Essay Towards a New Theory of Vision

George Berkeley

[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 brief passage that seems to present more difficulty than it is worth. Longer omissions are reported between brackets in normal-sized type.—The division of the each work into numbered paragraphs is Berkeley's; the divisions into lettered sections is not.

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Glossary

accurate: In Berkeley's day, 'accurate' could mean (as it does today) 'correct', 'fitting the facts', of the like. But it often—as in **130**—meant something more like 'detailed' or 'making fine distinctions' or 'precise'.

arbitrary: In early modern uses, this means 'chosen', resulting from someone's decision, or the like. There's no implication (as there is in today's use of the term) that there weren't good reasons for the choice.

condescend: These days condescension involves unpleasant patronising of someone whom one sees as lower on the social scale; but in early modern times it could be a praiseworthy way of not standing on one's dignity.

deist: Someone who believes there is a god (opposite of 'atheist'), but whose theology is *thin* compared with Christianity—e.g. the deist doesn't think of God as intervening in the world. Berkeley see the deist as someone who rejects religious revelation, purports to believe in natural religion, but is actually a covert atheist.

erect: Berkeley uses this to mean the opposite of 'inverted' or 'upside-down'.

feeling: In the main work this word occurs only in **93** and **145**. Berkeley seems to mean 'the sense of feeling' to cover proprioception (your sensory awareness of how your body is moving) as well as the sense of touch.

***minimum visibile*:** Latin for **visible point**.

minute philosopher: Cicero used this phrase to label philosophers who minimize things, regard as small things that most of us think are great. It is Berkeley's favourite name for philosophers who, like Shaftesbury (he thought), reject revealed religion, deny that men have free-will, say that morality is based on feelings rather than insight into necessary moral truths, and so on.

paint: You'll see for yourself how Berkeley uses this verb, namely in a way that doesn't bring in the noun! This was one standard way of using it at his time.

prenotion: 'A notion of something prior to actual knowledge of it; a preconceived idea' (OED).

prejudice: This basically means 'something judged or believed in advance' (of the present investigation, of the evidence, or of etc.)—an old, firm opinion. These days 'prejudice' usually has the narrower meaning of 'something pre-judged concerning race, sex, etc'., but Berkeley's use of it is not like that.

regarded: When Berkeley says that x is more 'regarded' than y he means that x is given more weight, seen as more important, attended to more, than y.

shape: Wherever this word occurs here it is as a replacement for 'figure'. In a few places, especially in **150–152** and **155–158** the word 'figure' is allowed stand, for obvious reasons.

situation: Sometimes Berkeley uses 'situation' to mean 'location'. In **98**, **101** and **v60** the 'situation' of the eye is the direction in which it is pointed—it's what changes if you keep your head still and roll your eyes. And Berkeley often, especially in **88–120** , uses 'situation' to mean 'orientation'. Where it's quite clear that that is his meaning, 'orientation' will be substituted for 'situation'.

speculation: Theorising. It doesn't *have to* be 'speculative' in our sense, involving guess-work. The 'practical and

speculative parts of geometry' are •applied geometry and •pure or theoretical geometry respectively.

sudden: By a 'sudden' judgment Berkeley means one that is made straight off, without a pause to calculate or consider.

visible point: The smallest amount of a visual image that can be noticed.

vulgar: Applied to people who have no social rank, are not much educated, and (the suggestion often is) not very intelligent.

The Main Work (1709)

1. My plan is to show *how* we perceive by sight the

- •distance [**2–51**],
- •size [**52–87**], and
- •orientation [**88–120**]

of objects. Also to consider the difference between the ideas of sight and those of touch, and whether there's any idea common to both senses [**121–159**].

A. The distance from us of the objects of sight

2. Everyone accepts, I think, that distance itself can't be immediately *seen*. Distance is a line directed end-wise to the eye, so it projects only one point onto the fund of the eye, and this point is always the same, whether the distance is longer or shorter. [The 'fund of the eye' often appears as 'the fund of the eye or retina', and from now on will be replaced by 'retina'.]

3. I find it also ·to be generally· acknowledged that our estimate of the distance of considerably remote objects is an act of •judgment based on experience rather than of •sense. When I perceive many intermediate objects—houses, fields, rivers, and the like—which I have experienced to take up a considerable space, this leads me to judge or conclude that the object I see beyond them is at a great distance. And when an object appears faint and small, though at a near distance I have experienced it to make a vigorous and large appearance, I instantly conclude it to be far off; and this is obviously the result of experience, without which I wouldn't have inferred anything concerning •the distance of objects from •the faintness and littleness ·of their appearance·.

4. But when an object is near enough to me for the distance between my eyes to be a significant proportion of the distance to the object, the theoreticians hold that the two optic axes meeting at the object make an angle by means of which the object is perceived to be nearer or further off depending on the size of that angle.[1] [Berkeley adds to 'two optic axes' the aside 'the fancy that we see with only one eye at once being exploded'.]

5. There's a remarkable difference between these two ways of estimating distance: whereas

- •there appears to be no necessary connection between small distance and a large strong appearance, or between large distance and a small faint appearance,
- •there appears to be a very necessary connection between an obtuse angle and near distance, and an acute angle and further distance.

The latter doesn't in the least depend on experience; someone with no experience of this can know for sure that •the nearer the meeting-point of the optic axes the larger the angle, and •the remoter their meeting-point is, the smaller will be the angle that they make.

6. Writers on optics mention another way in which, they say, we judge of distances that are significantly related to the breadth of the pupil ·of a single eye·. It depends on the larger or lesser divergence of the rays that reach the pupil from the visible point: the more (or less) the rays diverge, the nearer (or further) the point is judged to be. As the divergence of the rays decreases until they are to sense parallel, the apparent distance increases until it becomes infinite. This, it is said, is how we perceive distance when we look with only one eye.

[1] See what Descartes and others have written on this subject.

7. It's clear that here again we are not relying on experience. It is a certain, necessary truth that the nearer the direct rays falling on the eye approach to being parallel the further away is the point of their intersection, i.e. the visible point from which they flow.

8. The accounts given in **4** and **6** of perceiving near distance by sight are •accepted as true and accordingly •used in determining the apparent places of objects; but they seem very unsatisfactory, for the following reasons.

9. It is evident that when the mind perceives an idea other than •immediately and of itself, it must be •by means of some other idea. The passions in your mind are of themselves invisible to me; but I can perceive them by sight, though not immediately, by means of the colours they produce in your face. We often see shame or fear in the looks of a man by perceiving the changes of his face to red or pale.

10. It is also evident that an idea that isn't itself perceived can't be the means of perceiving any other idea. If I don't perceive the redness or paleness of a man's face themselves, I can't perceive *by them* the passions in his mind.

11. Now from **2** it is plain that distance is in its own nature imperceptible, and yet it is perceived by sight. So it must be brought into view by means of some other idea that is itself immediately perceived in the act of vision.

12. But those lines and angles through which some men claim to explain the perception of distance are not themselves perceived at all, and by people unskilful in optics they're never even thought about. I appeal to your experience: do you *ever*, when seeing an object, compute its distance by the size of the angle made by the meeting of the two optic axes? And do you *ever* think about the larger or lesser divergence of the rays that arrive from any point to your pupil? Everyone is himself the best judge of what he perceives and what he doesn't. It's no use telling me that I perceive certain lines and angles which introduce into my mind the various ideas of distance if I myself am conscious of no such thing!

13. Thus, since those angles and lines are not themselves perceived by sight, it follows from **10** that the mind doesn't judge the distance of objects on the basis of them.

14. The truth of this will be even more evident to anyone who bears in mind that those lines and angles have no real existence in nature, being only an hypothesis that the mathematicians formed and then introduced into optics so as to treat that science in a geometrical way.

15. The last reason I shall give for rejecting that doctrine is that even if we granted the real existence of those optic angles etc., and even if the mind could perceive them, these principles *still* wouldn't be sufficient to explain the phenomena of distance. I'll show this in due course.

16. Now, we know that distance is suggested to the mind by the mediation of some other idea that is itself perceived in the act of seeing; so now we should inquire into what ideas or sensations there are that •accompany vision and •may be connected with the ideas of distance in such a way as to introduce the latter into the mind. Well, **firstly**, experience shows us that when we look at a near object with both eyes, as it approaches or recedes from us we lessen or widen the interval between the pupils ·of our eyes·. This turn of the eyes is accompanied by a sensation, which seems to me to be what brings the idea of larger or lesser distance into the mind in this case.

17. Not because there's any natural or necessary connection between •the sensation we perceive by the turn of the eyes and •larger or lesser distance; but because the mind has constantly experienced •the different sensations corresponding to the different dispositions of the eyes each

to be accompanied by a different distance to the object, there has come to be an habitual or customary connection between those two sorts of ideas, so that as soon as the mind perceives the sensation arising from its turn of the eyes to bring the pupils nearer or further apart but it immediately perceives the idea of distance that has customarily been connected with that sensation—just as on hearing a certain sound the idea that custom has united with it is immediately suggested to the understanding.

18. I don't see how I can easily be mistaken about this. I know for sure that distance is not perceived of itself, and that therefore it must be perceived by means of some other idea that *is* immediately perceived and varies with the distance. I know also that the sensation arising from the turn of the eyes is immediately perceived, and its various degrees are connected with different distances that always accompany them into my mind when I view—distinctly with both eyes—an object whose distance is small enough for the interval between my eyes to be significant in proportion to it.

19. I know it is generally thought that •by altering the disposition of the eyes the mind perceives whether the angle of the optic axes. . . .is larger or lesser, and that •accordingly by a kind of natural geometry it judges the point of their intersection to be nearer or further away. But my own experience convinces me that that this is not true; I am not conscious of making any such use of the perception I have by the turn of my eyes; and it seems altogether incomprehensible that I should make those judgments and draw those conclusions without knowing that I'm doing so.

20. From all this it follows that our judgment of the distance of an object viewed with both eyes is entirely the result of experience. If we hadn't constantly found certain sensations arising from the various disposition of the eyes to be accompanied by certain distances, we would never make those sudden [see Glossary] judgments from them concerning the distance of objects; any more than we would claim to judge a man's thoughts by his pronouncing words we had never heard before.

21. Secondly, when an object that is quite close to the eye comes closer still it is seen more confusedly; and the nearer it comes the more confused its appearance is. Because this is constantly the case, there arises in the mind an habitual connection between degrees of confusion and distance; the larger confusion implying the lesser distance, and the lesser confusion implying the larger distance of the object.

22. So this confused appearance of the object seems to be the medium whereby the mind judges distance in those cases wherein the most approved writers of optics think it judges by the divergence with which the rays flowing from the radiating point fall on the pupil. No man, I believe, will claim to see or feel those imaginary angles that the rays are supposed to form at the surface of his eye. But he ·does see—he· can't help seeing—whether the object appears more or less confused. . . .

23. I agree that there's no necessary connection between confused vision and distance; but then what necessary connection is there between the redness of a blush and shame? Yet whenever we see that colour arise in someone's face it brings into our mind the idea of the passion that has been observed to accompany it.

24. What seems to have misled the writers of optics in this matter is that they imagine men judge distance in the way they judge an inference in mathematics. For *that* it is indeed absolutely required that there be an evident necessary connection; but men's sudden judgments about distance are nothing like that. We are not to think that

non-human animals and children, or even adult reasonable men, whenever they perceive an object to be approaching or retreating do it by virtue of geometry and demonstration.

25. For one idea to suggest another to the mind all that is needed is for them to have been observed to go together, without any demonstration of the necessity of their coexistence, and without even knowing why they coexist. Of this there are innumerable instances of which no-one can be ignorant.

26. Thus, •larger confusion having been constantly accompanied by •nearer distance, the moment the former is perceived it suggests the latter to our thoughts. And if it had been the ordinary course of nature that the *further off* an object was the more confused it appeared, it's certain the perception that now makes us think an object is approaching would have made us think it was retreating; because that perception ·of confusion·—abstracting from custom and experience—is equally fitted to produce the idea of great distance, or small distance, or no distance at all.

27. Thirdly, when an object that is fairly near to the eye is brought still nearer, we can at least for some time prevent the appearance's growing more confused, by straining the eye. In this case the sensation of straining the eye takes the place of confused vision in aiding the mind to judge the distance of the object. . . .

28. I have listed the sensations or ideas that seem to be the constant and general occasions of introducing into the mind the different ideas of near distance. It's true that in most cases various other circumstances also contribute to forming our idea of distance, namely the particular number, size, kind, etc. of the things seen. Concerning these. . . .I shall merely remark that none of them has in its own nature any relation or connection with distance, and that they couldn't possibly signify different distances unless they were found by experience to be connected with them.

29. I shall now use these principles to account for a phenomenon that has until now vastly puzzled the writers on optics, and is so far from being •explained by any of their theories of vision that it is—as they admit—clearly •in conflict with them. Even if there were no other objections to their theories, this alone would be sufficient to call them into question. I shall lay the whole difficulty before you in the words of the learned Dr Barrow, with which he concludes his lectures on optics. [Isaac Barrow was a theologian and quite important mathematician; among his pupils was Isaac Newton.]

> 'I have presented here what my thoughts have suggested to me concerning the part of optics that is more strictly mathematical. As for the other parts of that science—parts that are physical rather than mathematical, and are consequently full of plausible conjectures rather than certain principles—I have little to say that hasn't already said by Kepler, Scheinerus, Descartes, and others. And I think I'd do better saying nothing at all than repeating what has been so often said by others; so it's high time for me to take my leave of this subject. But before I do so, honesty requires me to acquaint you with a certain awkward difficulty that seems directly opposite to the doctrine I have been advocating, or at least can't be explained in terms of it'.

[Berkeley quotes, first in Latin and then in his English translation, Barrow's account of the difficulty, which is made harder to grasp by the accompanying diagram. [For the account and the diagram see page 37. For a detailed and deep treatment of this whole matter, see Thomas M. Lennon, 'The Significance of the Barrovian Case', *Studies in the History and Philosophy of Science* 38 (2007), pages 36–55; available on line at www.sciencedirect.com.] Like most theorists of optics at that time, Barrow took a

'geometrical' approach to the science of vision. He presented two problems that he and the others had about seeing things in a concave mirror. Only the second of them directly bears on Berkeley's present topic. **[A: location]** The geometrical theorists accepted principles which seemed to commit them to this:

> when an object O is seen via a concave mirror, light-rays hit all parts of the mirror and are reflected back towards one another; they converge at a focal point F, and the apparent location that O has when seen in this way is F.

But now suppose that your viewing eye, facing the mirror, is situated between the mirror and F; Barrow and the others are threatened with having to conclude that O appears to you to be behind your head—which is never true, and indeed hardly makes sense. **[B: distance]** Regarding the apparent distance of things seen with one eye, Barrow and his intellectual friends held the view that Berkeley has expounded in **6**. Here it is in terms of one example:

> Stand 20 yards from a house and look at it with one eye. Light rays reflected from the house will impinge on your eye, coming in at many different angles—from the roof, the ground floor, the west wing, the east wing, and so on. As you back away from the house, still looking, the angles will become more alike; and when you're far enough back, the light-rays from all parts of the house will be near enough to parallel. It's that near-to-parallelism that makes the house *look* further away when it *is* further away. And the approach to parallelism is also an approach to the house's looking (like a point, and looking) infinitely far away.

According to this account, when the light rays, instead of focusing *in* onto the eye, spread *out* onto the eye, the object will appear as (so to speak) less than a point and as (so to speak) more than infinitely far away. But in fact, of course, no such thing happens. Something seen in a concave mirror looks *close*, and if you retreat from the mirror it appears even closer. Now we can turn to what Berkeley says about this.

[**30.** He comments briefly on the **location** matter, as fatal to the most respectable version of geometrical optics; and then moves on to **distance**.]

31. [His initial discussion is extremely hard to follow, because it is stated in terms of Barrow's diagram. You can find it on page 38. Its key idea, which he restates more clearly in **39** after presenting it in more detail in **34–38**, is as follows. In normal vision (without mirrors) a *fuzzy* visual image is associated with an external object that is *too close* to be seen clearly, so that getting-a-fuzzier-image goes with getting-closer-to-the-object. When seeing something through a concave mirror, however, the eye may have a clear image which becomes fuzzier when the object comes closer and becomes fuzzier when it moves further away. Each case of how-it-looks involves the eye's interpretation of the fuzziness of its proper object, the visual image; one interpretation is right, the other wrong.]

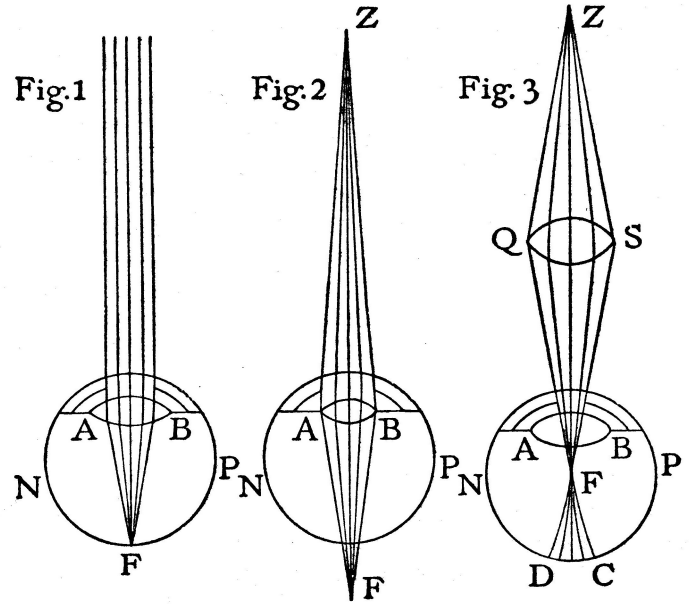
32. This case is like the situation where an Englishman meets a foreigner who uses English words with directly opposite meanings. The Englishman would be bound to make wrong judgments about what ideas were annexed to those sounds in the foreigner's mind. Similarly in the present case: the object speaks (if I may put it like that) with words that the eye is well acquainted with, namely confusions of appearance; but whereas until now the greater confusions always signified nearer distances, they have in this case a directly opposite signification, being connected with the larger distances. So the eye will inevitably be mistaken,

understanding the confusions in the sense it has been used to, which is directly opposed to the true one.

