) For us to know things by signs, the sign's appearing to the mind must be followed by the conception of and belief in the thing signified. If this doesn't happen the sign isn't understood or interpreted, in which case it isn't *to us* a sign, however suitable it may be *in itself* to serve as a sign.

Now, the mind passes from the appearance of a natural sign to the conception of and belief in the thing signified in three ways—by •original principles of our constitution, by •custom, and by •reasoning.

Our •original perceptions are had in the first of these ways, our •acquired perceptions in the second, and •everything that reason discovers concerning the course of nature in the third. In the first of these ways, nature through the sensations of touch informs us of the hardness and softness of bodies, of their extension, shape and motion, and of the space in which they move and are situated, as I explained in chapter 5 above. And in the second of these ways nature informs us by means of our eyes of almost all the same things that originally we could perceive only by touch.

In order to provide a better grasp of how we •learn to perceive so many things •by the eye which •originally could be perceived only •by touch, I should first point out

> the signs by which those things are exhibited to the eye, and the connection between those signs and the things signified by them;

and secondly consider

> how the experience of this connection produces the habit by which the mind passes, with no reasoning or reflection, from the sign to the conception of and belief in the thing signified.

·This all concerns 'acquired perceptions', the second of the trio listed just under item **(2)** above. It will be my topic until the end of section 23·.

Of all the acquired perceptions that we have by sight, the most remarkable is the perception of the distance of objects from the eyes. So I shall consider in some detail the signs by which this perception is exhibited, and only make some general remarks—·with much less detail·—concerning the signs that are used in other acquired perceptions.

22. The signs by which we learn to perceive distance from the eye

I remarked earlier that the original perceptions of sight are signs that serve to introduce the acquired ones; but this doesn't mean that no *other* signs are employed for that purpose. For clear vision, many motions of the eyes have to be varied according to how far away the object is; and such motions, being connected by habit with the corresponding distances of the object, become *signs* of those distances. The motions in question were at first made freely and deliberately; but as nature's intention was to produce perfect and clear vision by means of them, we soon learn by experience to regulate them according to that intention only, without even thinking about it.

A ship requires a different *trim* [= 'a different setting of the sails'] for every variation in the direction and strength of the wind; and—if I may be allowed to borrow that word—the eyes require a different *trim* for every degree of light and for every variation (within certain limits) in the distance of the object. The eyes are trimmed for a particular object by contracting certain muscles and relaxing others, as the ship is trimmed for a particular wind by pulling some ropes and slackening others. The sailor learns the trim of his ship, as we learn

the trim of our eyes, by experience. Although a ship is the noblest machine that human skill can boast, it is far inferior to the eye in this respect: it requires skill and ingenuity to navigate a •ship; and a sailor must *know* which ropes to pull and which to slacken to make her right for a particular wind; whereas one needs no skill or ingenuity to see by the •eye, because such superior wisdom has gone into its structure and workings. Even the part of vision that is acquired by experience is attained by idiots: we don't need to *know* which muscles to contract and which to relax to make the eye right for a particular distance of the object. But although we aren't conscious of the motions we make in order to make the eyes right for the distance of the object, we *are* conscious of the effort involved in producing those motions; and they are probably accompanied by some sensation that we don't attend to any more than we do to other sensations. And thus

•an effort consciously exerted, or

•a sensation resulting from that effort,

comes to be associated with

•the distance of the object that gave rise to it;

and this association enables the effort or the sensation to become a *sign* of that distance. I shall give examples of this when I come to discuss the means or signs by which we learn to see how far objects are from the eye. I accept Dr. Porterfield's list of these, despite our difference of opinion: he thinks that distance from the eye is perceived •originally, while I think it is perceived only •by experience.

In general, when a nearby object affects the eye in one way and the same object when further off affects it in a different way, these different states of the eye become *signs* of the corresponding distances. So I can show how we perceive distance by means of the eye by showing in what ways objects affect the eye differently depending on how far away they are. ·I shall discuss five of them in this section·.

1. It is well known that to see objects clearly at various distances, the shape of the eye must undergo some change. And nature has given us the power to adapt our eye to nearby objects by contracting certain muscles, and to distant objects by contracting other muscles.

Anatomists don't entirely agrees about how this is done and what muscles are employed in it. The ingenious Dr. Jurin, in his excellent essay on clear and blurred vision, seems to have given the most likely account of this matter, and I refer you to him.

Anyway,. . . .it is certain that young people generally have the power to adapt their eyes to all distances of the object from six or seven inches to fifteen or sixteen feet, so as to have perfect and clear vision at any distance within these limits. It follows from this that what we consciously do to adapt the eye to any particular object-distance within these limits will be connected and associated with that distance and will become a *sign* of it. When the object is moved away beyond the furthest limit of clear vision, it will be seen unclearly, but more or less so depending on whether its distance is greater or less; so that the degrees of clarity of the object can become the *signs* of distances considerably beyond the furthest limit of distinct vision. If this were our *only* way of perceiving the distance of visible objects, the most distant objects would appear to be no more than twenty or thirty feet from the eye, and the tops of houses and trees would seem to touch the clouds; for in that case the signs of all greater distances would be the same, so they would have the same signification and would thus give the same perception of distance.

Here is a more important point. When as children we learn to perceive distance by the eye, the closest objects that we learn to perceive clearly are about six or seven inches away, and for that reason no object that is seen clearly ever

appears to be closer than six or seven inches from the eye. We have devices for making a small object appear clearly when it is in reality not more than half an inch from the eye— either by using a single microscope, or by looking through a small pinhole in a card. When an object is made to appear clearly by either of these means, it *seems* to be at least six or seven inches away— i.e. within the limits of ·unaided· clear vision—however close it is in reality.

This observation gets extra importance from the fact that it provides the only •reason we can give why an object is *magnified* either by a single microscope or by being seen through a pinhole, and the only •means by which we can determine *by how much* the microscope or pinhole will magnify the object. Thus, if the object is really half an inch away from the eye and appears to be seven inches away, its diameter will seem to be enlarged in the same proportion as its distance, i.e. fourteen times.

2. For us to direct both eyes to an object, the optic axes must slope towards one another—more or less steeply, depending on how near or distant the object is. We aren't conscious of this slope, but we *are* conscious of the effort involved in creating it. This enables us to perceive things that are very close to us more accurately than we could do just by the shaping—·the 'trim'·—of the eye. And so we find that people who have lost the sight of one eye are apt to make mistakes about how far away objects are—even objects within an arm's length—these being mistakes that are easily avoided by those who see with both eyes. Such mistakes are often discovered in snuffing a candle, threading a needle, or filling a tea-cup. When a picture is seen fairly close up with both eyes, the representation doesn't seem as natural as when it is seen with only one. The intention of painting is to deceive the eye, making things appear to be at different distances when really they are on the same piece of canvas; and it is harder to deceive two eyes in this way than to deceive just one, because we perceive the distance of visible objects more accurately and precisely with two eyes than with one. If the shading and relief are carried out as well as they can be, the picture can have

> almost the same appearance to one eye as the objects themselves would have,

but it can't have

> the same appearance to one eye as to two.

This isn't the fault of the artist—it's an unavoidable imperfection in painting as such. What makes the picture look •better, close up, with one than with two is the very same fact that makes a single eye •worse than two eyes at judging distances and avoiding deception about them.

The biggest obstacle—and I think the only one that can't be overcome— to that agreeable deception of the eye that the painter aims at is our perception of *how far* visible objects are from the eye—a perception that we have partly through •the shape of the eye but mainly through •the angle between the optic axes. If this perception ·of distance· could be removed, I see no reason why a picture couldn't be made so perfect that it would *really deceive* the eye and be mistaken for the original object. In order to judge the merit of a picture, therefore, we ought as far as we can to exclude •those two means of perceiving the distance from us of its different parts.

In order to remove this perception of distance, art-lovers use a good method: they look at the picture with one eye, through a tube that excludes the view of all the other objects. This entirely excludes our main way of perceiving the distance of the object, namely the angle between the optic axes. I humbly suggest an improvement of this method of viewing pictures, namely making the tube through which one looks at the picture very narrow. If the aperture is as

small as a pinhole, so much the better, as long as there is enough light to see the picture clearly. The reason for my proposal is that when we look at an object through a small aperture it is seen clearly, whether or not the shape of the eye is adapted to its distance; and then our only remaining way to estimate the distance is the light and colouring in the picture, and those are up to the painter. So if he does his part properly, the picture will affect the eye in the same way that the object represented would do; which is the perfection of his art.

Although the second way of perceiving the distance of visible objects is more exact than the first, there are limits beyond which it is of no use. When the optic axes directed to an object are so nearly parallel that in directing them to an even more distant object we aren't conscious of any new effort and don't have any different sensation, that is where our perception of distance stops; all more distant objects affect the eye in the same manner, so we perceive them to be at the same distance. That is why the sun, moon, planets and fixed stars, when seen not near the horizon, appear to be all at the same distance as though they were on the inner surface of a great sphere. The surface of this heavenly sphere is at the distance beyond which all objects affect the eye in the same way. I shall explain later why this celestial ceiling appears more distant toward the horizon.

3. When objects are far away, their ·apparent· colours become fainter and more washed-out, and are tinged more with the blue of the intervening atmosphere; also, their small parts become less clear and their outline less precisely marked out. It is mainly through these facts that painters can represent objects ·as being· at very different distances, on the same canvas. Simply making an object *smaller* wouldn't have the effect of making it appear to be far off if there weren't also this degradation of its colour, and the unclarity of its outline and its small parts. If a painter made one human figure a tenth of the size of other human figures in the same picture, with the colours as bright and the outline and minute parts as precisely marked, it wouldn't appear like a man at a great distance but rather like a pygmy or Lilliputian. When an object has a variety of colours, its distance is more clearly indicated by the gradual fusion of the colours into one another than when it is of one uniform colour. In the steeple that stands before me at a small distance, the joinings of the stones are clearly perceptible; the grey colour of the stone is clearly marked off from the white cement; when I see at a greater distance, the joinings of the stones are less clear and the colours of the stone and of the cement begin to fuse into one another; at a still distance greater the joinings disappear altogether and the variety of colour vanishes. [Reid then makes the same point in terms of the appearances of colours and outlines as one backs away from an apple tree. He concludes:] This change of appearance, corresponding to the different distances, marks the distance more exactly than if the whole object had been of one colour.

Dr. Smith reports in his ·*System of* Optics· a fascinating observation made by Bishop Berkeley in his travels through Italy and Sicily. He observed that in those countries, cities and palaces seen at a great distance appeared to him miles nearer than they really were; and suggested this explanation: the purity of the Italian and Sicilian air gave to very distant objects the degree of brightness and clarity that was to be seen only in nearby objects in the polluted air of his own country. Italian painters commonly give a more lively colour to the sky than the Flemish ones do, and this has been attributed to the purity of the Italian air. Oughtn't they for the same reason to represent very distant objects with brighter colours and more clear detail of the small parts?

Just as in uncommonly pure air we are apt to think visible objects to be nearer and smaller than they really are, so in uncommonly foggy air we are apt to think them more distant and larger than they are. Walking by the seaside in a thick fog I see an object that seems to me to be a man on horseback about half a mile away. My companion, who has better eyes or is more accustomed to seeing such things in fog, assures me that it is a sea-gull. . . . On a second look I immediately agree with him: it now appears to me to be a sea-gull about seventy yards away. My mistake and my correction of it are both so sudden that we don't know whether to call them 'judgment' or simple 'perception'.