33. This phenomenon entirely subverts the opinion that we judge distances by lines and angles, on which supposition it is inexplicable; and it strikes me as strong confirmation of the truth of the principle by which *is* explained. But to develop this point more fully, and to show [said sarcastically:] how far determining the apparent place of an object is *helped* by the hypothesis that the mind judges by the divergence of rays, I need first to premise a few things that those who are skilled in dioptrics already know.

34. Any radiating point is distinctly seen when the rays proceeding from it are accurately [see Glossary] reunited in the retina by the refractive power of the lens. If they are reunited before reaching the retina or after passing it, there is confused vision.

35. In the three diagrams on the right, take NP to represent an eye in good condition and retaining its natural shape. In Figure 1, the rays falling nearly parallel on the eye are refracted by the lens AB so that their focus or point of union F falls exactly on the retina. In Figure 2 the rays are diverging as they fall on the eye, so that their focus F falls beyond the retina. In Figure 3 the rays are made to converge by the glass lens QS before they reach the eye, so that their focus F will fall before they reach the retina. It is evident from **34** that in 2 and 3 the appearance of the point Z will be confused. And the larger the divergence (or convergence) of the rays falling on the pupil, the further their point of reunion F will be behind (or before) the retina, and consequently the more confused point Z will appear. This, by the way, shows the difference between confused and faint vision. Vision is **confused** when the rays from each point of the object are not accurately re-collected in one corresponding point on the retina, but spread across some space on it so that rays from different points become mixed and confused together. This is opposed to **distinct** vision, and comes with **near** objects. Vision is **faint** when, because of the distance of the object or the cloudiness of the intervening medium, few rays get from the object to the eye. This is opposed to **vigorous** or clear vision, and comes with **remote** objects. Now back to the main thread.



36. The mind perceives only the confusion itself, without ever considering the cause of it; so it constantly annexes the same distance to the same degree of confusion. [Berkeley began that sentence 'The eye or (to speak truly) the mind. . . '; from here on he wobbles between the two, and this version will follow him.] Whether the confusion comes from converging or diverging rays doesn't matter. It follows (in the Figure 3 case) that the eye, viewing the object Z through the glass QS (which by refraction causes the rays ZQ, ZS, etc. to converge), should

judge Z to be at a distance such that

> if it were placed there it would send to the eye rays diverging to a degree that would produce the same confusion which is now produced by converging rays, i.e. would cover a portion of the retina equal to DC.

But this must be understood. . . .as abstracting from all other circumstances of vision, such as the shape, size, faintness, etc. of the visible objects, all of which do ordinarily contribute to our idea of distance because the mind has by frequent experience observed their various sorts or degrees to be connected with various distances.

37. It plainly follows from this that a person who couldn't see things distinctly unless they were close to his eye would not make the same wrong judgment that others do in this case. To him larger confusions will always suggest larger distances; so as he recedes from the glass and the object grows more confused, he must judge it to be further away; unlike those for whom the perception of the object's growing more confused is connected with the idea of approach.

38. We also see here that there may be good use of computation by lines and angles in optics; not because the mind judges distances immediately by them, but because it judges by something that is connected with them, and they can help in determining that something. The mind judges the distance of an object by the confusedness of its appearance, and this confusedness is greater or lesser to the naked eye according to whether the object is seen by rays more or less diverging. So a man can make use of the divergence of the rays in computing the apparent distance—not for its own sake but on account of the confusion with which it is connected. But the mathematicians entirely neglect the confusion itself, because it doesn't have the *necessary* relation with distance that angles of divergence are thought to have. These angles (especially because they can be dealt with mathematically) are treated as the only things that matter in determining the apparent places of objects, as though they were the sole and immediate cause of the mind's judgments about distance. Whereas in truth they shouldn't be accorded any importance except as the cause of confused vision.

39. Not considering this has been a fundamental and problem-creating oversight, for proof of which we need only look at the case before us. The problem arose for people who have observed that

- the most divergent rays bring into the mind the idea of nearest distance, and that as the divergence decreases the distance increases;

and who think that

- the connection between the various degrees of divergence and distance is *immediate*;

which naturally led them to conclude, from an ill grounded analogy, that

> converging rays will make an object appear at an immense distance, and that as the convergence increases the distance (if it were possible) should also increase.

That this was the cause of Dr Barrow's mistake is evident from his own words which I have quoted [see pages 37–38]. If the learned doctor had observed that

> diverging and converging rays, however opposite they may seem, produce the same effect, namely confusedness of vision;. . . .and that it is by this effect, which is the same in both, that either the divergence or convergence is perceived by the eye,

he would have made a quite contrary judgment, and rightly concluded that the rays that fall on the eye with greater convergence should make the object from which they come

appear so much the nearer. But clearly no man could have a right notion of this matter so long as he attended only to lines and angles and did not apprehend •the true nature of vision and •how far it was of mathematical consideration. [Presumably he meant 'how far it was *from*. . . '.]

40. [This section is an aside, in which Berkeley quotes Molyneux's suggestion for a rule to determine the apparent location of a body, and gives reasons for declaring it to be wrong. The details are technical, and the presentation unclear; we can safely do without it.]

41. From what I have maintained it clearly follows that if a man who had been born blind were made to see, he would at first have no idea of distance by sight; the sun and stars, the remotest objects as well as the nearer ones, would all seem to be in his eye, or rather in his mind. The objects brought to him by sight would seem to him to be (as in truth they are) nothing but a new set of thoughts or sensations, each as *near* to him as the perceptions of pain or pleasure or the most inward passions of his soul. When we judge any object perceived by sight to be at a distance from us, i.e. outside the mind, this is (see **28**) entirely the effect of experience, which our man born blind couldn't yet have attained to.

42. That is not how things are according to the common supposition that men judge distance by the angle of the optic axes, in the way a blind man or someone in the dark could judge a distance by the angle made by two sticks of which he had one in each hand. If that were right, a congenitally blind person who was made to see could perceive distance by sight without help from any new experience. I think I have sufficiently demonstrated that this is false.

43. And perhaps upon a strict inquiry we'll find that even normally sighted people are irrecoverably prejudiced on the other side, namely in thinking that what they see is at a distance from them. It seems these days to be agreed on all hands—by those who have any thoughts about this—that colours, which are the proper and immediate object of sight, are not outside the mind. But then this will be said:

> By sight we have also the ideas of extension, shape and motion; all of which are outside the mind, and at some distance from it, even though colour is not.

In answer to this I appeal to your experience: doesn't the visible extension of any object appear as near to you as that object's colour? don't they indeed seem to be in the very same place? Isn't the extension we see coloured? Can we even make sense of *colour separated and abstracted from extension*? And where the extension is, that is surely the place of the shape and of the motion. I'm speaking only of those that are perceived by sight.

44. But for a fuller explanation of this point, and to show that the immediate objects of sight are not even the *ideas or resemblances of* things placed at a distance, we must look more closely into the matter, and take careful note of what is meant by an ordinary speaker who says that what he sees is 'at a distance' from him. Here is an example:

> Looking at the moon, I say that it is 50 or 60 semi-diameters of the earth distant from me.

What moon am I speaking of here? Clearly it can't be the visible moon or anything like the visible moon—i.e. that which I see—because that is only a round, luminous plane of about 30 visible points [see Glossary] in diameter. Suppose from the place where I am standing I am taken directly towards the moon; it's obvious that the object will keep varying as I go, and by the time I have gone 50 or 60 semi-diameters of the earth I shan't be near to a small, round, luminous plane—indeed I'll perceive nothing like it. That object will have long since disappeared, and if I wanted to recover it I would have to go back to the earth from which I

set out. Or suppose I perceive by sight the faint and obscure idea of something of which I'm not sure whether it is a man or a tree or a tower, but which I judge to be about a mile away. Clearly this can't mean that *what I see* is a mile away, or that it is the image or likeness of anything that is a mile away, because with every step I take towards it the appearance alters, and from being obscure, small, and faint it grows clear, large, and vigorous. When I come to the mile's end, what I saw first is quite lost, and I don't find anything like it.

45. In cases like this the truth of the matter stands thus:

> Having for a long time experienced certain ideas perceivable by touch—such as distance, tangible shape, and solidity—to have been connected with certain ideas of sight, when I perceive these ideas of sight I immediately conclude what tangible ideas are likely to follow in the ordinary course of Nature. Looking at an object, I perceive a certain visible shape and colour, with some degree of faintness and other details, and all this leads me to think, on the basis of what I have formerly observed, that if I move forward so many paces or miles I'll be affected with such-and-such ideas of touch; so that very strictly speaking I don't see •distance itself or •anything that I take to be *at* a distance. Neither distance nor distant things are truly perceived by sight; nor are their ideas.

I'm sure of this as applied to myself; and I believe that if you look narrowly into your own thoughts, and examine what you mean by saying 'I see that thing at a distance', you will agree with me that what you see only •suggests to your understanding that after having gone a certain distance (to be measured by the motion of your body, which is perceivable by touch) you will come to perceive such-and-such tangible ideas that have usually been connected with such-and-such visible ideas. One might be deceived by these •suggestions of sense; there's no necessary connection between visible ideas and the tangible ideas suggested by them; to be convinced of this, look at a picture or into a mirror. Note that when I speak of 'tangible ideas', I am using 'idea' to stand for any immediate object of sense or understanding, this being the broad meaning it is commonly given by the moderns.

46. From what I have shown it clearly follows that the ideas of •space, •outness, and •things placed at a distance are not strictly speaking objects of sight; they aren't perceived by the eye any more than they are perceived by the ear. Sitting in my study I hear a coach drive along the street; I look through the window and see it; I go outside and and enter into it; thus common speech would incline one to think that I heard, saw, and touched the same thing, namely the coach. But it's certain that the ideas presented by the three senses are widely different and distinct from each other; but because they have been observed constantly to go together they are spoken of as one and the same thing. By the variation of the noise I perceive the different distances of the coach, and know that it is approaching before I look out. Thus I perceive distance by the ear in just the same way as I do by the eye.

47. Still, I don't say 'I hear distance' in same way that I say 'I see distance'; because the ideas perceived by hearing are not so apt to be confused with the ideas of touch as those of sight are; so a man is easily convinced that what he hears are not really •bodies and external things but only •sounds which suggest to his thoughts the idea of this or that body or distance. It is harder to get him to discern how the ideas of sight differ from the ideas of touch; though it's certain that a man no more sees and feels the same thing than he hears and feels the same thing.

48. One reason why this is so seems to be as follows. It is thought a great absurdity to imagine that one thing should have more than one extension and one shape. But because the extension and shape of a body can be into the mind in two equally good ways, by sight and by touch, it *seems* to follow that we see the same extension and the same shape that we feel.

49. But if we take a close and accurate view of things we'll have to acknowledge that we never see and feel one and the same object. What is seen is one thing, and what is felt is another; if the visible shape and extension are not the same as the tangible shape and extension, we're not to infer that a single thing has more than one extension. The true consequence is that the objects of sight and touch are two distinct things. It may require some thought rightly to conceive this distinction; and it is made harder by the fact that each cluster of visible ideas has the same name as the cluster of tangible ideas that it is connected with, this being an inevitable upshot of the use and end of language.

50. Thus, if we are to treat vision accurately [see Glossary] and unconfusedly, we must bear in mind that two sorts of objects are apprehended by the eye—

(1) one primarily and immediately,

(2) the other secondarily and by intervention of **(1)**.

Those of type **(1)** aren't outside the mind or any distance away, and they don't appear to be. They may grow larger or smaller, more confused or more clear or more faint, but they don't—*can't*—approach or recede from us. Whenever we say an object is at a distance—whenever we say that it's coming closer or moving away—we must be talking about an object of type **(2)**, which properly belongs to the ·sense of· touch and is not so truly •perceived by the eye as •suggested by it, in the way thoughts are suggested by the ear.

51. When we hear the words of a familiar language, the ideas corresponding to them immediately present themselves to our minds; the sound and the meaning enter the understanding at the very same instant. They are united so closely that it's not in our power to keep out one without excluding the other also. We even *act* just as though we heard the very thoughts themselves. So likewise the secondary objects—the ones that are only *suggested* by sight—often affect us more strongly than the proper objects of that sense do, and are more regarded [see Glossary] than them; and. . . .they have a far more strict connection with them than ideas have with words. That is why we find it so difficult to discriminate between the immediate and the mediate objects of sight, and are so apt to attribute to the former what belongs only to the latter. They are, as it were, most closely twisted, blended, and incorporated together. And the prejudice [see Glossary] is confirmed and riveted in our thoughts by a long stretch of time, by the use of language, and by lack of reflection. However, I believe that anyone who attentively considers what I have said and will say in the course of this work (especially if he pursues it in his own thoughts) may be able to free himself from that prejudice. I'm sure it is worth some attention for anyone who wants to understand the true nature of vision.

B. The size of objects of sight

52. I have now finished with distance, and proceed to show how we perceive by sight the size of objects. Some hold that we do it by angles, or by angles in conjunction with distance; but neither angles and distance are perceivable by sight, and the things we see are actually at no distance from us; so it follows that just as I have shown that the mind doesn't use lines and angles in apprehending an object's apparent place

·or distance from us·, so also they aren't what it uses when it apprehends the object's apparent size.

53. It is well known that a given size at a near distance subtends a bigger angle than it does at a larger distance; and we are told that the mind estimates the size of an object by this principle, relating the angle under which it is seen to its distance, and thence inferring its size. What inclines men to this mistake (beside the impulse to make one see by geometry!) is the fact that the perceptions or ideas that suggest distance do also suggest size. But if we examine this we'll find that they suggest size as immediately as they suggest distance. They don't first suggest distance, and then leave it to the judgment to infer the size from that. They have as close and immediate a connection with the size as with the distance; and suggest size as independently of distance as they do distance independently of size. All this will be evident to anyone who considers what I have said up to here and what follows.

54. I have shown that two sorts of objects are apprehended by sight, each with its own size or extension:

- one is really tangible, i.e. to be perceived and measured by touch, and not immediately falling under the visual sense;
- the other is really and immediately visible, and it is *through* this that the former is brought into view.

Each of these sizes is made up of points or minimums, and is large or lesser depending on how many points it contains. *Sensible* extension—as against extension in abstract—is not infinitely divisible; there's a *minimum tangibile* [Latin] and a *minimum visibile* [see Glossary], such that sense can't perceive anything smaller. Everyone's experience will tell him this.

55. The size of the object that exists outside the mind and is at a distance continues always invariably the same. But as you approach or move back from the tangible object, the visible object keeps changing—it has no fixed and determinate size. Thus, whenever we speak of the size of anything, for instance a tree or a house, we must mean the only thing that is steady and free from ambiguity, namely its tangible size. But though the tangible and visible sizes in truth belong to two distinct objects, those objects are called by the same name and are observed to coexist; so I shall sometimes avoid tediousness and linguistic oddity by speaking of tangible and visible size as belonging to one and the same thing.

56. To discover how the size of tangible objects is perceived by sight, I need only reflect on what happens in my own mind, and observe what the things are that introduce the ideas of larger or smaller into my thoughts, when I look at any object. I find these to be:

(1) the size or extension of the visible object, which is immediately perceived by sight and is connected with the object that is tangible and placed at a distance;
(2) The confusion or distinctness ·of the visible object·.
(3) The vigorousness or faintness of that visible appearance.

Other things being equal, the larger (or smaller) the visible object is, I conclude the tangible object to be correspondingly larger (or smaller). But however large the idea immediately perceived by sight, if it is confused I judge the size of the ·tangible· thing to be small; and if it is distinct and clear I judge it [the tangible thing] to be larger. And if it is faint, I apprehend it to be larger still. What I mean here by 'confused' and 'faint' was been explained in **35**.

57. Our judgments about size, like our judgments about distance, depend on the disposition of the eye and on the shape, number, and location of objects and other details that have been observed to accompany large or small tangible

sizes. For example, a given quantity of visible extension will suggest the idea of large size if it has the shape of a tower, and the idea of much smaller size if it has the shape of a man. You don't need me to tell you that this is because of our experience of the usual size of a tower and of a man.

58. It is also obvious that confusion or faintness aren't *necessarily* connected with small or large size, any more than they are with small or large distance. As they suggest the distance, so they suggest the size to our minds. If it weren't for experience, we wouldn't judge a faint or confused appearance to be connected with large or small size any more than we would judge it to be connected with large or small distance.