It isn't worthwhile to argue about labels; but it is evident that my first belief and my second corrected one were produced by •signs rather than by •arguments, and that in each of them my mind reached its conclusion by •habit and not by •reasoning. The process of my mind seems to have been as follows. Not knowing (or not bearing in mind) the effect of a foggy air on the visible appearance of objects, •I perceive the object as having the washed-outness of colour and fuzziness of outline that objects ·customarily· have at a distance of half a mile; taking that visible appearance as a sign, I •immediately proceed to the belief that the object is half a mile distant. Then that distance together with the visible size •signify to me that the real size must be equal to that of a man on horseback, and the figure—given the unclarity of its outline— agrees with that of a man on horseback. Thus the deception is brought about. But when I am assured that it is a sea-gull, the real size of a seagull together with the visible size presented to the eye immediately suggest the distance, which in this case can't be above seventy yards; the unclarity of the figure likewise suggests the fogginess of the air as its cause; and now the whole chain of signs and things signified seems stronger and better connected than it was before: the half mile shrinks to seventy yards, the man on horseback dwindles to a sea-gull, I get a new perception, and I wonder how I got the previous one or what has become of it; for it has now so entirely gone that I can't get it back.

I should add that in order to produce such deceptions from the clearness or fogginess of the air, it must be uncommonly clear or uncommonly foggy; for we learn from experience to make allowance for the variety of air-conditions that we have been accustomed to observe and that we are aware of. So Bishop Berkeley made a mistake in his explanation of why the moon appears larger near the horizon. The cause of this, he said, is that near the horizon the moon's light is faint because it has passed though more of the atmosphere ·than when it is higher in the sky·; but this is wrong, because we are so used to seeing the moon with different degrees of faintness and brightness that we learn to make allowance for this, and aren't led by the faintness of her appearance to imagine her size as increased. Besides, it is certain that when the moon near the horizon is seen through a tube that cuts off the view of the intervening ground and of all terrestrial objects, it loses all that unusual appearance of size.

4. We frequently perceive the distance of objects by means of intervening or contiguous objects whose distance or size is already known. When I perceive certain fields. . . .to lie between me and an object, it's obvious that they can become signs of its distance. Even if we don't know exactly how big the fields are, their similarity to others that we know suggests their sizes. We are so used to measuring with our eye the ground that we move across, and to comparing •the judgments of distances formed by sight with •what we know in other ways, that we gradually learn in this way to form a more accurate judgment of the distance of terrestrial objects than we could do by the means described earlier. An object

placed on the top of a high building appears much smaller than when it is placed on the ground at the same distance. When it stands on the ground

> •the intervening ground serves as a sign of •its distance, and •the distance together with •the visible size serves as a sign of •its real size.

But when the object is placed high up this sign of its distance is taken away; •the remaining signs lead us to place it at •a lesser distance; and •this lesser distance together with •the visible size becomes •a sign of a lesser real size. Methods 1 and 2 would never on their own make a visible object appear to be more than about two hundred feet away, because beyond that distance the shape of the eyes and the angle between their axes don't alter in any way that one could feel. Method 3 is only a vague and approximate sign when applied to distances greater than two or three hundred feet, unless we know the real colour and shape of the object. And method 5, which I shall come to shortly, can be applied only to objects that are familiar, or whose real size is known. So it follows that when unknown objects on or near the surface of the earth are perceived to be some miles away, it is always by this method 4 that we are led to that conclusion.

Dr. Smith has made the sound point that the known distance of the most distant terrestrial objects that we see makes •the part of the sky that is toward the horizon appear more distant than •the part that is toward the zenith. So the apparent shape of the sky is not that of •a hemisphere [= 'half-sphere'] but rather of •a segment of a sphere that is less than half of it. So, also, the diameter of the sun or moon, or the distance between two fixed stars, appears much greater when seen contiguous to a hill or to any distant terrestrial object than it appears when no terrestrial object is seen at the same time.

These observations have been sufficiently explained and confirmed by Dr. Smith. Let me add that when the visible horizon is terminated by very distant objects the sky seems to be enlarged in all dimensions. When I view it from a confined street or lane it has some proportion to the buildings that surround me; but when I view it from a large plain, surrounded by hills that rise one above another to a distance of twenty miles from the eye, I seem to see a new heaven whose magnificence declares the greatness of ·God·, its author, and puts every human building to shame; for now the lofty spires and gorgeous palaces shrink to nothing before it, and are no more comparable with the celestial dome than *their* makers are comparable with *its* maker!

5. Our only remaining way of perceiving the distance of visible objects is by the lessening of their visible or apparent size. By experience I know what a man (for example) looks like at a distance of ten feet; I perceive the gradual and proportional lessening of this visible figure at the distance of twenty, forty, a hundred feet, and at greater distances until it vanishes altogether. Thus, a certain visible size of a known object becomes the sign of a certain determinate distance, and brings with it the conception of and belief in that distance.

In this process of the mind, the sign is not •a sensation but rather •an original perception. We perceive the visible shape and visible size of the object by the original powers of vision; but the visible shape is used only as a sign of the real shape, and the visible size is used only as a sign either of the distance or of the real size of the object; and so these original perceptions—like other mere signs - pass through the mind without our attending to them or reflecting on them.

This last way of perceiving the distance of known objects serves to explain some very remarkable phenomena in optics—ones that would otherwise appear very mysterious.

When we view an object of known size through a telescope, there is no way of determining their distance except this method 5. From this it follows that known objects seen through a telescope must seem •to be brought nearer in proportion to the magnifying power of the glass, or to be moved to a greater distance in proportion to the minifying power of the glass.

Suppose that a man who has never before seen objects through a telescope is told that the telescope that he is about to use magnifies the diameter of the object ten times. When he looks through this telescope at a man six feet high, what will he expect to see? Surely he will naturally expect to see a giant sixty feet high. But he sees no such thing! The man appears no more than six feet high, and consequently no bigger than he really is; but he appears ten times nearer than he is. The telescope indeed magnifies tenfold the image of this man on the retina, and must therefore magnify his visible figure in the same proportion; and as we have been accustomed to seeing him with this visible size when—and *only* when—he was ten times nearer than he is at present, this visible size suggests the conception of and belief in that distance of the object with which it has been always connected. . . . That's why a telescope seems not to magnify known objects but to bring them nearer to the eye.