59. And it won't be found, either, that large or small visible size has any *necessary* relation to large or small tangible size, enabling one to be inferred *with certainty* from the other. But before I come to the proof of this ·in **62**·, I should consider the difference between •the extension and shape that is the proper object of touch and •the extension and shape that is termed 'visible'; and how when we look at any object it's the tangible extension and shape that we take notice of *principally but not immediately*. We regard [see Glossary] the objects around us in proportion as they are apt to benefit or injure our own bodies and thereby produce in our minds the sensations of pleasure or pain. Now, we are apt to get hurt or advantage from bodies operating immediately—directly—on our organs; and this depends entirely on the bodies' tangible qualities and not at all on the visible ones. This is a plain reason for us to give the tangible qualities much more importance than the visible ones; and that seems to be why the visual sense was bestowed on animals: by the perception of visible ideas (which in themselves can't make any difference to their bodily condition) they can foresee the damage or benefit that is like to ensue if this or that body that is now at a distance comes to be directly applied to their own bodies—this 'foreseeing' depending on the experience they have had concerning what tangible ideas are connected with what visible ones. Your own experience will tell you how necessary this foresight is to an animal's preservation. That is why when we look at an object we principally attend to its tangible shape and size, taking little heed of the visible shape and size. These, though more immediately perceived, concern us less because they aren't fitted to produce any alteration in our bodies.

60. That this is how things stand will be evident to anyone who considers that a man ten feet away is thought to be as large as if he were only of five feet away; which is true with relation to his tangible size, but not his visible size, which is much bigger at one distance than at the other.

61. Inches, feet, etc. are settled stated lengths by which we measure objects or estimate their size; we say for example that an object appears to be six inches long. We can't be talking about visible inches because a visible inch isn't a constant, determinate size, so it can't serve to mark out and determine the size of anything else. Take an inch marked on a ruler; view it from several different distances; at each distance the inch will have a different visible extension, i.e. there will be more or fewer points discerned in it. Which of these various extensions is the determinate one that is agreed on for a common measure of other sizes? No reason can be given for selecting one rather than another. If there weren't some invariable, determinate extension fixed on to be marked by the word 'inch', it obviously would be pointless to say that that a thing contains this or that number of inches—the most it could mean is that the thing is extended. And there's this: an inch and a foot will exhibit the same

visible size from different distances, yet we say that one seems several times larger than the other. From all this it is clear that the sight-based judgments that we make about the size of objects refer solely to their tangible extension. Whenever we say that an object is large, or small, or of such-and-such a size, we must be talking about the tangible and not the visible extension; the latter, though immediately perceived, is little taken notice of.

62. That these two extensions are not necessarily connected is evident from this: Our eyes might have been structured in such a way that they couldn't see anything except what is less than the *minimum tangibile* [i.e. in such a way that anything big enough for us to feel would be too big for us to see]. In that case we might have perceived the very same immediate objects of sight that we do now, but they wouldn't be connected (for us) with the different tangible sizes that they are now. Which shows that the judgments we make about the •size of things placed at a distance, on the basis of the various •sizes of the immediate objects of sight, aren't based on any essential or necessary connection between them, but only on a customary tie that has been observed between them.

63. Moreover, it is not only certain that

> •any idea of sight might not have been connected with the particular idea of touch that we now observe to accompany it'

it is also certain that

> •larger visible sizes might have been connected with (and introduced into our minds) smaller tangible sizes, and the smaller visible sizes larger tangible sizes.

Indeed, we have daily experience that this actually does happen: an object that makes a strong and large appearance doesn't seem nearly as large as another whose visible size is much less but more faint and the appearance upper or (the same thing) painted [see Glossary] lower on the retina, which faintness and situation suggest both larger size and greater distance.

64. From this and from **57–58** it's clear that just as we don't perceive the sizes of objects immediately by sight, we also don't perceive them by the mediation of anything that has a necessary connection with them. The ideas that now suggest to us the various sizes of external objects before we touch them *could* have suggested no such thing; or they might have signified them in a directly contrary manner, so that the visual ideas that lead us to judge an object to be small served instead to make us conclude it to be large. Our visual ideas. . . .are comparable with *words*, the intrinsic nature of which is equally fit for meaning this or that or nothing at all.

65. As we see distance, so we see size. And we see both in the same way that we see shame or anger in the looks of a man. Those passions are themselves invisible, but they are let in by the eye along with the colours and changes of facial expression that •are the immediate object of vision, and •signify the passions merely because they have been observed to accompany them. If we hadn't experienced that, we wouldn't have taken blushing for a sign of shame any more than of gladness.

66. Yet we are exceedingly prone to imagine things that are perceived only by the mediation of other things to be themselves *immediate* objects of sight, or at least to be *intrinsically fit* to be suggested by those other things before being experienced to coexist with them. Not everyone will find it easy to emancipate himself from this prejudice, however clearly the case against it is made out. There are reasons to think that

> if there was only one language in the world—one that didn't change—and men were born with the ability to

> speak it, many people would believe that the ideas in other men's minds were strictly perceived by the ear, or at least had a necessary and inseparable tie with the sounds associated with them.

All of which seems to arise from a failure to make proper use of our discerning faculty—·our ability to make distinctions·—in order to distinguish among the ideas in our understandings and consider them apart from each other. That would preserve us from running together ideas that are different, and would make us see whether this or that idea includes or implies this or that other idea.

·THE HORIZONTAL MOON PHENOMENON· [to **78**]

67. Here is a celebrated phenomenon:

> When the moon is •on the horizon its apparent size is much greater than when it is •directly overhead, although the angle under which the moon's diameter is seen isn't found to be larger in the former case than in the latter. Also, the horizontal moon doesn't always have the same apparent size; it seems far larger at some times than at others.

I shall try to explain this, using the principles I have laid down concerning how we apprehend by sight the size of objects.

68. The explanation requires us to take account of this: the particles that compose our atmosphere intercept the rays of light coming from any object to the eye; and the bigger the portion of atmosphere between the object and the eye, the more the rays are intercepted, thus making the appearance of the object more faint. . . . Now, when the moon is on the horizon there is much more atmosphere between it and the eye than there is when it is directly overhead. This brings it about that the appearance of the horizontal moon is fainter, and therefore by **56** it should be thought bigger in that situation than when it is directly overhead or at any other elevation above the horizon.

69. Also, because the air is impregnated varyingly—sometimes more and sometimes less—with vapours and exhalations that can intercept and beat back the rays of light, it follows that the appearance of the horizontal moon isn't always equally faint, so that it is judged larger at some times than at others although it is in the very same situation.

70. To be even surer that this is the true explanation of the phenomena of the horizontal moon, consider:

- **(a)** Whatever it is that suggests the idea of larger size in this case must be something that is itself perceived; for something that isn't perceived can't suggest anything else to our perception.
- **(b)** It must be something that undergoes some change or variation, because the appearance of the horizontal moon varies, being at one time larger than at another.
- **(c)** It can't be the visible shape or size, because that remains the same, or rather ·the visible size· is lesser by how much the moon is nearer to the horizon.

So we are left with the true cause being the. . . .alteration of the visible appearance that comes from the greater paucity of rays arriving at the eye—what I call 'faintness'. This satisfies **(a)**–**(c)**, and I'm not aware that any other perception does so.

71. Add to this the common observation that in misty weather the appearance of the horizontal moon is far larger than usual; this works with and greatly strengthens my explanation. And if it turned out that the horizontal moon sometimes seem enlarged beyond its usual extent even in clearer weather, that is perfectly consistent with what I have said. That is because we must take into account not only •the mist that happens to be in the place where we stand but also •the whole sum of vapours and exhalations that lie

between the eye and the moon. These could all cooperate in making the moon's appearance more faint and thereby increasing its size. . . .

72. It may be objected that on my principles the interposition of a somewhat opaque body which can intercept a great part of the rays of light will make the appearance of the overhead moon as large as that of the horizontal moon. I answer that what suggests larger size is not •faintness as such but •faintness of a kind and in circumstances that have been observed to accompany the vision of large sizes. We're not dealing with a necessary connection here, but only an experimental connection between those two things. When we see large objects from a distance, the •unperceivable particles of the intervening air and vapours interrupt the rays of light, making the appearance less strong and vivid; and faintness of appearance *caused in this way* has been experienced to coexist with large size. But when it is caused by the interposition of an opaque •perceivable body, this circumstance alters the case: a faint appearance caused in this way doesn't suggest larger size, because it hasn't been experienced to coexist with it.

73. Like all the other ideas or perceptions that suggest size or distance, faintness does it it in the same way that words suggest the notions to which they are annexed. Now, we know that a word pronounced in certain circumstances or in a certain context with other words doesn't always have the same meaning that it has when pronounced in some other circumstances or different verbal context. A visible appearance when placed •on high won't suggest the same size that it would—I mean the same appearance as to faintness and all other respects—if it were seen at the same distance •on a level with the eye. Here is why: We are rarely accustomed to view objects at a great height; our concerns lie among things situated in front of us rather than above us; and our eyes are placed in our heads accordingly. . . . And this being the usual situation when we see distant objects, it enables us to account for the commonly observed facts that an object's size—even its *width*—appears different to someone who sees it a hundred feet up (e.g. on top of a steeple) from how it appears to someone who sees it a hundred feet away down at ground level. It has been shown that our judgment about the size of a thing depends not only on the visible appearance but also on various other circumstances. . . . So it's not surprising if a distant object's size is judged **differently** when

- •it is viewed in the ordinary way, with the ordinary posture of the head and eyes

from how it is judged when

- •it is viewed in a different location which requires a different posture of the head.

But you'll want to know why a high object always appears **smaller** than an equidistant low object of the same size, for so it is observed to be. Here is my explanation. If our judgments about distant things' sizes were based solely on the extent of their visible appearances, they would certainly be judged to be much smaller than they in fact seem to be (see **79**.) But various circumstances contribute to our judgment on the size of distant objects, making them appear far larger than others whose visible appearance has an equal or even larger extension; so that when any of the circumstances that usually accompany the vision of distant objects is changed or omitted, the objects now being seen appear smaller than they otherwise would. . . . That is why in the present case the object we look up to on the top of the steeple seems smaller than the same object when see from the same distance on (or nearly on) a level with the eye. All this seems to me to contribute considerably to magnifying the appearance of

the horizontal moon, and shouldn't be passed over in the explanation of it.

74. If we attentively consider the phenomenon before us, we shall find that what mainly makes it hard for people to explain it is their failure to distinguish the •mediate from the •immediate objects of sight. The size of the visible moon—i.e. of that which is the proper and immediate object of vision—is no larger when the moon is on the horizon than when it is directly overhead. So how does it come to seem larger in one situation than the other? What can cheat the understanding in this way? Its only perception of the moon is what it gets by sight; and what is seen—i.e. the visible appearance—has the same size, or rather a smaller size, when the moon is viewed on the horizon than when it is viewed overhead; and yet it is judged larger in the former than in the latter. This difficulty vanishes—admits of a most easy solution—if we consider that the visible moon not only *isn't* larger on the horizon than directly overhead but also *isn't thought to be* larger. I have already shown that in any act of vision the •visible object in itself is hardly noticed because the mind moves right along from it to some •tangible ideas that have been observed to be connected with it and thus come to be suggested by it. So when a thing is said to 'appear large' or 'appear small'. . . .this is being said not about the visible object but about the tangible object. When you think about this you'll find it easy to reconcile the seeming contradiction in the moon's appearing to have a different size when its visible size remains the same. For by **56** the very same visible extension, with a different faintness, suggests a different tangible extension. So when the horizontal moon is said to appear larger than the overhead moon, this must be understood as asserting not a larger visible extension but a larger tangible or real extension that is suggested to the mind by the unusual faintness of the visible appearance.

75. Many attempts have been made by learned men to account for this appearance. Gassendi, Descartes, Hobbes and several others have employed their thoughts on that subject; but how fruitless and unsatisfactory their attempts have been is sufficiently shown by Mr Molyneux in the *Philosophical Transactions* 187, where you can see their various opinions set forth and confuted, with some surprise at the gross blunders that ingenious men have been forced into by trying to reconcile this appearance with the ordinary principles of optics. Since the writing of that paper the *Transactions* have published another paper on this matter—a paper in which the celebrated Dr Wallis tries to account for horizontal-moon phenomenon. The paper seems not to contain anything new, or different from what had been said before by others, but I shall consider it here.

76. Wallis's opinion, in short, is this:

> We judge the size of an object not by the visual angle alone but by that in conjunction with the distance. So even if the angle remains the same or even becomes less, if the distance seems to have been increased the object will appear larger. Now, one of our ways of estimating the distance of anything is by the number and extent of the intermediate objects; so when the moon is seen on the horizon, the variety of fields, houses, etc.—together with the large prospect of the wide land or sea that lies between the eye and the horizon—suggest to the mind the idea of greater distance, and consequently magnify the appearance.

This, according to Dr Wallis, is the true explanation of the extraordinary largeness attributed by the mind to the horizontal moon at a time when the angle subtended by its diameter is not one jot larger than it is usually.

77. With reference to this opinion (and not repeating what I have already said about distance) I shall make just two points. **(1)** If the view of intervening objects is what suggests the idea of further distance, and this idea of further distance is the cause that brings into the mind the idea of larger size, it should follow that if one looked at the horizontal moon from behind a wall it would appear no bigger than usual. For in that case the wall would cut off all the prospect of sea and land etc. that might otherwise increase the moon's apparent distance and thereby its apparent size. Someone might say:

> 'Still, *memory* suggests all that extent of land, etc. that lies within the horizon; and this suggestion occasions a sudden [see Glossary] judgment of sense that the moon is further off and larger than usual.'

But that can't be right. Ask any man who thinks the moon larger than usual when viewing the horizontal moon in this way whether he has at that time in his mind any idea of the intervening objects, or the long stretch of land that lies between his eye and the extreme edge of the horizon? And whether that idea causes him to making that judgment? I think he'll reply in the negative, and declare that the horizontal moon appears ·to him· larger than the overhead moon even if he never thinks of any of the things that lie between him and it. **(2)** This hypothesis can't account for the moon's appearing in the very same situation larger at one time than at another; which I have shown to be easily and natural explained by the principles I have laid down. For the further clearing up of this point, I point out that what we immediately and properly see are only lights and colours—in various situations and shades, and degrees of faintness and clearness, confusion and distinctness—and these visible objects are only in the mind, and don't suggest anything external, whether distance or size, except through habitual connection, in the way words suggest things. We should also notice that along with the straining of the eyes and the vivid/faint and distinct/confused appearances**. . . .**there are other things that also suggest both distance and size; particularly the situation of visible points or objects as upper or lower; the former suggesting a further distance and larger size, the latter a nearer distance and lesser size. All of which is purely an effect of custom and experience, because. . . .there is no necessary connection between upper/lower and either further/nearer or larger/smaller. Now, these customary, experimental means of suggesting distance and size suggest them equally immediately: they don't (see **53**) first suggest distance and then leave the mind to infer or compute size from that. [The bold-type ellipsis in 'appearances**. . . .**there' replaces '(which bearing some proportion to lines and angles, have been substituted instead of them, in the foregoing part of this treatise)'. This somewhat puzzling parenthetical remark is relocated to this note so that it doesn't interrupt the flow of Berkeley's thought at that point.]

78. This phenomenon of the horizontal moon is a clear example of the inadequacy of lines and angles for explaining how the mind perceives and estimates the size of external objects. They do have some use in computing the apparent size of things, insofar as they are connected with and proportional to those other ideas or perceptions that are the true and immediate occasions that suggest things' apparent sizes to the mind. But mathematical computation in optics can never be very precise and exact, because our judgments about the size of external things often depend on several circumstances that are not proportional to lines and angles and can't be defined by them.

·END OF HORIZONTAL MOON DISCUSSION· [from **67**]

79. From what I have said we can safely infer this: A man born blind, and made to see, would on first opening his eyes make, regarding the sizes of the objects presented by them, a very different judgment from what others do. He wouldn't consider the ideas of sight with reference to the ideas of touch, or as having any connection with them. His view of them being entirely terminated within themselves [= 'his view of them being entirely confined to *them*'], he can't judge them great or small except on the basis of their containing a larger or smaller number of visible points. Now, all that a visible point can cover or exclude from view is one other visible point; so whatever object intercepts the view of another has an equal number of visible points; and consequently the newly sighted man will think they have the same size. He might use his thumb to hide a tower, in which case he'll think they have the same size; his hand could conceal the firmament from his view, leading him to think that *they* are equal in size. How great an inequality soever there may, in our apprehensions, seem to be between those two things, because of the customary and close connection that has grown up in our minds between the objects of sight and touch, whereby the very different and distinct ideas of those two senses are so blended and confounded together, as to be mistaken for one and the same thing; out of which prejudice we cannot easily extricate ourselves. [That sentence is exactly as Berkeley wrote it.]

80. To improve my account of the nature of vision and set the way we perceive sizes in a due light, I shall make some observations about matters that relate to this—matters that are apt to create in us mistaken and confused notions if we don't •reflect enough and •separate tangible ideas from visible ones. My first observation is that the *minimum visibile* [see Glossary] is exactly equal in all beings that have eyesight. No exquisite formation of the eye, no special sharpness of sight, can make it less in one creature than in another; for it doesn't have *parts* and so must be the same for all. Suppose that the *minimum visibile* x of a mite, for instance, were less than the *minimum visibile* y of a man; then y could be made equal to x by the removal of some part; so it would *have* parts, which is inconsistent with the notion of a *minimum visibile* or point.

81. You might want to object:

> 'The *minimum visibile* of a man really does contain parts whereby it surpasses that of a mite, but the parts aren't perceivable by the man.'

To which I answer that the *minimum visibile* has been shown to have no existence outside the mind of him who sees it, so it can't have any part that isn't actually perceived and therefore visible. (In this respect it is like all the other proper and immediate objects of sight.) And for any object to •contain several distinct visible parts and at the same time to •be a *minimum visibile* is obviously a contradiction.

82. At every moment we see an equal number of these visible points. The number is just as great when our view is contracted and bounded by near objects as when it extends to objects that are larger and more distant. Because one *minimum visibile* can't possibly keep out of sight more than one other, it clearly follows that when my view is bounded on all sides by the walls of my study I see just as many visible points as I could if the study-walls and other obstructions were removed and I had a full view of the surrounding fields, mountains, sea, and open firmament. . . . Thus, whenever we are said to have a greater prospect at one time than another, this must be understood to refer not to the proper and immediate objects of vision but to the secondary and mediate ones, which I have shown to belong properly to the sense of touch.

83. The visual faculty considered with reference to its immediate objects has two defects. **(i)** The extent or number of visible points that are at once perceivable by it is narrow and limited to a certain degree. It can take in at one view only a certain determinate number of *minima visibilia*, beyond which it can't extend its prospect. **(ii)** Our sight is not only narrow but also for the most part confused; of the things we take in at one view we can see only a few at once clearly and unconfusedly; and the more we fix our sight on any one object the darker and more indistinct the rest will appear.

84. Corresponding to these two defects of sight we may *imagine* two perfections: **(i)** comprehending in one view a larger number of visible points, and **(ii)** being able to view them all equally and at once, with the utmost clearness and distinctness. Are there some intelligences of a different order and capacity from ours that actually *have* those perfections? It is impossible for us to know.

85. Microscopes don't contribute to the improvement of sight in either of those two ways. When we look through a microscope we don't **(i)** see more visible points, and the points we see at one time aren't **(ii)** more distinct, than when we look with the naked eye at objects placed in a due distance. A microscope brings us into a new world, so to speak, presenting us with a new scene of visible objects that is quite different from what we see with the naked eye. The most remarkable difference is this: whereas •the objects perceived by the eye alone have a certain connection with tangible objects, from which we learn to foresee what will happen when distant objects approach or touch the parts of our own body (which contributes greatly to our body's preservation), •there is no such connection between tangible things and the visible objects that are perceived by help of a fine microscope.

86. Hence it is evident that we would not be much benefited by having our eyes given the nature of microscopes. We would be deprived of the advantage I have just mentioned that we at present get from the visual faculty, and would be left with only the empty pastime of seeing, without any other benefit arising from it. You may want to say: 'But in that case our sight would be far sharper and more penetrating than it now is.' But what *is* that sharpness that is regarded as such a great an excellency of sight? From what I have already shown, it is certain that the *minimum visibile* is never larger or lesser, but in all cases constantly the same; and the only difference that microscopical eyes would make, as far as I can see, is that we would lose the observable connection between our various perceptions of sight and touch, which before enabled us to regulate our actions by the eye, so that now our eyes would be utterly unserviceable for that purpose.

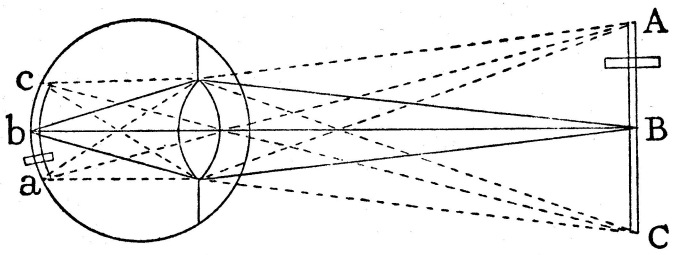
87. Upon the whole it seems that if we consider the use and purpose of •sight, together with the present state and circumstances of our existence, we shan't find any great cause to complain of any defect or imperfection in •it, or easily conceive how it could be improved. With such admirable wisdom is that faculty designed for the pleasure and convenience of life.

C. The orientation of the objects of sight

88. Having finished what I intended to say about the distance and size of objects, I shall now discuss the way in which the mind perceives by sight objects' orientation. Among the discoveries of recent years one of the most notable has been an explanation—clearer than any we ever had before—of how vision works. Everyone knows today

- that the pictures of external objects are painted on the retina,
- that we can't see anything that isn't so painted, and
- that according as the picture is more distinct or confused, so also is our perception of the object.

But there's one mighty difficulty in this explanation of vision. The objects are painted in an inverted order at the back of the eye: the upper part of an object is painted on the lower part of the eye, and the lower part of the object on the upper part of the eye; and ·there's a switch· also as to right and left. Since the pictures are thus inverted, the question is raised as to how we come to see the objects erect [see Glossary] and in their natural posture?



89. The accepted answer to this difficulty goes as follows:

> The mind, perceiving an impulse of a ray of light on the upper part of the eye, considers this ray as coming in a direct line from the lower part of the object; and in tracing the ray that strikes on the lower part of the eye it is directed to the upper part of the object. Thus in the above figure C, the lowest point of the object ABC, is projected onto *c* the upper part of the eye; and the highest point A is projected onto *a* the lowest part of the eye, so that the representation cba is inverted. But the mind considering the stroke that is made on *c* as coming in the straight line Cc from the lower end of the object; and the stroke or impulse on *a* as coming in the line Aa from the upper end of the object, is directed to make a correct judgment of the orientation of the object ABC, despite its picture's being inverted.

This is illustrated in terms of a blind man holding in his hands two sticks that cross each other, touching with them the top and the bottom of some object. This man will judge that what he touches with the stick held in the lower hand is the upper part of the object, and that what he touches with the stick in his upper hand is the lower part of the object. This is the common explanation of the erect appearance of objects; Molyneux tells us that everyone finds it satisfactory.

90. But this account doesn't strike me as any degree true. If I *perceived* those impulses, cross-overs and directions of light-rays in the way described in the account, it wouldn't at first view be altogether void of probability. And there might be something to the comparison of sight with the blind man and his crossed sticks. But the case is far otherwise. I know very well that I perceive no such thing, and so can't estimate the orientation of objects in this way. I appeal to your experience: when you perceive by sight the position of an object, are you ever conscious to yourself of thinking about the intersection made by the cluster of rays, or of following out the impulses they give in straight lines? To me it seems evident that crossing and tracing of the rays is never thought on by children, by idiots, or indeed by anyone who hasn't studied optics. As for the possibility of the mind's judging the orientation of objects by those things without perceiving them, or perceiving them without knowing it—to me those are equally incomprehensible. And there's another point: explaining vision by the example of crossed sticks and hunting for the object along the axes of the clusters of rays presupposes that the proper objects of sight are perceived at a distance, and I have demonstrated that they are not.

91. So we have to look for some other explanation of this difficulty. I think we can find one, if we examine it to the bottom and—something that can't be too often emphasised in treating of vision—carefully distinguish the ideas of sight from the ideas of touch. We need to carry that distinction in our thoughts constantly when considering this matter, because the failure to understand it properly seems to be the main source of the difficulty of explaining erect vision.

92. To disentangle our minds from whatever prejudices we may have concerning this subject, nothing seems more appropriate than think about the case of someone who was born blind and then as an adult becomes able to see. It may be hard for us to divest ourselves entirely of the experience we have received from sight, so as to put our thoughts *exactly* into the posture of this man's, but we must do our best to form true conceptions of what might reasonably be supposed to pass in his mind.

93. It is certain that a man who had been blind from birth would through his sense of feeling [see Glossary] come to have ideas of *upper* and *lower*. By the motion of his hand he could discern the orientation of any tangible object placed within his reach. The part on which he felt himself supported, or towards which he perceived his body to gravitate, he would term *lower* and the opposite to this *upper*, and label in the same way the parts of any objects he touched.

94. But then the only judgments he makes about the orientation of objects would concern ones that are perceivable by touch. Things that are intangible and of a spiritual nature—his thoughts and desires, his passions, and in general all the states of his soul—he would never describe in terms of 'upper' and 'lower', except in a purely metaphorical sense. He might by way of allusion speak of 'high' or 'low' thoughts, but those words in their proper meanings would never be applied to anything that wasn't conceived to exist outside the mind. A man who was born blind and stayed blind could only use the words 'higher' and 'lower' to mean a larger or smaller distance from the earth; and he would measure this distance by the motion or application of his hand or some other part of his body. So it's obvious that all the things that he would think of as higher or lower than one another must be things conceived to exist in the surrounding space outside his mind.

95. From which it plainly follows that if this man were enabled to see, he wouldn't at first sight think of anything he saw as being high or low, erect or inverted; for I have demonstrated in **41** that he wouldn't think the things he perceived by sight to be at any distance from him or outside his mind. The objects that he has until now described in terms of 'up' and 'down', 'high' and 'low', have been ones that were in some way perceived by his ·sense of· touch. But the proper objects of vision constitute a new set of ideas that are nothing like those former ones and can't possibly be perceived by touch. So there is *nothing* that could induce him to think those words to be terms applicable to them; and he wouldn't think this until he came to observe their connection with tangible objects, and the same prejudice began to insinuate itself into his understanding that had grown up in the understandings of other men from their infancy.

96. To set this matter in a clearer light, here is an example. Suppose that our blind man, by his touch, perceives a man to stand erect. Let us inquire into how this happens. By applying his hand to the various parts of a human body he perceived different tangible ideas which, being collected into various complex ones, have distinct names annexed to them. Thus one combination of a certain tangible shape,

size and consistency of parts is called the •head, another the •hand, a third the •foot, and so on. These complex ideas in his understanding would have to be made up only of ideas perceivable by touch. He also obtained by touch an idea of •earth or •ground, which he perceives the parts of his body to have a natural tendency to move towards. Now, all that is meant by 'erect' is the perpendicular position of a man in which his feet are nearest to the earth; so if the blind person by moving his hand over the parts of the man who stands before him perceives the tangible ideas that compose the head to be furthest from •that other combination of tangible ideas that he calls 'earth', and perceives the tangible ideas that compose the feet to be nearest to •it, he will describe that man as 'erect'. But if we suppose him suddenly to receive his sight and to see a man standing before him, it's obvious that he wouldn't judge the man he sees to be erect or inverted. He has never known those terms applied to any but tangible things, or existing in the space outside him, and what he sees is neither tangible nor perceived as existing outside him, so he can't know that in propriety of language they are applicable to it.

97. Afterwards, when upon turning his head or eyes up and down to the right and left he observes the visible objects to change, and also comes to know that they are connected with the objects perceived by touch and called by the same names as them, then indeed he *will* come to speak of them and their orientation in the same terms that he has been used to applying to tangible things: those that he perceives by turning up his eyes he will call 'upper', and those he perceives by turning down his eyes he will call 'lower'.

98. This seems to me the true reason for him to think that the objects painted on the lower part of his eye are uppermost: he'll see them distinctly by turning his eye up. And he'll think that the objects painted on the lower part of his eye are lowest because he'll see them distinctly by turning his eye down. I have shown that he would not apply the terms 'high' and 'low' to •the immediate objects of sight considered in themselves, so he must be guided by some circumstances that are observed to accompany •them; and it's clear that these are the actions of turning the eye up and down, which suggest a very obvious reason for the mind to call the objects of sight 'high' or 'low' correspondingly. Without this motion of the eye. . . ., it would never have occurred to him to apply to the ideas of sight such terms as 'erect', 'inverted' and the like which he has understood in terms of the position of tangible objects. The mere act of seeing includes nothing in it to that purpose; whereas the different situations [see Glossary] of the eye naturally direct the mind to make a suitable judgment of the orientation of objects presented by it.

99. Furthermore, when he has learned by experience the connection between the various ideas of sight and of touch, he will be able from his perception of the situation of visible things in relation to one another to make a sudden and true estimate of the orientation of external tangible things corresponding to them. That's how he will perceive by •sight the orientation of external objects that don't strictly fall under •that sense.

100. I know that we're very apt to think that if we had just this moment gained eyesight we should judge concerning the •orientation of visible things as we do now. But we're equally apt to think that at first sight we would apprehend the •distance and •size of objects as we do now; and I have shown that this opinion is false and groundless. Well, so is the confident opinion that most men have (before they have thought hard enough) that they could determine by the eye at first view whether objects were erect or inverted.

101. You might want to object against my opinion in the following way. 'A man is thought to be erect when his feet are next to the earth, and inverted when his head is next to the earth; so we *could* determine by the mere act of vision whether he was erect or inverted, without any experience or altering the situation of the eye. The earth itself and the limbs of the man standing on it are both perceived by sight, so one can't help seeing what part of the man is nearest to the earth and what part furthest from it, i.e. seeing whether he is erect or inverted'.

102. To which I reply that the ideas that constitute the tangible earth and man are entirely different from those that constitute the visible earth and man. Using the visual faculty alone, without •bringing in any experience of touch or •altering the position of the eye, one couldn't know—one couldn't have any reason even to *suspect*—that there was any relation or connection between them. A man at first view wouldn't call anything he saw 'earth' or 'head' or 'foot'; so he couldn't tell by the mere act of vision whether the head or feet were nearest the earth. Indeed, unaided eyesight wouldn't have given us *any* thought of earth or man, erect or inverted; and that will be made yet more evident if we look in careful detail into the differences between the ideas of sight and of touch [see **121–159**].

103. What I *see* is only a variety of light and colours. What I *feel* is hard or soft, hot or cold, rough or smooth. What similarity, what connection, does one set of ideas have with the other? How could anyone see reason to give one and the same name to combinations of ideas that are so very different, before he had experienced their coexistence? We don't find any necessary connection between this or that tangible quality and any colour whatsoever. And we may sometimes perceive colours where there is nothing to be felt. All of which makes it obvious that no man on first receiving his sight would know that there was *any* agreement between •this or that particular object of his sight and •any object of touch that he was already acquainted with. The colours of the head wouldn't suggest to him the idea of *head* any more than they would the idea of *foot*.

104. You might think that the visible sizes of head and foot would bring into the mind, at first opening of the eyes, the respective tangible sizes of those parts. Not so. I have at large shown (see **63–64**) there is no discoverable necessary connection between any given visible size and any one particular tangible size; that our ability by the perception of visible extension to inform ourselves regarding the extension of any tangible object is entirely the result of custom and experience. . . .

105. That line of thought makes it clear that the visible shape of any part of the body has no necessary connection with its tangible shape, so as to suggest it to the mind at first sight. Shape is the termination of size; from which it follows that because no visible size has in its own nature an aptness to suggest any one particular tangible size, no visible shape can be inseparably connected with its corresponding tangible shape in such a way as to suggest the latter without relying on experience. This becomes even more obvious if we consider that what seems smooth and round to the touch may seem quite otherwise to sight if viewed through a microscope.

106. The points that I have made, when properly assembled and considered, clearly imply the following conclusion. In the first act of vision no idea entering by the eye would have a perceivable connection with the ideas to which the names 'earth', 'man', 'head', 'foot' etc. were linked in the mind of a person blind from birth so as to introduce them into his

mind and get him to call them by the same names. . . .as he will apply to them later ·after experience has come to his aid·.

107. But there's still one difficulty that may seem to press hard on my opinion and to deserve to be considered. Even granted that neither the colour, size, or shape of the visible feet have any necessary connection with the ideas that compose the tangible feet,. . . .it seems undeniable that because the *number* of the visible feet is the same as the *number* of the tangible feet I may without any help from experience reasonably conclude that they represent or are connected with the feet rather than the head. That is: it seems the idea of two visible feet will suggest to the mind the idea of two tangible feet rather than of one head; so that the blind man when he first begins to see might know which were the feet (or *two*) and which was the head (or *one*).

108. To get clear of this seeming difficulty we need only observe that diversity of visible objects doesn't necessarily imply diversity of corresponding tangible objects. A picture painted with great variety of colours affects the sense of touch in one uniform manner; which shows that I don't by any necessary connection—independently of experience—judge the number of tangible things from the number of visible things. So when I first open my eyes I ought not to conclude that because I see two I shall feel two. So how can I, without being taught by experience, know that the visible legs, because two, are connected with the tangible legs, or that the visible head, because one, is connected with the tangible head? The things I see are so very different and heterogeneous from the things I feel that the perception of the one would never have suggested the other to my thoughts, or enabled me to pass the least judgment on them, until I had experienced their connection.

109. For a fuller illustration of this matter, considered the following. Although some regard number as one of the primary qualities, it is in fact nothing fixed and settled, not something really existing in things themselves. It is entirely the creature of the mind, considering a single idea or any combination of ideas to which it gives one name and so makes it pass for a unit. According as the mind variously combines its ideas, the unit varies; and as the unit varies, so does the number, which is only a collection of units. We call a window one, a chimney one, and yet a house with many windows and many chimneys has an equal right to be called one, and many houses go to the making of one city. Examples like these show that the unit constantly relates to the particular drafts the mind makes of its ideas, to which it attaches names and in which it includes more or less as best suits its own purposes. Thus, whatever the mind considers as *one* is a unit. Every combination of ideas is considered as one thing by the mind, and accordingly is marked by one name. This naming and combining together of ideas is perfectly arbitrary [see Glossary], and done by the mind in whatever way experience shows to be most convenient. Without experience our ideas would never have been collected into such distinct combinations as they now are.

110. It follows that a man born blind and then as an adult made to see would not in his first act of vision parcel out the ideas of sight into the same distinct collections as do others who have experienced which collections regularly coexist and are appropriate for being bundled up together under one name. He would not, for example, make into one complex idea and regard as one thing all the particular ideas that constitute the visible head or foot. There's no reason for him to do so simply from seeing a man stand upright before him. There crowd into his mind the ideas that compose the visible

man along with all the other visual ideas perceived at the same time; but he would not sort these ideas into distinct combinations until experience, e.g. observing the motion of the parts of the man, teaches him which are to be separated and which to be collected together.