When we look through a pinhole or a single microscope at an object that is half an inch from the eye, the picture of the object on the retina is not enlarged but only clarified; and the visible figure isn't enlarged either; yet the object appears to the eye twelve or fourteen times more distant, and twelve or fourteen larger in diameter, than it really is. A telescope such as the one I have mentioned amplifies the image on the retina, and the visible figure of the object, ten times in diameter, and yet makes it seem no bigger but only ten times nearer. Writers on optics have known about these appearances for a long time, and have struggled to explain them through •optical principles; but they had no chance of succeeding. The appearances must be explained in terms of •habits of perception that are acquired by •custom, though they are apt to be mistaken for •original perceptions. Berkeley first provided the world with the proper key for opening up these mysterious appearances, but he made considerable mistakes in his use of it. Dr. Smith, in his elaborate and judicious treatise *System of Optics*, has applied it to the apparent distance of objects seen through glasses, and to the apparent shape of the sky, with such wonderful success that there is now no room for doubt about the causes of these phenomena.

23. The signs used in other acquired perceptions

The most important thing to be learned in vision is *the distance of objects from the eye*. Many others things are easily learned on the basis of that.

- •The distance of the object joined with •its visible size is a sign of •its real size; and
- •the distances of the object's various parts joined with •its visible shape is a sign of •its real shape.

Thus, when I look at a globe that stands before me, all I perceive by the original powers of sight is something that is circular and variously coloured. The visible figure has no distance from the eye, isn't convex, and has only two dimensions; even its size is incapable of being measured in inches, feet, or other linear measures. But when I have learned to perceive the *distance from the eye of each part* of this object, this perception gives it convexity and a spherical shape, adding a third dimension to the two that it had before. The *distance of the whole object* similarly makes me perceive its real size. . . .

I showed in section 7 that the visible shape of a body can be inferred by mathematical reasoning from its real shape, distance and orientation in relation to the eye; similarly we can, by mathematical reasoning infer from the visible shape, together with the distances from the eye of the various parts of it, infer the real shape and orientation. But this second inference is usually made not by mathematical or any other kind of *reasoning*, but by custom.

The original appearance that the colour of an object makes to the eye is a sensation for which we have no name, because it is used merely as a sign and is never attended to in common life; but this appearance signifies different things in different circumstances. If a piece of cloth with one uniform colour is placed partly in sunlight and partly in the shade, the appearance of colour in these different parts is very different; yet we perceive the colour to be the same because we interpret the variety of appearance as •a sign of light and shade and not as •a sign of real difference in colour. But if our eye could be deceived into not perceiving the difference of light on the two parts of the cloth, then we would interpret the variety in the appearance to signify different colours in the parts of the cloth.

If a piece of cloth is placed as before, but with the shaded part so much brighter in colour than the part in sunlight that the two parts give the same appearance to the eye, we'll interpret the •sameness of appearance as a sign of a •difference in colour, because we'll allow for the effect of light and shade.

When the •real colour of an object is known, its •apparent colour indicates

the degree of light or shade, or

the colour of the surrounding bodies whose rays it reflects, or

how far or near the object is (as I noted in section 22),

depending on the circumstances; and these can ·in their turn· suggest other things to the mind. Thus, an unusual appearance in the colour of familiar objects may lead to the diagnosis of a disease in the spectator. The appearance of things in my room may indicate sunshine or cloudy weather, the earth covered with snow or blackened with rain. . . .

I have already remarked that •the original and acquired perceptions that we have by our senses are •the language of nature to man, which is similar in many respects to human languages. My examples of acquired perceptions suggest this point of resemblance: just as ambiguities are often found in human languages, the language of nature in our acquired perceptions has them too. We have seen this especially in the case of vision, where the same appearance to the eye can in different circumstances indicate different things. So when the circumstances on which the interpretation of the signs depends are unknown, the signs must be ambiguous; and when the circumstances are mistaken, the meaning of the signs must also be mistaken.

This is the case with all the phenomena that we call 'fallacies of the senses', and especially with those we call 'fallacies of vision'. The appearance of things to the eye always conforms to the fixed laws of nature, so strictly speaking there are no fallacies in the senses. Nature always speaks the same language, and uses the same signs ·with the same meanings· in the same circumstances; but we sometimes mistake the meaning of a sign, either through ignorance of the laws of nature or through ignorance of the circumstances in which the sign has occurred. To someone who doesn't know the principles of optics, almost every experiment made with a prism, a magic lantern, a telescope or a microscope seems to produce some fallacy in vision! Even the appearance of a common mirror would seem most remarkably fallacious to someone who knew nothing

at all about how mirrors work. For how can a man be more deceived than he is in seeing in front of him something that is really behind him? In seeing himself several yards away from himself? Yet children who haven't yet learned to speak learn not to be deceived by these appearances. These, as well as all other surprising appearances produced by optical glasses, are a part of the visual language; and to those who understand the laws of nature concerning light and colours they are in no way fallacious, but have a true and clear meaning.

24. How perception is analogous to the trust we have in human testimony

There are countless objects of human knowledge, but the channels through which the knowledge is conveyed to the mind are few. Among the important channels are these two:

> the perception of external things by our senses, and
> the information we get through human testimony.

The analogy between these two is so remarkable, as is the analogy between the forces of the mind used by one and those used by the other, that I shall without further apology consider them together.

In the testimony of nature given by the senses, as well as in human testimony given by language, things are signified to us by signs; and in each of them the mind passes, either by original forces or by custom, from the sign to the conception of and belief in the things signified.

I have divided our perceptions into •original and •acquired; and have divided language into •natural and •artificial. There is a great analogy between •acquired perception and •artificial language, but an even great analogy between •original perception and •natural language.

In original perception the signs are *sensations*, of which nature has given us a great variety, suited to the variety of the things signified by them. Nature has established a real connection between the signs and the things signified; and nature has also taught us how to interpret the signs, so that independently of experience the sign suggests the thing signified and creates the belief in it.

In natural language the signs are features of the face, gestures of the body and modulations of the voice; and the variety of *these* is suited to the variety of the things signified by them. Nature has established a real connection between these signs and the thoughts and mental dispositions that they signify; and nature has taught us how to interpret these signs, so that independently of experience the sign suggests the thing signified and creates the belief in it. A man on a social occasion can, without doing good or evil, behave himself

> gracefully, civilly, politely,

or, on the contrary,

> meanly, rudely and impertinently,

without uttering a word! We see the disposition of his mind by their natural signs in his face and his behaviour, in the same way that we perceive the shape and other qualities of bodies by the sensations that nature has connected with them.

The signs in the natural language of the human face and behaviour, as well as the signs in our original perceptions, have the same signification [= 'meaning'] in all climates and in all nations, and the ability to interpret them is innate, not acquired.

In acquired perception the signs are either •sensations or •things that we perceive by means of sensations. The connection between the sign and the thing signified is established by nature, and we discover this connection by

experience—but helped in this by our original perceptions or by previously acquired ones. After we have discovered this connection, the sign always suggests the thing signified, and creates the belief in it—just as with original perception.

In artificial language, the signs are articulate sounds that are connected by human decision with the things signified by them. In learning our mother tongue we discover this connection by experience— but we're helped in this by natural language or by previously learned artificial language. And after we have this connection, the sign always suggests the thing signified, and creates the belief in it—just as with natural language,

We don't have many original perceptions compared with the acquired ones, but without the former we couldn't possibly attain the latter. Similarly, natural language is scanty compared with artificial language; but without the former we couldn't possibly attain the latter.

Our original perceptions, as well as the natural language of human features and gestures, must be explained in terms of the *particular* forces at work in the human constitution. Thus it is by one of these that certain features express anger, and by another that certain features express benevolence. Similarly, it is because of one *particular* force of our constitution that a certain sensation signifies hardness in the body that I handle, and it is by another that a certain sensation signifies motion in that body.

But •our acquired perceptions and •the information we get through artificial language must be explained in terms of *general* forces in the human constitution. When a painter perceives that this picture is the work of Raphael and that the work of Titian, a jeweller that this is a true diamond and that a counterfeit, a sailor that this is a ship of five hundred tons and that a ship of four hundred—these different acquired perceptions are produced by the same general forces in the human mind, which operate differently ·at different times· in one person, depending on how he applies them, and operate differently in different person, depending on their various upbringings and ways of life. Similarly, when certain articulate sounds convey to my mind the knowledge of the battle of Pharsalia and to others the knowledge of the battle of Poltowa, or when a Frenchman and an Englishman receive the same information through different articulate sounds, the signs used in these different cases produce, by means of the same general forces in the human constitution. the knowledge of and belief in the things signified. Now, if we compare •the general forces in our constitution that enable us to receive information from our fellow creatures by language with •the general forces that enable us to acquire the perception of things by our senses, we shall find them to be very similar in their nature and manner of operation.

When we begin to learn our mother tongue, we perceive (through the help of natural language) that those who speak to us use certain sounds to express certain things; we imitate the same sounds when we want to express the same things, and we find that we are understood.

But here a difficulty occurs that we should attend to because the solution of it leads to some original forces in the human mind that are of great importance and of very extensive influence. We know by experience that men *have* used such-and-such words to express such-and-such things. But all experience is of the past, and it can't in itself give any notion of or belief in what is future. So how do we come to believe—and to rely confidently on the belief—that men who *could* do otherwise w*ill* continue to use the same words when they think the same things? Where do we get it from, this knowledge and belief (or, better, this *foresight*) of the future voluntary actions of our fellow-creatures? Have they promised that they will never deceive us by ambiguity or

falsehood? No, they have not. And even if they had, that wouldn't remove the difficulty, for such a promise would have to be expressed by words or by other signs, and we couldn't rely on it unless we were assured that they were giving the usual meanings to the signs expressing promise. No sensible person ever thought of taking a man's own word for his honesty: when we rely on someone's word or promise, we are obviously already taking his truthfulness for granted. Anyway, this reliance on the declarations and testimony of men is found in children long before they know what a promise is.

So there is in the human mind an early expectation, not derived from •experience or from •reason or from any •contract or promise, that when our fellow-creatures use language they will use the same signs when they have the same thoughts.

This is in reality a kind of foreknowledge of human actions; and it seems to me to be an original force in the human constitution, without which we couldn't have language and so couldn't receive instruction.

The wise and beneficent author of nature, who intended •that we should be social creatures and •that we should receive the largest and most important part of our knowledge through information from others, has for these purposes implanted in our natures two forces that fit in with one other.

1. The first is a propensity to speak the truth, and to use the signs of language so as to convey our real thoughts. This operates powerfully, even in the greatest liars; for even they speak truth a hundred times for every lie they tell. Truth is always uppermost, and is the natural output of the mind. It requires no skill or training, no inducement or temptation; to be truthful all we need do is to yield to a natural impulse. Lying on the other hand is doing violence to our nature; and even the worst men never do it without some temptation. •Speaking truth is like •eating our natural food, which our appetite would lead us to do even if it didn't lead to any ·desired· end ·such as preserving health·; but •lying is like •taking medicine, which tastes disgusting and which no-one takes except for some end that he can't otherwise achieve.

You may want to object: 'Men can be influenced by moral or political considerations to speak the truth, so their doing so is no proof of an *original* force such as you have mentioned.' I answer first •that moral or political considerations can't come into play until we arrive at years of understanding and reflection; yet we know from experience that children invariably keep to the truth before they are capable of being influenced by such considerations. And secondly •that when we are influenced by moral or political considerations, we must be *aware* of that influence and capable of perceiving it on reflection. Now, when I reflect on my actions most attentively I am not aware that in speaking the truth I am influenced on ordinary occasions by any moral or political motive. I find that truth is always at the door of my lips, and goes out spontaneously if I don't hold it back. For truth to come out, it isn't necessary for me to have any good or bad intention; all that is needed is for me to be simple, straightforward, not *up to* anything. It may well be that some •temptations to falsehood would be too strong for the natural force of •truthfulness unless forces of •honour or virtue were bought to its aid; but when there is no such temptation we speak the truth *by instinct*; and this instinct is the force I have been explaining.