111. From all this it emerges that the objects of sight and of touch make, if I may so say, two sets of ideas that are widely different from each other. To objects of either kind we. . . .attribute the terms 'high' and 'low', 'right' and 'left', and such like, denoting the position or orientation of things; but we must well observe that the position of any object is determined with respect only to objects of the same sense. [The ellipsis in that sentence replaces 'indifferently'—a bewildering adverb in that place.] We call an object of touch 'high' or 'low' according as it is more or less distant from the tangible earth; and we denominate an object of sight 'high' or 'low' in proportion as it is more or less distant from the visible earth. But to define the location of visible things in terms of their distance from tangible things, or vice versa, would be absurd and perfectly unintelligible. All visible things are equally in the mind, and take up no part of the external space; so they are equidistant from *any* tangible thing that exists outside the mind.

112. Or rather, to speak truly, the proper objects of sight are at no distance—neither near nor far—from any tangible thing. For if we look into this carefully we'll find that the only things that are inter-related in terms of distance are ones that exist in the same way or belong to the same sense. All that is meant by 'the distance between x and y' is 'the number of intermediate points between x and y'. If x and y are visible, the distance between them is the number of the intervening visible points; if they are tangible the distance between them is a line consisting of tangible points; but if x is tangible and y is visible, the distance between them. . . .is utterly inconceivable. . . .

113. Much of the difficulty about erect appearances has arisen from people's not being aware of the points I have been making in the two last sections. The difficulty is supposed to be this:

> The head, which is painted ·on the retina· nearest the earth, seems to be furthest from it; and the feet, which are painted furthest from the earth, are thought nearest to it.

Now let us express this more clearly and without ambiguity:

> How does it happen that the visible head, which is nearest to the tangible earth, seems to the eye furthest from the earth? and that the visible feet, which are furthest from the tangible earth, seem to the eye nearest to the earth?

When the question is put like that, anyone can see that the 'difficulty' is based on the supposition that the eye or eyesight—or rather the soul by means of eyesight—should judge the situation of visible objects in terms of their distance from the tangible earth! Obviously the tangible earth is not perceived by sight. And I have shown in **111–112** that the location of visible objects is determined only by their distance from one another, and that it is nonsense to talk of distance, far or near, between a visible and a tangible thing.

114. If we confine our thoughts to the proper objects of sight the whole thing is plain and easy. The head is painted furthest from the visible earth and the feet nearest to it; and so they appear to be. What is there strange or unaccountable in this? Let us suppose the pictures in the retina to be the immediate objects of the sight. The consequence is that things should appear in the same posture they are painted in—and isn't it so? The head that is seen seems furthest

from the earth that is seen; and the feet that are seen seem nearest to the earth that is seen; and just so they are painted.

115. You object: 'The picture of the man is inverted, yet the appearance is erect'. What do you mean by the picture of the man? Or, the same question, what do you mean by the visible man's being inverted? You tell me that it's inverted because the heels are uppermost and the head undermost? Explain this to me. You say that by the head's being undermost you mean that it is nearest to the earth; and by the heels being uppermost you mean that they are furthest from the earth. What earth do you mean? You can't mean the earth that is painted on the eye, or the visible earth; because the picture of the head is furthest from the picture of the earth, and the picture of the feet nearest to the picture of the earth; so the visible head is furthest from the visible earth, and the visible feet nearest to it. So it must be that you mean the *tangible* earth, and are determining the orientation of visible things in relation to tangible things—contrary to what I demonstrated in **111–112**. The provinces of sight and touch should be considered apart, as if their objects had no. . . .sort of relation to one another in regard to distance or position.

116. Something that greatly contributes to our going wrong about this matter is that when we think of the pictures in the retina we imagine ourselves looking at the retina of someone else's eye, or someone else looking at the retina of our own eye, and seeing the pictures painted thereon. Suppose two eyes A and B: A from some distance looks at the pictures in B, sees them inverted, and concludes that they are inverted in B. But this is wrong. At the back of A there are small images of the pictures of (let's say) man, earth, etc. that are painted on B. And besides these small images A also contains larger images of the eye B itself and the objects around it, together with another earth. Now, the eye A regards these larger images as the true objects, and the smaller ones as only pictures in miniature. And it is with respect to those larger images that A determines the orientation of the smaller images: relating **the small man to the large earth**, A judges him to be inverted, i.e. judges that the feet are furthest from the large earth and the head is nearest to it. Whereas if A relates **the small man to the small earth**, then he will appear erect, i.e. his head will seem furthest from the small earth and his feet nearest to it. But B doesn't see two earths as A does; it sees only what is represented by the small pictures in A, and consequently it will judge the man to be erect. The fact is that the man in B is *not* inverted, for in the feet are next to the earth. What *is* inverted is the representation of this in A, because in A the head of the representation of the picture of the man in B is next to the earth, and the feet furthest from the earth, meaning the earth that is outside the representation of the pictures in B. For if you take the small images of the pictures in B and consider them by themselves only in relation to one another, they are all erect and in their natural posture.

117. And there's a further mistake in imagining that the pictures of external objects are painted at the back of the eye. I have shown that the ideas of sight have no resemblance to tangible things, and that that the proper objects of sight don't exist outside the mind. From this it clearly follows that the pictures painted at the back of the eye are not pictures of external objects. Consult your own thoughts, and then say what likeness there is between •that particular variety and layout of colours that constitute the visible man, or picture of a man, and •that other combination of far different ideas, sensible by touch, that make up the tangible man. But—·you may object·—if there's no likeness, how do they come to be regarded as *pictures* or *images*, which implies that they copy or represent some originals?

118. I answer that in the above example the eye A takes the small images that are included within the representation of the other eye B to be pictures or copies, but what they are picture *of* are not •external things but •the larger pictures on A's own retina; and A regards these not as pictures but as the originals. . . . Though if we suppose a third eye C to see the retina of A from an appropriate distance, then the things projected onto it will seem to C to be pictures or images, in the same sense [Berkeley's word] that the ones projected onto B's retina seem to A.

119. Rightly to conceive this point, we must carefully distinguish between the ideas of sight and touch, between the visible and tangible eye, for certainly nothing is or seems to be painted on the tangible eye. And the visible eye—like all other visible objects—has been shown to exist only in the mind, which perceives its own ideas and relates them to one another, calling some of them pictures of others. What I have said, when all put together and rightly comprehended, does (I think) offer a full and genuine explanation of the erect appearance of objects; and I must confess that I don't see how that phenomenon can be explained by any theories of vision published before mine.

120. In discussing these things the use of language is apt to cause some obscurity and confusion, and create wrong ideas in us. Because language is accommodated to the common notions and prejudices of men, it is hardly possible to deliver the naked and precise truth without great circumlocution, impropriety, and (to an unwary reader) seeming contradictions. So if you think it is worth your while to understand what I have written concerning vision, I now ask you—once for all—not to pick on this or that phrase or manner of expression, but fairly collect my meaning from the whole sum and tenor of my discourse. Lay aside the words as much as possible, consider the bare notions themselves, and then judge whether they are in conformity with truth and your own experience.

D. Ideas of sight and of touch

121. I have shown how the mind by the mediation of visible ideas perceives the distance, size, and orientation of tangible objects. I come now to inquire in more detail into the difference between the ideas of sight and of touch that are called by the same names, to discover whether there is any idea common to both senses. From what I have presented and demonstrated in the earlier parts of this treatise, it's clearly the case that:

> No one extension is perceived both by sight and touch. Particular shapes and extensions perceived by sight are called by •the same names as those perceived by touch, and are thought to be •the same things, but in fact they are different things and have an existence distinct and separate from them.

So my present question is not whether sight and touch have any one **individual idea** in common but whether there is any any one **sort or species of ideas** equally perceivable to both senses? i.e. whether extension, shape, and motion perceived by sight are specifically distinct from extension, shape, and motion perceived by touch?

·Four sections on 'extension in abstract'·

122. But before I get into that I think I should consider extension in abstract. There is much talk of this, and I'm inclined to think that when men speak of *extension* as being an idea common to two senses they are secretly supposing that

> we can single out extension from all other tangible and visible qualities, and form an abstract idea of it that is common both to sight and touch.

So we are to understand by 'extension in abstract' an idea of extension—e.g. a surface—entirely stripped of all other sensible qualities and circumstances that could fix it as being of any particular kind: it is not black or white or red or any other colour; and it has no tangible quality whatsoever. So it has no finite determinate size, because in the absence of qualitative differences there can be no boundaries or distinctions ·and thus no size-measurement·.

123. I don't find that I can perceive, imagine, or in any way form in my mind an abstract idea such as is here spoken of. A line or surface that is not black or white or blue or yellow etc., and not long or short, rough or smooth, square or round etc., is utterly incomprehensible. I'm sure of this as regards myself; other men can best tell how far *their* faculties can reach.

124. It is commonly said that the subject-matter of geometry is abstract extension. But geometry is about *shapes*, and shape is the termination of size; whereas I have shown that extension in abstract has no finite determinate size, from which it clearly follows that it can't have any shape and therefore isn't what geometry is about. It is indeed a tenet among the modern philosophers as well as of the ancients that *all general truths* are about universal abstract ideas, without which—we are told—there could be no science, no demonstration of any general proposition in geometry. It wouldn't be difficult to show that propositions and demonstrations in geometry could be universal without those who make them ever thinking of abstract general ideas of triangles or circles; but my present purposes don't require me to go into that.

125. After repeated attempts to grasp the general idea of a triangle I have found it altogether incomprehensible. If anyone *could* introduce that idea into my mind, it would surely be the author of the *Essay Concerning Human Understanding* [Locke]—he who has so far distinguished himself from most writers by the clearness and significance of what he says. Let us see, then, how this celebrated author describes the general or abstract idea of a triangle:

> 'It must be neither oblique nor rectangular, neither equilateral, equicrural nor scalenum; but all and none of these at once. In effect it is something imperfect that cannot exist; an idea wherein some parts of several different and inconsistent ideas are put together.' (*Essay* IV.vii.7)

This is the idea that he thinks •is needed for the enlargement of knowledge, •is the subject of mathematical demonstration, and •without which we could never come to know any general proposition about triangles. He acknowledges it does 'require some pains and skill to form this general idea of a triangle'. If he had borne in mind what he said earlier, namely that 'ideas of mixed modes wherein any inconsistent ideas are put together cannot so much as exist in the mind, i.e. be conceived' (*Essay* IV.iii.10), he might well have admitted that all the pains and skill he was master of wouldn't suffice for him to form the above-mentioned idea of a triangle, which is made up of obvious glaring contradictions. That a man who thought so much and laid such stress on clear and determinate ideas should talk in this way seems very surprising. But you'll be less surprised if you consider that this opinion flows from the prolific womb that has brought forth innumerable errors and difficulties in all parts of philosophy and in all the sciences. But a full treatment of this matter is too big and inclusive a subject to to be presented here. So much for extension in abstract.

126. Some may think that •pure space, •vacuum, or •the three dimensions are objects equally of sight and touch. But though we have a great tendency to think the ideas of outness and space are the immediate object of sight, I think that in the foregoing parts of the present work I have clearly demonstrated this to be a mere delusion. It arises from the quick and sudden suggestion of the imagination, which so closely *connects* the idea of distance with ideas of sight that we're apt to think it *is* a proper and immediate object of that sense, till reason corrects the mistake.

127. Now that I have shown that there are no abstract ideas of shape, and that it is totally impossible for us to form an idea of extension that is

- •common both to sight and touch, and
- •abstract, i.e. separate from all other visible and tangible qualities,

the remaining question is this:

- •Are the particular extensions, shapes, and motions perceived by sight are of the same *kind* as the particular extensions, shapes, and motions perceived by touch?

In answer to this I venture to lay down the following proposition: *The extension, shapes, and motions perceived by sight are specifically distinct from the ideas of touch called by the same names; there is no such thing as one idea or kind of idea common to both senses.* This proposition can fairly easily be gathered from things I have said in several places in this essay. But because it seems so remote from—indeed, *contrary to*—the accepted notions and settled opinion of mankind, I'll try to demonstrate it more comprehensively and in more detail by the following arguments.

128. (i) When having perceived an idea I assign it to this or that *sort*, I do this because it

- •is perceived in the same way as, or
- •has a likeness or conformity with, or
- •affects me in the same way as,

other ideas of the *sort* I put it into. So it mustn't be entirely new; it must contain something old, something already perceived by me; it must have enough in common with the ideas I have previously known and named to make me give it the same name as them. But I think I have clearly shown that a man born blind would not, when first enabled to see, think that •the things he saw were of the same nature as the objects of touch, or had anything in common with them; but would think that •they were a new set of ideas, perceived in a new manner and entirely different from any he had perceived before. So that he wouldn't call them by the same name, or regard them as being of the same sort, as anything he had previously known.

129. (ii) Everyone accepts that light and colours constitute a sort or species entirely different from the ideas of touch; and I don't think anyone will say that they can be perceived by that sense. But light and colours are the only immediate object of sight; so it follows that there is no idea common to both senses.

130. It is a prevailing opinion, even among those who have thought and written most accurately [see Glossary] about our ideas and how they enter into the understanding, that something more is perceived by sight than merely light and colours with their variations. Locke calls sight 'the most comprehensive of all our senses, conveying to our minds the ideas of light and colours, which pertain only to that sense, and also the far different ideas of space, shape, and motion' (*Essay* II.ix.9). Well, I have shown that space or distance is no more the object of sight than it is of hearing (see **46**). As for shape and extension, I leave it to anyone who will calmly

attend to his own clear and distinct ideas to decide whether his eyesight immediately and strictly presents him with anything but light and colours. Or whether he can form in his mind a distinct abstract idea of visible extension or visible shape, exclusive of all colour; and on the other hand whether he can conceive colour without visible extension. For my own part, I must admit that I can't achieve such a fine-grained abstraction; in a strict sense I see nothing but light and colours with their various shades and variations. Someone who by eyesight perceives not only •light and colours but also •ideas far different and distinct from them has a more perfect and comprehensive eyesight than I can lay claim to ! By the mediation of light and colours other very different ideas are *suggested* to my mind; but so they are by hearing, which beside sounds (which pertain only to that sense) also by the mediation of sounds suggests not only space, shape, and motion but also all other ideas whatsoever that can be signified by words.

131. (iii) I think it is a universally accepted axiom that quantities *of the same kind* can be added together to make one entire sum. Mathematicians add lines together; but they don't add a line to a solid, or conceive a line as making one sum with a surface. They regard these three kinds of quantity as entirely disparate and heterogeneous, and therefore as incapable of any such addition and therefore incapable of being compared together in the various ways of proportion. Now, try in your thoughts to add a visible line or surface to a tangible line or surface, so as to conceive them making one continued sum or whole. If you can do this, you may think them to be homogeneous; but if you can't then by the foregoing axiom you must think them to be heterogeneous. A blue line and a red one I can conceive added together into one sum, making one continued line; but to make in my thoughts one continued line out of a visible line and tangible one added together is, I find, a much harder task, indeed an impossible one; and I leave it to the reflection and experience of each individual person to determine this for himself.

132. (iv) A further confirmation of our tenet may be drawn from the solution of Molyneux's problem, published by Locke in his *Essay*. Here it is, along with Locke's opinion of it: 'Suppose a man born blind, and now adult, and taught by his touch to distinguish between a cube and a sphere of the same metal and roughly of the same size, so as to tell when he felt each of them which is the cube and which the sphere. Suppose then the cube and sphere placed on a table, and the blind man made to see: Question: *Could he, by his sight before he touched them, tell which is the globe and which the cube?* To which the acute and judicious proposer answers: Not. For though he has obtained the experience of how a globe and how a cube affects his touch, he hasn't yet had the experience that what affects his touch so-or-so must affect his sight so-or-so; or that a protuberant angle in the cube that pressed his hand unequally will appear to his eye as it does in the cube. I agree with this thinking gentleman. . . .in his answer to this problem. . . .' (*Essay* II.ix.8)

133. Now, if a square surface perceived by touch was of the same sort as a square surface perceived by sight, our blind man certainly could know a square surface as soon as he saw it; it would only involve introducing into his mind by a new inlet an idea that he is already well acquainted with. Since he is supposed to have known by his touch that a cube *is* and a sphere *is not* a body terminated by square surfaces, on the supposition that a visible and tangible square differ only *in numero* [= 'are distinct things but not different *sorts* of thing'], it follows that he could know by the unerring mark of the square surfaces which was the cube and which wasn't. . . .

So we must accept that either •visible extension and shapes are specifically distinct from tangible extension and shapes or •the solution of this problem given by those two thoughtful and ingenious men is wrong.

134. Much more might be said in proof of the proposition I have advanced; but I think that what I have said is sufficient to convince anyone who attends to it reasonably. As for those who won't take the trouble to think a little, no piling on of words will ever suffice to make *them* understand the truth or rightly understand what I am saying.

135. I cannot let the Molyneux problem go without some reflection on it. It has been made evident (see **106**) that a man blind from his birth would not at first sight give to anything he saw the names he had been used to associating with ideas of touch. 'Cube', 'sphere', 'table', are words he has known applied to things perceivable by touch, but he never knew them applied to perfectly intangible things. Those words in their usual application always marked out to his mind *bodies*, i.e. solid things that were perceived by the resistance they gave. But no solidity or resistance or protrusion is perceived by sight. The ideas of sight are all new perceptions that can't be associated with any names in his mind; so he can't understand what is said to him about them ·in the Molyneux situation·: if he is asked regarding the two bodies that he saw placed on the table 'Which is the sphere, which the cube?' he will regard that question as. . . .unintelligible, because nothing he sees can suggest to his thoughts the idea of body, distance, or in general of anything he had already known.

136. It is a mistake to think the same thing affects both sight and touch. If the angle or square that is the object of touch were also the object of vision, what would hinder the blind-from-birth man from knowing it at first sight? The manner in which it affected his sight would be different from the manner in which it affected his touch; but alongside this new and unknown manner or circumstance there would be the old and known angle or shape, and he couldn't fail to discern it.