By this instinct, a real connection is formed between our words and our thoughts—one that makes the former fit to be signs of the latter, which they couldn't otherwise be. This connection is broken every time someone lies or trades on ambiguity; but cases of this are comparatively rare, so the

authority of human testimony is only weakened by them, not destroyed.

2. A second original force implanted in us by ·God·, the supreme being, is a disposition to trust in the truthfulness of others and to believe what they tell us. Let the first of the two forces be called 'the force for truthfulness'; then this second one—the counterpart of the first—can be called 'the force for trust'. It is unlimited in children until they meet with instances of deceit and falsehood, and it stays pretty strong throughout life.

If nature had left the mind of the *speaker* evenly balanced between truth and falsehood, children would lie as often as they spoke the truth, until their •reason had developed far enough to suggest that lying is •imprudent, or their •conscience had developed far enough to suggest that lying is •immoral. [Reid wrote 'as often as they *speak* the truth', making lying much commoner than truth-telling. This was presumably a slip.] And if nature had left the mind of the *hearer* evenly balanced between believing and disbelieving what is said, we wouldn't take anyone's word until we had positive evidence that he was speaking the truth. In those circumstances his testimony would have no more authority than his dreams - which may be true or false, but no-one is inclined to believe them *just because they were dreamed*! It is obvious that in the matter of testimony nature tips the balance of human judgment to the side of belief; that is the side our judgment takes when there is nothing put into the opposite scale. If this were not so, no proposition that is uttered in discourse would be believed until it was examined and tested by reason, and most men would be unable to find reasons for believing a thousandth part of what is told to them. Such distrust and disbelief would deprive us of the greatest benefits of society and make our condition worse than that of savages.

On this supposition ·of equilibrium between belief and disbelief·, •children would be absolutely untrusting and therefore absolutely unteachable; •those ·adults· who had little knowledge of human life and of the manners and characters of men would be in the next degree untrusting; and the most trusting people would be •those with the greatest experience and deepest thought, because they would often be able to find good *reasons* for believing the testimony—reasons that the weak and the ignorant couldn't discover.

In short: •if trust were the effect of reasoning and experience, it would grow up and gather strength in the same proportion as reason and experience do. But •if it is a gift of nature, it will be strongest in childhood and limited and restrained by experience. You don't have to know much about human life to realise that the second of these is really the case, and not the first.

Nature intends that we should be carried in the arms of others before we can walk on our legs; similarly, nature intends that our belief should be guided by the authority and reason of others before it can be guided by our own reason. The weakness of the infant and the natural affection of the mother plainly indicate the former of these; and the natural trustfulness of youth and the authority of age equally plainly indicate the latter. The infant, by proper nursing and care, acquires strength to walk without support. Reason likewise has her infancy when she must be carried in arms; at that time she leans entirely on authority, by natural instinct, as if she were conscious of her own weakness; and without this support she becomes dizzy. When brought to maturity by proper development she begins to feel her own strength and to lean less on the reason of others; she learns to suspect testimony in some cases and to disbelieve it in others, and she sets limits to that authority to which she was at first entirely subject. But still, throughout her life she finds that

•she has to borrow light from testimony when she has no light of her own ·to shine on the matter in question·, and that •she has to lean somewhat on the reason of others when she is conscious of her own weakness.

Just as reason, even in her maturity, often gets help *from* testimony, so she also sometimes gives help back *to* testimony and strengthens its authority. For just as we find good reason to reject testimony in some cases, so in others we find good reason to rely on it with perfect confidence in our most important concerns.

> The witnesses are trustworthy people. There are many of them. They have nothing personally at stake in this matter. They can't have come together to agree on their testimony. It's not credible that the agreement of their testimony came about by chance.

These facts may give an irresistible strength to testimony, compared with which its native and intrinsic authority is very inconsiderable.

Having now considered the general forces in the human mind that enable us to receive information from our fellow-creatures by means of language, let us next consider the general forces that enable us to receive information about nature through our own acquired perceptions. It is undeniable—and nobody *does* deny—that when we have found two things to be constantly conjoined in the course of nature, the appearance of one of them is immediately followed by the conception of and belief in the other. The former becomes a natural sign of the latter; and the knowledge of their constant conjunction in the past, whether acquired by experience or in some other way, is sufficient to make us rely confidently on the continuance of that conjunction.

This process of the human mind is so familiar that we never think of inquiring into the forces that underlie it. We are apt to conceive it as a self-evident truth that *what is to come must be similar to what is past*. Thus if a certain degree of cold freezes water today and has been known to do so throughout the past, we have no doubt that the same degree of cold will freeze water tomorrow or a year hence. I freely grant that this is a truth that all men believe as soon as they understand it, but my question is: What *makes* it evident to us? Not the relating of ideas, surely; for when I set the idea of •cold alongside that of •water hardened into a transparent solid body, I can perceive no connection between them; no-one can show one to be a necessary effect of the other, or give a shadow of reason why nature has conjoined them. But don't we learn their conjunction from experience? True; experience informs us that they *have been* conjoined in the past; but no-one has ever had any experience of what is future, and that's our question—*How do we come to believe that the future will be like the past?* Has the author of nature promised this? Or were we told about his planning at the time when he established the present laws of nature and settled how long they were to continue for? No, surely. Indeed, if we believe that there *is* a wise and good author of nature, we can see a good reason why he should give a long lease of life to the same laws of nature and the same connections of things. The reason is that if he did otherwise we couldn't learn anything from what is past, and all our experience would be useless to us. But though this consideration can when we come to the use of reason confirm our belief in the continuance of the present course of nature, it can't have given rise to this belief ·in the first place·, for children and idiots have this belief as soon as they know that *fire will burn them*. So it must be an effect of instinct, not of reason.