137. Visible •shape and •extension having been demonstrated to be of an entirely different nature from tangible shape and extension, we still have to ask about •motion. That visible motion is not of the same sort as tangible motion seems to need no further proof, because it obviously follows from what I have shown concerning the difference between visible and tangible extension. But here is a more complete and explicit proof of it:

> Our blind-from-birth man could not by touch perceive any motion except what was •up or down, •to the right or left, •towards or away from him; he can't possibly have any idea of motion except these and their several varieties or complications. So he wouldn't think to be motion, or label as 'motion', any idea that he couldn't classify in terms of those particular kinds of motion. But **95** makes it obvious that the mere act of vision couldn't present him with motion up or down, to the right or left, or in any other possible direction. From which I conclude that he wouldn't know motion at all at first sight; from which it clearly follows that motion perceivable by sight is of a distinct sort from motion perceivable by touch.

As for the idea of motion in abstract, I shan't waste paper on that, but leave it to you to make the best you can of it. To me it is perfectly unintelligible.

138. There may be more to be said about motion; but I shan't go on about it because what I have already said about how the visual sense suggests objects' various •distances,

•sizes, and •orientations makes it easy to see how the mind apprehends by sight their •motions. I shall instead proceed to inquire what are the most plausible objections to the proposition I have shown to be true; for where there's so much prejudice [see Glossary] to be encountered, a mere undecorated demonstration of the truth will hardly suffice. We must also satisfy the objections that men may raise in favour of their preconceived notions, show how their mistake arises and how it came to spread, and carefully reveal and root out the false convictions that an early prejudice might have implanted in the mind.

139. First, it will be demanded: 'How do visible extension and shapes come to be called by the same names as tangible extension and shapes, if they aren't of the same kind? It must be something more than a whim or accident that caused a custom as constant and universal as this one, which has obtained in all ages and nations of the world, and amongst all ranks of men, the learned as well as the illiterate.'

140. To which I answer that we can no more argue that

> •a visible and a tangible square are of the same species because they are called by the same name

than we can argue that

> •a tangible square and the six-letter monosyllable by which it is marked are of the same species because they are both called by the same name.

It is customary to call •written words and •the things they signify by the same name. Because words aren't regarded [see Glossary] in their own nature or in any way except as marks of things, it would have been superfluous and irrelevant to the purpose of language to give them names distinct from those of the things marked by them. [In philosophical circles these days we prefer to name a word not by the word itself but by the-word-in-quotation-marks.] The same reason holds here also. Visible shapes are the marks of tangible shapes, and from **59** it is clear that they aren't much regarded in themselves or in any other way except for their connection with the tangible shapes which by nature they are ordained to signify. And because this language of nature [Berkeley's phrase] doesn't vary in different ages or nations, it comes about that in all times and places visible shapes are called by the same names as the respective tangible shapes suggested by them. It's not because they are alike, or of the same sort as them.

141. You will say: 'But surely a tangible square is more like a visible square than a visible circle. It has four angles and four sides, and so has the visible square; whereas the visible circle has no such thing, being bounded by one uniform curve with no straight lines or angles, which makes it unfit to represent the tangible square but very fit to represent the tangible circle. From this it clearly follows that visible shapes are patterns of the respective tangible shapes represented by them; they are of the same species as them, are *like* them, fitted by their own nature to represent them because they are of same *sort*. They are in no respect arbitrary [see Glossary] signs as words are.'

142. I have to agree that the visible square is more fit than the visible circle to represent the tangible square, but not because it is more like it, more of a species with it. Rather, it is because the visible square does, whereas the visible circle doesn't, contain several distinct parts by which to mark the several distinct corresponding parts of a tangible square. The square perceived by touch has four distinct equal sides, and four distinct equal angles; so the visible shape that marks it best must have four distinct equal parts corresponding to the four sides of the tangible square, and four other distinct and equal parts by which to denote its four

angles. And accordingly we see the visible shapes contain in them distinct visible parts, answering to the distinct tangible parts of the shapes signified or suggested by them.

143. But it won't follow that any visible shape is *like* or *of the same species as* its corresponding tangible shape, unless it is also shown that not only the •number but also the •kind of the parts is the same in both. Here is an illustration. •Visible shapes represent •tangible shapes in much the same way that •written words represent •sounds. In this respect words are *not* arbitrary; it isn't indifferent what written word stands for any sound. Each written word has to contain as many distinct characters as there are variations in the sound it stands for. Thus the single letter 'a' is proper to mark one simple uniform sound; and the word 'adultery' is suitable for representing the sound annexed to it. In the making of that sound there are eight different changes of the air by the organs of speech, each of which produces a difference of sound; so it was fit that the word representing it should consist of eight distinct characters to mark each of the eight parts of the whole sound. But I don't think anyone will say that the single letter 'a' or the word 'adultery' are *like*—of the same species as—the respective sounds they represent. It is indeed arbitrary that the letters of any language represent sounds at all; but once it is agreed that they will, it isn't arbitrary what combination of letters shall represent this or that particular sound. I leave this for you to pursue, and apply it in your own thoughts.

144. Admittedly, we aren't as apt to confound other •signs with the things •signified, or to think them of the same species, as we are •visible and •tangible ideas. But a little consideration will show us why this is so without our supposing them to be *alike*. These ·visible· signs are constant and universal, their connection with tangible ideas is learnt when we first come into the world; and almost every moment after that it occurs to our thoughts and fastens and strikes deeper on our minds. When we observe that ·linguistic· signs are variable, and instituted by humans; when we remember that there was a time when they weren't connected in our minds with the things they now so readily suggest, and that their signification was learned by the slow steps of experience; this preserves us from confusing them ·with the things they signify·. But when we find that the same ·visual· signs suggest the same ·tangible· things all over the world; when we know they aren't instituted by humans, and we can't remember that we ever learned their signification, and think ·though wrongly· that at first sight they would have suggested to us the same things they do now; all this persuades us that they are of the same species as the things they respectively represent, and that it's by a natural resemblance that they suggest them to our minds.

145. And another point: Whenever we look carefully and in detail at an object, successively directing the optic axis to each point on it, the motion of the head or eye traces out certain lines and shapes that are really perceived by feeling [see Glossary] but so *mix* themselves with the ideas of sight (so to speak) that we can hardly avoid thinking of them as visual. Also: the ideas of sight enter into the mind, several at once, more distinct and unmingled than is usual in the other senses (apart from the sense of touch). When different sounds, for example, are perceived at the same instant they are apt to coalesce (so to speak) into one sound: But we can perceive at the same time a great variety of visible objects, very separate and distinct from each other. Now tangible extension is made up of many distinct coexistent parts, and this may be another reason for our tendency to imagine a likeness or analogy between the immediate objects of sight and of touch. But nothing contributes more to

blending and confounding them together than their strict and close connection with each other. The moment we open our eyes the ideas of distance, bodies, and tangible shapes are suggested by them. The transition from visible to tangible ideas is so swift and sudden, and so unperceived, that we can hardly help thinking of them as equally the immediate object of vision.

146. The prejudice that comes from these causes and perhaps others sticks so fast ·in our minds· that it's impossible without obstinate striving and mental labour to get entirely clear of it. But our reluctance to rejecting an opinion can't be an argument for its truth in the mind of anyone who considers what I have already shown regarding the prejudices we entertain concerning the distance, size, and orientation of objects; prejudices so familiar to our minds, so confirmed and inveterate, that they will hardly give way to the clearest demonstration.

147. I think we can fairly conclude that the proper objects of vision constitute a **universal language of the Author of nature** by which we are told how to regulate our actions so as to •get the things we need for the preservation and well-being of our bodies and •avoid whatever may be hurtful and destructive of them. Their information is our principal guide in all the transactions and concerns of life. As for *how* they signify and mark to us objects that are at a distance, it's the same as how humanly devised languages signify things—not by any likeness or identity of nature, but only by an habitual connection that experience has shown us between them.

148. Suppose that someone who is blind and always has been is told by his guide that after he has taken ten steps forwards he will come to the brink of a precipice (or that he'll be stopped by a wall); mustn't this to him seem very wonderful and surprising? He can't conceive how it is possible for mortals to frame predictions such as these, which to him would seem as strange and unaccountable as prophecy does to others. Even those who are blessed with eyesight might find it to be a sufficient cause of wonder (though familiarity makes it less observed). •The wonderful art and contrivance with which it is fitted to the goals and purposes for which it was apparently designed; and •the vast extent, number, and variety of objects that are at once suggested by it with so much ease, speed and pleasure; these provide materials for much speculation—*pleasing* speculation—and may give us some glimmering, analogous prenotion [see Glossary] of things that we can't properly discover and comprehend in our present state. [See Glossary on 'speculation'.]

·THE SUBJECT-MATTER OF GEOMETRY·

149. I don't plan to put work into drawing corollaries from the doctrine I have laid down. If it survives the test, then others may (as far as they see fit) employ their thoughts in extending it further and applying it to whatever purposes it may serve. But I can't forbear to make some inquiry about the object of geometry, a question that naturally arises out of the topics I have been treating. I have shown there is no such idea as that of *extension in abstract*, and that there are two kinds of sensible extension and shapes, which are entirely distinct and dissimilar from one another. It is natural to ask: which of these is the object of geometry?

150. Some things incline one at first sight to think that geometry's topic is visible extension. We are strongly led in that direction by the constant use of our eyes in both the practical and the speculative parts of that science. A mathematician would certainly find it odd if we tried to convince him that the diagrams he sees on paper are not the figures—or even *likenesses* of the figures—that his demonstrations are about. The contrary view is regarded as an unquestionable truth

not only by mathematicians but also by •those who apply themselves more particularly to the study of logic—I mean •those who consider the nature of science, certainty, and demonstration. Those people give as one reason for the extraordinary clearness and evidentness of geometry that in this science the reasonings are free from the drawbacks of the use of arbitrary signs, because the very ideas themselves are copied out and exposed to view on paper! (Incidentally, how well does this square with what they say about abstract ideas' being the object of geometrical demonstration? I leave that for you to think about.)

151. To reach a decision about this, we need only observe what I said in **59.–61**, where I showed •that visible extensions in themselves are little regarded [see Glossary] and have no settled determinate size, and •that measurements are always made by applying tangible extension to tangible extension. All of which makes it evident that visible extension and figures are not the object of geometry.

152. So it's clear that visible figures have the same use in geometry as words have, and that they have no more claim to be the subject-matter of that science than words have, because the only relevance to it that either of them has is as representing or suggesting to the mind the particular tangible figures connected with them. There is indeed this difference between the two:

- •how words signify ideas is variable and uncertain, depending entirely on the arbitrary decisions of men, whereas
- •how visible figures signify tangible figures is fixed and immutably the same in all times and places—a visible square suggests to the mind in Europe the same tangible figure that it suggests in America.

That is why the voice of the Author of nature that speaks to our eyes is not open to the misinterpretation and ambiguity that languages of human design are unavoidably subject to.

153. What I have said may suffice to show what we ought to think about the object of geometry; but I shall illustrate it more fully by considering a possible being who is

> an intelligence—i.e. an unbodied spirit—which sees perfectly well, i.e. has a clear perception of the proper and immediate objects of sight, but has no sense of touch.

(·I shall call him 'UI', short for 'unembodied intelligence'·.) It doesn't matter for my purposes whether there is any such being in nature; all I need is that the supposition of him contains no contradiction. Let us now examine what proficiency UI can have in geometry. This will lead us to see more clearly whether the ideas of sight can possibly be the object of that science.

154. First, then, it is certain that UI can have no idea of a solid, i.e. of a quantity of three dimensions, because he has no idea of distance. We're apt to think that we have by sight the ideas of space and solids, being led into this error by imagining that we do strictly speaking *see distance* and see some parts of an object at a greater distance than others; which I have demonstrated to be the effect of the experience we have had of what ideas of touch are connected with such-and-such ideas of vision. But UI has no experience of touch, so he doesn't judge as we do. He does not have immediately or by suggestion any idea of distance, outness, or depth, so he has no idea of space or body. Clearly, then, he can't have any notion of the parts of geometry that •relate to the measurement of solids and their convex or concave surfaces, and •have to do with the properties of lines generated by the section of a solid. The conceiving of

any part of this is beyond the reach of his faculties.

155. Further, he can't understand geometers' way of describing a straight line or circle, because he can't possibly have any notion of the ruler and compass and their uses. Nor is it any easier for him to conceive the placing of one plane or angle on another in order to prove their equality, because that requires some idea of distance or external space. All of which makes it obvious that UI could never know even the first elements of plane geometry. And a careful inquiry will show that he can't even have an idea of plane figures, any more than he can of solids; because forming the idea of a geometrical plane requires some idea of distance, as you'll see if you think about it a little.

156. All that is properly perceived by eyesight amounts to •colours with their variations, and •different proportions of light and shade; and the way those immediate objects of sight perpetually alter and flit away makes it impossible to manage them in the way geometrical figures are managed; nor would it be of the slightest use to do so. It's true that a variety of them are perceived at the same time, more of some ·kinds· and less of others; but even if it were possible to compute their size accurately and assign precise determinate proportions to things so variable and inconstant, it would be a very trivial and pointless labour.

157. I must admit that some able men seem to hold that flat or plane figures are immediate objects of sight, though they acknowledge that solids are not. This opinion of theirs is based on what is observed in painting, where (they say) the ideas immediately imprinted on the mind are only of variously coloured planes, which by a sudden [see Glossary] act of the judgment are changed into solids. But with a little attention we shall find that the planes here described as the immediate objects of sight are not visible planes but tangible ones. When we say that pictures are 'planes' we mean that they appear **smooth and uniform** to the touch. But then this smoothness and uniformity—i.e. this planeness—of the picture is not perceived immediately by vision, for the picture appears to the eye **various and multiform**.

158. From all of which we can conclude that planes are no more the immediate object of sight than solids are. What we strictly see are neither solids nor variously coloured planes but only diversity of colours. Some of these suggest solids to the mind and others suggest plane figures, according to what they have been experienced to be connected with. So that we 'see planes' in the same way that we 'see solids', both being equally suggested by the immediate objects of sight, which accordingly are themselves called 'planes' and 'solids'. But though they are called by the same names as the things marked by them, they are of an entirely different nature, as I have demonstrated.

159. What I have said seems to me enough to decide the question I set out to examine, concerning the ability of a pure spirit such as UI to know geometry. It is indeed hard for us to enter precisely into the thoughts of such an intelligence, because it's very hard for us to completely separate and disentangle in our thoughts •the proper objects of sight from •objects of touch that are connected with them. Indeed, it seems hardly possible to do this completely. And that won't seem strange to us if we consider how hard it is for anyone to hear the words of his native language pronounced in his ears without understanding them. He may try to separate the meaning from the sound, but it will intrude into his thoughts and he'll find it extremely difficult, if not impossible, to put himself exactly in the position of a foreigner who has never learned the language, so as to be affected barely with the sounds themselves and not perceive their meaning. By this

time, I suppose, it is clear that the object of geometry is neither abstract extension nor visible extension. Not realising this may have created some difficulty and useless labour in mathematics.

THE END

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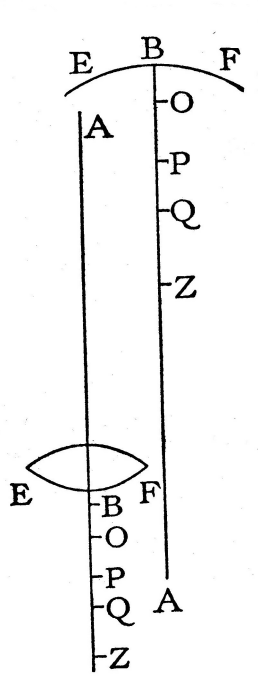
Barrow's presentation of the problem in 29:

In short it is this. Before the double convex glass or concave mirror EBF, let the point A be placed, at such a distance that the rays proceeding from A, after refraction or reflection, be brought to unite somewhere in the Ax AB. And suppose the point of union (i.e. the image of the point A, as has been already set forth) to be Z; between which and B, the vertex of the glass or mirror, conceive the eye to be any where placed. The question now is, where the point A ought to appear? Experience shows that it does not appear behind at the point Z, and it were contrary to nature that it should; since all the impression which affects the sense comes from towards A. But from our tenets it should seem to follow that it would appear before the eye at a vast distance off, so large as should in some sort surpass all sensible distance. For since if we exclude all anticipations and prejudices, every object appears by so much the further off, by how much the rays it sends to the eye are less diverging. And that object is thought to be most remote from which parallel rays proceed to the eye. Reason would make one think, that object should appear at yet a larger distance which is seen by converging rays. Moreover it may in general be asked concerning this case, what it is that determines the apparent place of the point A, and makes it to appear after a constant manner, sometimes nearer, at other times further off?

To which doubt, I see nothing that can be answered agreeable to the principles we have laid down except only that the point A ought always to appear extremely remote. But on the contrary, we are assured by experience that the point A appears variously distant, according to the different situations of the eye between the points B and Z. And that it does almost never (if at all) seem further off, than it would if it were beheld by the naked eye, but on the contrary, it does sometimes appear much nearer. Nay, it is even certain that



by how much the rays falling on the eye do more converge, by so much the nearer does the object seem to approach. For the eye being placed close to the point B, the object A appears nearly in its own natural place, if the point B is taken in the glass, or at the same distance, if in the mirror. The eye being brought back to O, the object seems to draw near: and being

come to P it beholds it still nearer. And so on by little and little, till at length the eye being placed somewhere, suppose at Q, the object appearing extremely near, begins to vanish into mere confusion. All which does seem repugnant to our principles, at least, not rightly to agree with them. Nor is our tenet alone struck at by this experiment, but likewise all others that ever came to my knowledge are, every whit as much, endangered by it. The ancient one especially (which is most commonly received, and comes nearest to mine) seems to be so effectually overthrown thereby, that the most learned Tacquet has been forced to reject that principle, as false and uncertain, on which alone he had built almost his whole Catoptrics [= optical theory regarding mirrors], and consequently by taking away the foundation, has himself pulled down the superstructure he had raised on it. Which, nevertheless, I do not believe he would have done, had he but considered the whole matter more thoroughly, and examined the difficulty to the bottom. But as for me, neither this nor any other difficulty shall have so great an influence on me, as to make me renounce that which I know to be manifestly agreeable to reason: Especially when, as it here falls out, the difficulty is founded in the peculiar nature of a certain odd and particular case. For in the present case something peculiar lies hid, which being involved in the subtilty of nature will, perhaps, hardly be discovered till such time, as the manner of vision is more perfectly made known. Concerning which, I must own, I have hitherto been able to find out nothing that has the least show of probability, not to mention certainty. I shall, therefore, leave this knot to be untied by you, wishing you may have better success in it than I have had.

Berkeley's treatment of Barrow's problem in 31:

Let us now see how this phenomenon agrees with our tenets. The eye the nearer it is placed to the point B in the foregoing figures, the more distinct is the appearance of the object; but as it recedes to O, the appearance grows more confused; and at P it sees the object yet more confused; and so on till the eye being brought back to Z sees the object in the greatest confusion of all. Wherefore by section 21 the object should seem to approach the eye gradually as it recedes from the point B, that is at O it should (in consequence of the principle I have laid down in the aforesaid section) seem nearer than it did at B, and at P nearer than at O, and at Q nearer than at P; and so on, till it quite vanishes at Z. Which is the very matter of fact, as any one that pleases may easily satisfy himself by experiment.

The Theory of Vision Vindicated and Explained (1733)

A. Letter from an anonymous critic

[We have the critic's letter, which was published in a journal, but it won't be given here. Considered as criticism of Berkeley's work it is boring and worthless; its writer was at best a fourth-rate thinker.]

B. A warning against creeping atheism

v1. [Berkeley opens with remarks about the kind of critic 'who contradicts himself and misrepresents me', and doesn't deserve to be answered. Then he continues:] But argument, I allow, has a right to be considered, and where it doesn't convince it has a right to be opposed with reason. Being convinced that the *Theory of Vision* published with *Alciphron* provides thinking men with a new and unanswerable proof of the existence and immediate operation of God, and the constant condescending [see Glossary] care of his providence, I think I ought to defend and explain it as well as I can at a time when atheism has made more progress than some are willing to admit and than others are willing to believe.

v2. Anyone who •considers that the present open enemies of Christianity began their attacks against it under the specious pretext of defending the Christian church and its rights, and •observes the same men pleading for natural religion, will be tempted to suspect their views and to judge their sincerity in one case from what they have shown in the other. Certainly the notion of a watchful, active, intelligent, free Spirit who has dealings with us and in whom we 'live and move and have our being' [*Acts* 17:28] is not the most prominent topic in the books and conversation even of the so-called deists! [see Glossary] Besides, as their schemes take effect we can plainly see moral virtue and the religion of nature fading away, and can see—both from reason and from experience—that destroying the revealed religion must end in atheism or idolatry. Admittedly, many minute [see Glossary] philosophers would not like at present to be accounted atheists. But twenty years ago how many would have been offended to be thought infidels but would now be much more offended to be thought Christians! It would be unjust to charge with atheism people who are not really tainted with it; but it would be very uncharitable and imprudent to overlook it in those who *are*, and allow such men under specious pretexts to spread their principles and eventually play the same game with natural religion that they have done with revealed religion.

v3. [The 'admired writer' referred to here is Shaftesbury, who is the primary target of Berkeley's long and sometimes bitter attack *Alciphron, or The Minute Philosopher*. That work can be found on the website that houses this version of the vision works.] Some innocent admirers of a certain plausible pretender to deism and natural religion would doubtless be shocked if someone told them that that admired writer's works show strong signs of atheism and irreligion—lack of natural religion as well as of revealed religion. But

- •to introduce taste instead of duty ·as the basis for morality·,
- •to make man a necessary ·rather than a free· agent, and
- •to make fun of the day of judgment

seem to all intents and purposes atheistic, i.e. subversive of *all* religion. And every attentive reader can clearly discover those to be his principles, although it isn't always easy to fix

a determinate sense on such a loose and incoherent writer. There seems to be a certain way of writing—whether good or bad, tinsel or sterling, sense or nonsense—that is suited to the size of understanding that qualifies its owners for the minute philosophy, and impresses and dazzles those clever men who are led by it, they don't know how and they don't know where to. The atheist with the best chance of spreading his principles is the one who gilds them and insinuates them and at the same time disclaims them. He may in the cause of virtue and natural religion acknowledge the strongest traces of wisdom and power throughout the structure of the universe; but what good is *that* if this wisdom isn't employed to observe our actions and the power isn't used to reward or punish them, i.e. if we don't believe •that we are accountable or •that God is our judge?

v4. Everything that is said ·by deists· about

- •a vital principle, or order, harmony, and proportion,
- •the natural rightness and fitness of things,
- •taste and enthusiasm,

can hang together and be supported without

- •any religion, even natural religion,
- •any notion of law or duty,
- •any belief in a lord or judge, or
- •any religious sense of a God.

Contemplating the ideas of beauty, virtue, order, and fitness is one thing; a sense of religion is another. So long as we admit no source of good actions but natural affection, no reward but natural consequences; so long as we apprehend no judgment, harbour no fears, and cherish no hopes of a future state, but laugh at all these things with the author of the *Characteristics* [Shaftesbury] and those he admires as the liberal and polished part of mankind, how can we be said to be *religious* in any sense? What is here that an atheist can't provide for in his account in as well as a theist? On this view of things, couldn't •fate or •nature serve the same moral purpose as a •deity? And isn't this what all those charming pretences ultimately add up to?

v5. Atheistic men who accept no principles of any religion, natural or revealed, are increasing in number, including people of high rank in society; this has long since been explicitly acknowledged by this same plausible pretender to deism and enthusiasm—who'll be agreed to be a good judge!. . . .

v6. That atheistic principles have taken deeper root, and are further spread, than most people are apt to imagine, will be obvious to anyone who considers that •pantheism, materialism, and fatalism are nothing but slightly disguised atheism; that •the notions of Hobbes, Spinoza, Leibniz and Bayle are relished and applauded; that •just as those who deny the freedom and immortality of the soul are in effect denying its existence, so also those who deny that God is an observer, judge, and rewarder of human actions are in effect denying his existence; and that •the course of arguing pursued by infidels leads to atheism as well as infidelity. . . .

If •I see it in their writings, if •they admit it in their conversation, if •their ideas imply it, if •their goals require them to suppose it, if •their leading author has claimed to *demonstrate* atheism but thought fit to conceal his demonstration from the public, if •this was known in their clubs and yet that author had followers and was represented to the world as believing in natural religion—if these things are so (and I know them to be so), surely what the supporters of their schemes want to tone down is what others have a duty to display and refute.

v7. To men of plain sense and common understanding the characters of divinity are large and legible throughout the whole creation; but there are others whom we have to

convert, adversaries we have to oppose—men committed to false systems and proof against the common arguments, who must be dealt with on a different basis. Conceited, metaphysical, disputing men must be paid in another coin; we must show that truth and reason in all shapes are equally against them. . . .

v8. Meanwhile this much is evident: good men who don't care to employ their thoughts on this *Theory of Vision* have no reason to find fault. They are just where they were, in full possession of all the other arguments for a God, none of which are weakened by this one. As for those who take the trouble to examine and consider this subject, I hope they'll be pleased to find, at a time when so many schemes of atheism are restored or invented, a new and unique argument in proof of the immediate care and providence of a God who present to our minds and directs our actions. These considerations convince me that I can't employ myself more usefully than in contributing to awaken and possess men with a thorough sense of the Deity inspecting, concerning, and interesting itself in human actions and affairs, so I hope it won't be disagreeable to you [he is addressing the critic] if for this purpose I make my appeal to reason from your remarks on what I have written about vision. Men who differ about the means may yet agree about the goal, both with open honesty and love of truth.

C. Reply to the critic: preliminaries

[The next ten paragraphs give a beginner's lesson, for the critic, who clearly needed it! It is included here, as being of some general interest.]

v9. By a 'sensible object' I mean something that is properly perceived by sense. Things *properly* perceived by sense are *immediately* perceived. There may also be other things *suggested* to the mind by means of those proper and immediate objects; things suggested in this way are not objects of that sense, because they are really only objects of the imagination that originally belonged to some other sense or faculty. Thus, sounds are the proper objects of hearing, being properly and immediately perceived by that sense and by no other. By the mediation of sounds or words, other things can be suggested to the mind, but those things aren't thought of as objects of hearing.

v10. The objects of each sense, though truly or strictly perceived only by that sense, can be suggested to the imagination by some other sense. So the objects of all the senses can become objects of imagination, a faculty that represents all sensible things. A colour, which is truly perceived by sight alone, may upon hearing the words 'blue' or 'red' be apprehended by the imagination. It is in a primary and unique manner an object of sight; in a secondary manner it is an object of imagination; but it can't properly be supposed to be an object of hearing.

v11. The objects of sense, being things immediately perceived, are otherwise called 'ideas'. The cause of these ideas, i.e. the power of producing them, is not the object of sense because it isn't itself perceived but only inferred by reason from its effects—namely the objects or ideas that *are* perceived by sense. From our ideas of sense we are entitled to make inferences to power, cause, agent. But we're not to infer that our ideas are *like* this power, cause, or active being. On the contrary, it seems evident that the only thing an idea can be like is another idea, and that our ideas or immediate objects of sense don't include anything involving power, causality, or agency.

v12. It follows that the power or cause of ideas is an object not of sense but of reason. Our knowledge of the cause is measured by the effect; of the power, by our idea. We have

nothing to say about the absolute nature of external causes or powers; they aren't objects of our sense or perception. So the only definite intelligible sense for the phrase 'sensible object' is as referring not to •the absolutely existing external cause or power but to •the ideas themselves produced by it.

v13. When two ideas are observed to be inter-connected, the man in the street sees this as involving the relation of

•cause to effect,

whereas in strict and philosophic truth they are only related as

•sign to thing signified.

We know our ideas, so we know that one idea can't be the cause of another. We know that our ideas of sense are not the causes of themselves. We know also that *we* don't cause them. Hence we know they must have some efficient cause distinct from any ideas and distinct from us.

v14. My purpose in treating vision was to consider

•the effects and appearances,

•the objects perceived by my senses,

•the ideas of sight as connected with those of touch;

to inquire how one idea comes to suggest another belonging to a different sense, how things visible suggest things tangible, how present things suggest distant and future things, whether by likeness, by necessary connection, by geometrical inference, or by arbitrary institution [= 'or through systems set up by men'].

v15. It has indeed been a prevailing opinion—an undoubted principle—among mathematicians and philosophers that there are certain ideas common to both senses; from which arose the distinction between primary and secondary qualities. But I think I have demonstrated that there is no such thing as a *common object*, an idea or kind of idea perceived both by sight and touch.

v16, To talk about the nature of vision with due exactness, the first thing needed is precision in what we say about our own ideas:

•to distinguish where there is a difference;

•to call things by their right names;

•to define terms, and not confuse ourselves and others by using them ambiguously.

Failure in those respects has often produced mistakes: talking as if one idea was the efficient cause of another; mistaking inferences of reason for perceptions of sense; confusing the power residing in something external with the proper object of sense, which is in truth no more than our own idea.

v17. When we have well understood and considered the nature of vision we may, by reasoning from that be better able to acquire some knowledge of the external unseen cause of our ideas—whether it is one or many, thinking or non-thinking, active or inert, body or spirit. But the most promising way to get an intelligible theory of vision in the first place, and to learn its true principles, is *not* by attending to unknown substances, external causes, agents or powers; and *not* by drawing conclusions about things that are obscure, unperceived, and altogether unknown—or by drawing conclusions *from* such things.

v18. . . . .It follows that if someone is planning to treat of the nature of vision it would be wrong if instead of attending to visible ideas he defined the object of sight to be that obscure cause, that invisible power or agent, which produced visible ideas in our minds. Such a cause or power doesn't seem to be the object of the visual sense or of the science of vision, because anything we know about it we know only from its effects. I now proceed to consider the principles laid down in your letter, which I shall take in order you gave them.

D. Reply to the critic

[Berkeley now devotes sixteen paragraphs to picking apart the critic's letter. The letter is so bad that Berkeley's patient dealings with it are neither instructive nor interesting to the rest of us. Only the final two paragraphs are given here.]

v33. We impose not only on others but often on ourselves when we use terms in an unsteady or ambiguous way. One would imagine that an 'object' is something that is perceived; and when that word is used in a different sense [as it is by the critic], I'm at a loss for its meaning and consequently can't understand any arguments or conclusions in which it occurs. My treatise on vision may be difficult for a casual reader, perhaps through •some inaccuracy [see Glossary] in my writing and also •the special nature of the subject, which isn't always easy to explain or to conceive. But to anyone who attends properly and makes my words stimulus to his own thinking, I think the whole work will be very intelligible, and when it is rightly understood I hardly doubt that it will be assented to. One thing at least I can affirm: if I am mistaken, I can't blame that on haste or carelessness, because I have taken true pains and much thought about it.

v34. If you, Sir, had thought it worthwhile to deal with the subject in more detail, to point out individual passages in my treatise, to answer any of my objections to currently accepted notions, to refute any of my arguments on behalf of mine, or made a particular application of your own—then I might well have profited by your reflections. But it seems to me that either we have been considering different things, or we have been considering the same things in such different views that neither can cast any light on the other. But I shall take this opportunity to make a review of my theory, in order to make it more easy and clear; especially because in all my work on this subject it has become familiar to me, and in expounding things that are familiar to ourselves we're too apt to think them familiar to others.

E. A review of the theory

v35. It seemed proper, if not unavoidable, to begin in the usual style of writers on optics by admitting as true various things that are not strictly true but only accepted by the vulgar [see Glossary] and regarded as true. There has been a long and close connection in our minds between the ideas of sight and of touch. So they are considered as one thing, a prejudice which fits well enough with the purpose of life, and language is also fitted to this prejudice. The work of science and speculation [see Glossary] is to unravel our prejudices and mistakes,

- •untwisting the closest connections,
- •distinguishing things that are different,
- •giving us distinct views instead of confused or perplexed ones,
- •gradually correcting our judgment, and reducing it to a philosophical exactness.

But this takes time and is done gradually, so that it is extremely difficult—if not impossible—to escape the snares of everyday language and avoid being betrayed by it into saying things that aren't strictly true or even consistent. This makes thought and candour more especially necessary in the reader. Because language is fitted to men's •prenotions [see Glossary] and •everyday doings, it is difficult to use it to express the precise truth of things, which is so distant from those doings and so contrary to our prenotions.

v36. In the design of vision as of other things, the wisdom of providence seems to have had a concern for man's operations rather than his theoretical understanding. The very features that are so admirably fitted to practical convenience often

perplex the understanding. These immediate suggestions and constant connections are useful to direct our actions; but distinguishing things that get run together is no less necessary for speculation and knowledge of truth.

v37. The knowledge of these connections, relations, and differences of visible things and tangible things—their nature, force, and significance—has not been duly considered by previous writers on optics, and seems to have been the great *desideratum* in that science, which has been confused and imperfect because of the lack of it. So the understanding of vision has needed

- a treatise of this philosophical kind

at least as much as it has needed

- the physical consideration of the eye, nerve, coats, humours, refractions, bodily nature, and motion of light; or
- the geometrical application of lines and angles for practise or theory, in dioptric glasses and mirrors, for computing and reducing to some rule and measure our judgments so far as they are proportional to the objects of geometry.

For a complete theory of optics, vision should be considered in all these three ways.

v38. In developing my theory of vision I followed a certain known method in which men often arrive at truth by starting from false and popular suppositions. There is also a way of delivering science or truth that has already been found, in which the order is reversed: we start from the conclusions that we reached by the other method. I shall therefore now begin with the conclusion that **vision is the language of the Author of nature**, deducing from that theorems and solutions of phenomena, and explaining the nature of visible things and the visual faculty.

v39. Ideas that are observed to be connected with other ideas come to be considered as *signs* by means of which things that aren't actually perceived by sense are signified or suggested to the imagination, whose objects they are and which alone perceives them. And just as sounds suggest other things, so characters—·e.g. letters of the alphabet·—suggest other sounds; and quite generally *all* signs suggest the things signified; there's no idea that can't offer to the mind another idea that has frequently been joined with it. In certain cases a sign may suggest its correlate as an image [= 'as something like it'], in others as an effect, in others as a cause. But even when there's no such similarity or causality, and no necessary connection whatsoever,

- one thing can suggest or signify another merely through their coexistence; and
- one idea can suggest or signify another merely through their being perceived together.