The wise author of our nature intended that a great and necessary part of our knowledge should be derived from experience before we are capable of reasoning, and

he has provided means that are perfectly adequate to this intention. **(1)** God governs nature by fixed laws, so that we find innumerable connections of things that continue from age to age. Without this stability in the course of nature there could be no experience, or ·there would be experience but· it would be a false guide and lead us into error and trouble. If there were no force for truthfulness in the human mind, men's words wouldn't be signs of their thoughts; and if there were no regularity in the course of nature, no one thing could be a natural sign of something else. **(2)** God has implanted in human minds an original force which leads us to believe in and expect the continuance of the course of nature and of the connections that we have observed in the past. It is through this general force in our nature that when two things have been found connected in the past the appearance of one produces a belief in the other.

I think that the ingenious author of the *Treatise of Human Nature*, ·David Hume·, was the first to point out that our belief in the continuance of the laws of nature can't be founded either on knowledge or probability; but, far from conceiving it to be an original force in the mind, he tries to explain it in terms of his favourite hypothesis, namely that belief is nothing but a certain degree of liveliness in the idea of the thing that is believed. I made one remark on this curious hypothesis in chapter 2, and now I shall make another.

- •The belief we have in perception is a belief in the *present* existence of the object.
- •The belief we have in memory is a belief in the object's *past* existence.
- •The belief I am now discussing is a belief in the object's *future* existence, and
- •In imagination there is no belief at all.

What I want Hume to tell me is this: How does it come about that one degree of liveliness ties the existence of the object to •the present moment, another carries it back to •a past time, a third goes the opposite way and carries it into •the future, and a fourth carries it •out of existence altogether? Suppose I see the sun rising out of the sea; I remember having seen it rise yesterday; I believe it will rise tomorrow near the same place; I can likewise imagine it rising in that place, without any belief at all. Now, according to ·Hume's· sceptical hypothesis, this perception, this memory, this foreknowledge and this imagination are all *the same idea*, varied only by different degrees of liveliness: the perception of the sun rising is the liveliest idea, the memory of its rising yesterday is the same idea a little fainter, the belief in its rising tomorrow is the same idea fainter still; and the imagination of its rising is *still* the same idea but faintest of all. One would have thought that this idea might gradually pass through all possible degrees of liveliness without stirring out of its position ·in time·; but if we do think this we deceive ourselves (according to Hume), for as soon at the idea begin to grow faint it moves backward into the past. Well, if we grant this, we would at least expect that. . . .the •more its liveliness fades the •further back in time it will go, until it recedes out of sight. But here we are deceived again (according to Hume), for at a certain point in this declining liveliness the idea, as if it had met an elastic obstacle in its backward motion, suddenly rebounds from the •past to the •future without touching on the •present en route. And now that the idea has come into the regions of futurity, we might expect that the future gives it room enough to spend all its remaining vigour; but yet again we are deceived (according to Hume), because the idea makes another vigorous jump up into the airy region of imagination. . . . This article of the sceptical creed is so full of mystery. . . .that it appears to require as

much faith as does the Athanasian Creed!

However, I agree with Hume that our belief in the continuance of nature's law is not derived from reason. It is an *instinctive* foreknowledge of the operations of nature, very like the foreknowledge of human actions that makes us rely on the testimony of our fellow creatures; and just as we need the latter if we are to be able to receive information from men by language, so we need the former if we are to be able to receive information about nature by means of experience.

All our knowledge of nature beyond our original perceptions is acquired by experience, and consists in the interpretation of natural signs. The constancy of nature's laws connects the sign with the thing signified, and, by the natural force I have just explained we rely on the continuance of the connections that experience has revealed; and thus the appearance of the sign is followed by the belief in the thing signified.

This aspect of the workings of our constitution is the basis not only for acquired perception but for all inductive reasoning and all our reasoning from analogy; so, for want of another name, let me call it the 'inductive force'. It is what leads us to assent immediately to the axiom on which all our knowledge of nature is built, namely that *effects of the same kind must have the same cause*. For 'effects' and 'causes' in the operations of nature mean nothing but 'signs' and 'things signified by them'. We don't perceive in any natural cause any real causality or effectiveness, but only a connection established in the course of nature between it and what is called its 'effect'. Our constitution makes us expect, independently of all reasoning, that there is a fixed and steady course of nature; and we have an eager desire to discover it. We pay attention to every conjunction of things that presents itself, and expect that conjunction to continue. And when such a conjunction has been often observed, we think of the things as naturally connected, and the appearance of one carries along with it the belief in the other, without any reasoning or reflection ·on our part·.

If you think that the inductive force can be explained in terms of what philosophers usually call the 'association of ideas', you should bear in mind that this force associates a natural sign are not only with an *idea* but with a *belief in the thing signified*. This can't properly be called an 'association of *ideas*' unless ideas and belief are one and the same thing. A child has found the prick of a pin conjoined with pain, so now he believes and knows that these things are naturally connected; he knows that the one will always follow the other. If you want to call this only an 'association of ideas' I don't want to argue about words, but I think you are speaking very improperly. For if we express it in plain English, it is a foreknowledge that things you have found conjoined in the past will be conjoined in the future. And this foreknowledge is an effect not of reasoning but of an original force in human nature, which I have called the 'inductive force'.

This force, like the force for trust, is unlimited in infancy and is gradually restrained and regulated as we grow up. It leads us often into mistakes, but on the whole it is infinitely helpful to us. By the inductive force

(1) a child who has once been burnt keeps away from the fire, and

(2) a child who has once been inoculated runs away from the surgeon who did it.

It is better that he should do **(2)** than that he should not do **(1)**. But the mistakes we are led into by these two natural forces are of different kinds. Men sometimes lead us into mistakes when we perfectly understand their language, by speaking lies. But nature never misleads us in *this* way; her language is always true, and it is only by misinterpreting it that we fall into error. There must be many •accidental

conjunctions of things, as well as •natural connections; and •the former are apt to be mistaken for •the latter. Thus in example **(2)** the child connected the pain of inoculation with the surgeon, whereas it was really connected only with the needle's going in. Philosophers and men of science also make such mistakes; indeed all false reasoning in philosophy comes from them. •False reasoning is drawn from experience and analogy just as •sound reasoning is; if it weren't, it wouldn't be plausible; but the difference between them is that between •an unskilful and rash interpretation of natural signs and •a sound and legitimate interpretation of them. If a child or an educated man were told to interpret a book of science, written in his mother tongue, how many blunders and mistakes would he be apt to fall into? Yet he knows as much of this language as he needs for his manner of life.

The language of nature is what we all study, and the students of it belong to different classes. •Brutes, idiots and children engage in this study, and owe to it all their acquired perceptions. •Ordinary not very educated men make more progress with it, and learn through a little thought many things that children don't know. •Philosophers [here = 'scientists'] fill up the top class in this school, and are scholars of the language of nature. All these different classes have one teacher, Experience, enlightened by the inductive force. Take away the light of this inductive force and Experience is as blind as a mole; she may indeed feel what is present and what immediately touches her, but she sees nothing that is spatially or temporally separated from her.

The rules of inductive reasoning, i.e. of a sound interpretation of nature, as well as the fallacies by which we are apt to misinterpret her language, have been brilliantly set out by the great genius of Francis Bacon; so that his *New Organon* can fairly be called 'a grammar of the language of nature'. It adds greatly to the merit of this work, and excuses its defects, that at the time Bacon wrote it the world had not seen any tolerable model of inductive reasoning from which the rules of such reasoning might be copied. The arts of poetry and eloquence had grown up to perfection when Aristotle described them; but the art of interpreting nature was still an embryo when Bacon described the features and proportions it would have as an adult. Aristotle drew his rules ·for poetry etc.· from models of those arts that are still the best that have appeared; but the best models of inductive reasoning that have appeared, which I take to be the third book of Newton's *Principia* and his *Optics*, were drawn from Bacon's rules! The purpose of all those rules is to teach us to distinguish seeming or apparent connections of things in the course of nature from ones that are real.

Those who are unskilful in inductive reasoning are more likely to fall into error in their •reasonings from the phenomena of nature than in their •acquired perceptions. This is because we often •reason from *a few* instances, and thus risk mistaking accidental conjunctions of events for natural connections; whereas the •habit of passing without reasoning from the sign to the thing signified, which is what acquired perception is, has to be learned through *many* instances or experiments; and the number of experiments serves not only to confirm our belief in natural connections but also to disconnect the events that have been accidentally conjoined.

From the time that children begin to use their hands, nature directs them to handle everything over and over, to look at it while they handle it, and to put it in various postures and at various distances from the eye. We are apt to excuse this as something that children do because they have to be doing *something* and haven't the mental resources to entertain themselves in a more grown-up way. But if we think more justly we'll find that they are engaged in a most serious and important study, and if they had all

the reason of a philosopher they couldn't be better employed. For it is this childish conduct that enables them to make proper use of their eyes. Through it they every day acquire habits of perception that are of greater importance than anything we could teach them. The original perceptions that nature gave them are few, and insufficient for the purposes of life; so she made them capable of acquiring many more perceptions by habit. And to complete her work she has made children tireless in conducting the exercises by which those perceptions are acquired.

This is the education that nature gives to her children. And while I am on this topic I might as well add that another part of nature's education is that in the natural course of things children often can't gratify their curiosity and satisfy their appetites without exerting all their muscular force and employing all their ingenuity. What they want can be obtained only at the expense of labour and patience and many disappointments. By the exercise of body and mind necessary for satisfying their desires, they acquire agility, strength and dexterity in their motions, as well as health and vigour in their constitutions; they learn patience and perseverance; they learn to take pain in a good spirit and to bear up under disappointment. Nature's education is most perfect in savages, who have no other tutor; and we see that in

> the acuteness of all their senses,
> the agility of their motions,
> the hardiness of their constitutions, and
> the strength of their minds to bear hunger, thirst, pain and disappointment,

savages commonly far exceed civilized people. This seems to be what has led a very able writer to prefer the savage life to that of society. But nature's education, unaided, could never produce a Rousseau! Nature intends that human education should be added to her rÃ©gime in order to form the man. And she has equipped us for human education by the natural forces for imitation and for trust, which reveal themselves almost in infancy, as well as by others that develop later.

When the education we receive from men doesn't give scope to nature's education, it is wrongly directed; it tends to hurt our faculties of perception, and to weaken both the body and mind. Nature has her way of rearing men, as she has her way of curing their diseases. •The art of medicine is to follow nature, imitating her and helping her to cure the diseases; and •the art of education is to follow nature, helping and imitating her in her way of rearing men. In ancient times the inhabitants of the Balearic Islands followed nature in teaching their children to be good archers: they hung their dinner up high by a thread, and left the youngsters to bring it down by their skill in archery!

The education of nature, with the addition only of such human care as is needed to preserve life, makes a perfect savage. Human education added to that of nature can make a good citizen, a skillful artisan, or a well bred man. But to produce a Rousseau, a Bacon or a Newton there must be tutoring ·not only from nature and from men, but also· from reason and reflection. Despite the innumerable errors committed in human education, hardly any education is so bad that it's worse than having none. And I think that even Rousseau, if he had to choose whether to educate a son among the French, the Italians, the Chinese or the Eskimos, wouldn't choose the Eskimos.

When reason is properly employed it will confirm the documents of nature, which are always true and wholesome; and it will distinguish the good from the bad among the documents of human education, rejecting the bad with modesty [here = 'without making a big fuss'] and holding onto the good with reverence.

Most men continue throughout their lives to be just what •nature and •human education made them. Their behaviour, their opinions, their virtues and their vices are all acquired by habit, imitation and instruction, and reason has little or no share in forming them.