In these cases, the connection between them is arbitrary [see Glossary], but all that's needed for this 'suggest or signify' relation is that there *be* this connection—·it doesn't matter that its source is·.

v40. A great number of arbitrary signs, varied and appropriate, constitute a language. If the arbitrary connections are instituted by men it is an **artificial language**; if by the Author of nature it is a **natural language**. There's no limit to the different kinds of light and sound there can be, enabling each to supply an endless variety of signs; which is why each has been employed to form languages—one by the arbitrary appointment of mankind, the other by that of God himself. A connection established by the Author of nature in the ordinary course of things can surely be called 'natural', as that made by men will be named 'artificial'; but they are equally arbitrary. There is no more similarity or necessary connection between •tangible things and •the modifications

of light than there is in ·artificial· languages between •the meanings and •the sounds. When you understand how various tones and articulations of voice are connected with their respective meanings, *that* is also how the various modes of light are connected with their respective correlates—i.e. how the ideas of sight are connected with the ideas of touch.

v41. As for light and its various modes or colours, all thinking men are agreed that they are ideas only of sight; they aren't ideas of touch and they aren't *like* any ideas that are perceived by that sense. But herein lies the mistake ·that even thinking men make·, of supposing that there are also other ideas that are common to both senses, being equally perceived by sight and by touch, such as

- •extension,
- •size,
- •shape, and
- •motion.

But I have proved in my *New Theory of Vision* that there are in reality no such common ideas, and that the objects of sight marked by those ·four· words are entirely different and dissimilar from whatever is the object of touch and marked by the same names. [He adds some scolding words addressed to the writer of the critical letter.]

v42. To perceive is one thing; to judge is another. Similarly, to be suggested is one thing and to be inferred is another. Things are suggested and perceived by sense. We make judgments and inferences by the understanding. What we immediately and properly perceive by sight is its primary object, light and colours. What is suggested, or perceived by mediation of these, are tangible ideas, which may be considered as secondary and improper objects of sight. We infer causes from effects, effects from causes, and properties from one another when they are necessarily connected. But how does it happen that we apprehend by the ideas of sight certain other ideas that

- •don't resemble them,
- •don't cause them,
- •aren't caused by them, and
- •have no necessary connection with them?

The solution of this problem, in its full extent, takes in the whole *New Theory of Vision*. This way of stating the situation puts it on a new footing, and throws a different light on it from all preceding theories.

v43. **(i)** To explain how the mind or soul of man simply sees is one thing, and belongs to philosophy. **(ii)** To consider particles as moving in certain lines, rays of light as refracted or reflected or crossing and making angles, is quite another thing and belongs to geometry. **(iii)** To account for the visual sense by the mechanism of the eye is a third thing, which belongs to anatomy and experiments. Of these, **(ii)** and **(iii)** are of use in practice, to make good the defects of sight and remedy its illnesses in accordance with the natural laws contained in this world of ours. But **(i)** is what makes us understand the true nature of vision considered as a faculty of the soul. And the whole of this, as I have already said, comes down to this simple question:

> How does it happen that a set of ideas that are altogether different from tangible ideas nevertheless suggest them to us, when there's no necessary connection between them?

To which the proper answer is that this is done in virtue of an arbitrary connection set up by the Author of nature.

v44. The proper and immediate object of vision is light in all its modes and variations—

- •colours that vary in kind, in degree, in quantity;
- •some colours lively and others faint;

•more of some colours and less of others;
•colours that vary in their boundaries or limits;
•colours that vary in their order and situation.

A blind man when first made to see might perceive these objects in which there is an endless variety; but he wouldn't perceive—and wouldn't even imagine—resemblance or connection between these •visible objects and •the ones perceived by touch. Lights, shades, and colours would suggest nothing to him about bodies, hard or soft, rough or smooth; nor would their quantities, limits, or order suggest to him geometrical figures, or extension, or situation, which they must do according to the generally accepted supposition that these objects are common to sight and touch.

v45. All the various sorts, combinations, quantities, degrees, and dispositions of light and colours would when first perceived be considered in themselves only as a new set of sensations and ideas. To a man born blind they would be wholly new and unknown, so he wouldn't at first sight give them the names of things he already knew and perceived by his sense touch. But after some experience he would perceive their connection with tangible things, and would therefore •consider them as signs, and •give them (as is usual in other cases) the same names as the things signified.

v46. More and less, greater and smaller, extent, proportion, interval are all found in time as in space; but it doesn't follow that these are homogeneous quantities. Similarly, from the attribution of common names across two senses it doesn't follow that that visible ideas are homogeneous with those of touch. It's true that terms denoting tangible extension, figure, location, motion, and the like are also applied to denote the quantity, relation, and order of the ideas of sight, but this comes only from experience and analogy. There is a higher and lower in the notes of music; men speak in a high or a low key. This is obviously no more than metaphor or analogy. Likewise, to express the order of visible ideas the words 'situation', 'high' and 'low', 'up' and 'down' are used, and their meaning when so used is analogical.

v47. But in the case of vision we don't rest on a supposed analogy between different and heterogeneous natures. We suppose an identity of nature, i.e. one and the same object common to both senses. What leads us into this mistake is the following. The various motions of the head—upward and downward, to the right and to the left—are **accompanied by** a diversity in the visible ideas ·that are perceived·; so those motions and situations of the head, which in fact are tangible, confer their own attributes and labels on the visible ideas they are connected with. Thus visible ideas come to be termed 'high' and 'low', 'right' and 'left', and to be marked by other names indicating the modes of position. Before the **experienced connection** these words wouldn't have been attributed to visual ideas, at least not in the primary and literal sense.

v48. This shows us how the mind is enabled to discern by sight the situation of distant objects. Those immediate ·visual· objects whose mutual relations and order come to be expressed by words concerning tangible place because they are connected with the real objects of touch, what we say and judge concerning the one we say and judge concerning the other, transferring our thought. . . .from the signs to the things signified. It is like what happens when we are hearing or reading a discourse: we overlook the sounds or letters, and instantly pass on to the meaning.

v49. But there is a great difficulty concerning the orientation of objects, as perceived by sight. The pencils of light-rays coming from any luminous object, after passing through the pupil and being refracted by the lens, delineate inverted

pictures in the retina—pictures that are taken to be the immediate proper objects of sight. So how does it come about that the objects the pictures are *of* seem erect [see Glossary] and in their natural orientation when the pictures are inverted? The objects are perceived only by their pictures, so when the pictures are inverted it should follow that the objects seem to be inverted too. This difficulty is inexplicable on all the generally accepted principles and theories, but it has a most natural solution if we bear in mind that

- •the retina,
- •lens,
- •pupil, and
- •light-rays crossing when refracted ·by the lens· and reunited in distinct images similar to the external objects

are all things of an entirely tangible nature.

v50. The so-called pictures formed by the packets of rays after their crossing and refraction are not so truly pictures as images, or figures, or projections—tangible figures projected by tangible rays on a tangible retina, which are so far from being the proper objects of sight that they are not perceived by sight at all, being by nature altogether of the tangible kind and apprehended only by the imagination when we suppose them actually taken in by the eye. These tangible images on the retina have some resemblance to the tangible objects from which the rays are sent, and relative to those objects they are indeed inverted. But they are not and cannot be the proper immediate objects of sight. The writers of optics vulgarly suppose that they are; but this is a vulgar error, and when it is removed the difficulty I have mentioned is removed with it; it admits a just and full solution, being shown to arise from a mistake.

v51. So 'pictures' can be understood in a twofold sense, i.e. as referring to two quite dissimilar and heterogeneous kinds of item:

- •**pictures** properly so-called, consisting of light, shade, and colours;
- •items that are not properly pictures, but **images** projected on the retina.

Pictures are visible, and are the special objects of sight. Images are so far from this that a man blind from birth can perfectly imagine, understand, and comprehend them. And perhaps I should point out here that shapes and motions that we can't actually feel but only imagine can nevertheless be regarded as *tangible* ideas because •they are of the same kind as objects of touch and •the imagination drew them from that sense.

v52. Throughout this whole affair the mind •is wonderfully apt to be deluded by the sudden suggestions of fancy [= 'imagination'], which it confuses with the perceptions of sense, and •is prone to mistake a close and habitual connection between things that are utterly unalike for an identity of nature. The solution of this knot about inverted images seems to be the principal point in the whole optic theory; the hardest to comprehend, perhaps, but the most deserving of our attention, and when rightly understood the surest way to lead the mind into a thorough knowledge of the true nature of vision.

v53. Although these inverted **images** on the retina are altogether different in kind from the proper objects of sight, i.e. **pictures**, they can nevertheless be proportional to them. Indeed, the most different and heterogeneous things in nature can have analogy and be proportional each to other. For any given distance an image should be large or small in proportion as the radiating surface is large or small; so that

the picture is large or small in proportion to the size of the radiating surface, i.e. the tangible real size of the thing; but it doesn't follow that in common sight we perceive or judge concerning those tangible real sizes simply by the visible sizes of the pictures; because in common sight the distance is not given, tangible objects being placed at various distances; and the diameters of the images to which the pictures are proportional are inversely proportional to those distances, which •are not immediately perceived by sight. And even if they •were, it is certain that the mind does not compute the sizes of tangible objects of sight by means of the inverse proportion of the distances, and the direct proportion of the pictures. Your own experience will tell you that no such inference or reasoning accompanies the common act of seeing!

v54. To know how we perceive or apprehend by sight the real size of tangible objects, we must consider the properties of the immediate visible objects, namely the pictures. Some of these pictures are more lively, others more faint. Some are higher, others are lower in their own order or location; and although *their* order is quite distinct and altogether different from the order of tangible objects, it has a relation and connection with it and thus comes to be signified by the same terms—'high', 'low', and so forth. Now, by the size of the pictures, their faintness and their situation, we perceive the size of tangible objects. . . .

v55. To explain this point further, let us suppose. . . . [and then he launches into something that is quite straightforward, but his presentation of it gets off to a bad start. The basic idea is as follows. You are standing looking out at a landscape which stretches horizontally from you to the horizon. (Berkeley will be referring to this as 'the horizontal plane'.) Suppose you are looking at this through a vertical transparent plane that is close to your eye and divided into small equal squares. What you see through the lowest squares of the vertical plane will be the bits of landscape closest to you; as your eye moves up to higher squares, you are looking at things that are further away; and because they are further away they will, Berkeley says:] appear vastly bigger than those seen through the lower squares, though occupying as many or even more of those equal squares in the vertical transparent plane.

v56. Rays coming from every point of each item in the horizontal plane, reaching the eye through the vertical transparent plane, exhibit to the imagination an image of the horizontal plane and all its parts, delineated in the transparent plane and occupying its squares up to a certain height marked out by a straight line reaching from the eye to the horizon—I call this the 'reflection'. Every square contains an image of some corresponding part of the horizontal plane. We can call this entire image the 'horizontal image', and the picture corresponding to it the 'horizontal picture'. In this representation the upper images suggest much greater sizes than the lower ones; and these upper images are also fainter. So •faintness and •situation co-operate with •visible size to suggest tangible size. For the truth of all this I appeal to the experience and attention of the reader who will add his own reflection to what I have written.

v57. It is true this transparent plane and the images supposed to be projected onto it are of a purely tangible nature. But then there are **pictures** corresponding to those **images**; those pictures have an order among themselves corresponding to the order among the images, and they (the pictures) are said to be 'higher' and 'lower' in terms of *their* order. These pictures also are more or less faint; and it's really they and not the images that are the visible

objects. So what I have said about the images must be thought of as said about the corresponding pictures, whose •faintness, •situation, and •size—all immediately perceived by sight—concur in suggesting the size of tangible objects, doing this only by an experienced connection.

v58. You might think that the size of the picture has a necessary connection with the size of the tangible object, or. . . .at least to be the sole means of suggesting it. But this is so far from being true that of two equally large visible pictures, one that is fainter and higher will suggest a tangible size a hundred times greater than the other suggests. . . .

v59. As well as the size, situation, and faintness of the pictures, our prenotions [see Glossary] concerning the kind, size, shape, and nature of things also contribute to the suggestion of tangible sizes. A picture in the shape of a •man will suggest a smaller size than it would in the shape of a •tower, even if size, faintness and situation were the same in both cases.

v60. Where the kind, faintness, and situation of the horizontal pictures are given, the suggested tangible size will be proportional to the visible size. . . . As an object gradually ascends from the horizon towards being overhead, our judgment concerning its tangible size gradually comes to depend more entirely on its visible size. The faintness is lessened as the quantity of intervening air and vapours is reduced. And as the object rises in the sky the eye of the spectator is also raised above the horizon, so that •faintness and •horizontal situation [see Glossary] cease to influence the suggestion of tangible size, and this suggestion (or judgment) moves towards being the effect solely of the visible size and the prenotions. But obviously if faintness, situation, and visible size concur to enlarge an idea, as some of those things are gradually omitted the idea will be gradually lessened. That is what happens with the moon, when it rises above the horizon and gradually lessens its apparent size as its altitude increases.

v61. It is natural for mathematicians to regard the visual angle and the apparent size as the sole or principal means of our apprehending the tangible size of objects. But what I have been saying makes it clear that our apprehension is much influenced by other things that have no similarity or necessary connection with tangible size.

v62. And these means that suggest tangible things' size also suggest their distance; and in the same way, i.e. by experience alone and not by any necessary connection or geometrical inference. So the true medium by which we apprehend tangible distances are

- •faintness/vividness,
- •upper/lower situations,
- •the visible size of the pictures, and
- •our prenotions concerning tangible objects' shape and kind.

This. . . .will be evident to anyone who bears in mind that visual angles etc. are not perceived by sight or by experience of any other sense. Whereas it is certain that the pictures—with their sizes, situations, and degrees of faintness—*are* proper objects of sight, and indeed the only ones; so that whatever is perceived by sight must be perceived by means of them. And this perception is partly produced by the prenotions that are gained by experience of touch or sight and touch conjointly.

v63. We need only to reflect on what we see to be assured that the smaller the pictures are, the fainter they are, and the higher they are (provided they are beneath the horizontal line [see **v56**] or its picture), the greater the distance will seem to be. . . . Obviously none of these things has in

its own nature any necessary connection with the various distances. It will also appear, upon a little reflection, that various circumstances of shape, colour, and kind influence our judgments or apprehensions of distance; all of which follows from our prenotions, which are merely the effect of experience.

v64. It is natural for mathematicians to reduce things to the rule and measure of geometry, which makes them apt to suppose that apparent size has a greater share than it really does in forming our judgments concerning the distance of things from the eye. No doubt it would be an easy and ready rule to determine the apparent place of an object if we could say that *its distance is inversely proportional to the diameter of its apparent size*, and judge by this alone without bringing in any other circumstance. But this wouldn't be a true rule, because in certain cases of vision by refracted or reflected light the lessening of the apparent size is accompanied by an apparent *lessening* of the distance [see **31**].

v65. To satisfy us further that our judgments or apprehensions of size or distance don't depend on the apparent size and nothing else, we need only ask the first painter we meet. He, considering nature rather than geometry, and knows well that several other circumstances contribute also; and . . . .we need only observe pieces of perspective and landscapes to be able to judge concerning this.

v66. When the object is so near that the distance between the pupils is a significant proportion of the distance to the object, the eyes turn or strain inward so as to unite the two optic axes; and the sensation that accompanies this is to be considered as one means of our perceiving distance. Admittedly this sensation belongs properly to the sense of feeling; but because it has a regular connection with distinct vision of near distance (the shorter the distance the greater the sensation), it's natural that it should become a sign of distance and suggest it to the mind. That it actually does so can be seen from the known experiment of hanging up a ring edge-wise to the eyes, and then trying with one eye shut to insert a stick into it by a lateral motion. This turns out to be harder to do than with both eyes open, because with one eye closed one doesn't have this means of judging by the sensation that accompanies the nearer meeting or crossing of the two optic axes.

v67. The mind of man is pleased to observe in nature rules or methods that are simple, uniform, general, and reducible to mathematics, as a means of rendering its knowledge at once easy and extensive. But we mustn't •let our liking for uniformities or analogies take us away from truth and fact, or •imagine that the apparent place or distance of an object must be suggested by the same means in all cases. Indeed it squares with the purpose of vision to suppose that the mind has certain additional means or helps for judging more accurately the distance from us of the objects that are the nearest, and that consequently most concern us.

v68. When the distance is so small that the breadth of the pupil bears a considerable proportion to it, the object appears confused. This confusion is constantly observed in looking at such near objects, and it increases as the object comes closer, so this is a means of suggesting the place of an object. One idea is qualified to suggest another merely by being often perceived with it. And if one increases either directly or inversely in proportion to increases of the other, various degrees of the former will suggest various degrees of the latter by virtue of such habitual connection and proportional increase or diminution. Thus the gradual changing confusedness of an object may contribute to our apprehension of closeness when we look only with one eye. And this alone

may explain Dr Barrow's difficulty over the case he presented in **29**, because that involved only one visible point. When several points are considered, i.e. the image is an extended surface, its increasing confusedness will co-operate with the increasing size to diminish its ·apparent· distance, which will be inversely proportional to both.

v69. Our experience in vision comes through the naked eye. We apprehend or judge from this same experience when we look through glasses. But we can't in all cases conclude from the one to the other; because certain circumstances added or excluded by the use of glasses may sometimes alter our judgments, particularly as they depend upon prenotions.

v70. What I have written here may serve as a commentary on my *Essay towards a New Theory of Vision*; and I believe it will make it plain to thinking men. At a time when we hear so much about thinking and reasoning, it may seem needless to remark how useful and necessary it is to *think* if one is to

- •obtain just and accurate notions,
- •distinguish things that are different,
- •speak consistently,
- •know even one's own meaning.

And yet for lack of thinking we may see many, even in these days, run into perpetual blunders and paralogisms. So no friend to truth and knowledge would restrain or discourage thinking. There are, it must be admitted, certain general maxims—the result of ages and of the collected sense of thinking persons—which serve instead of thinking as a guide or rule for the multitude; because the multitude don't care to think for themselves, it is appropriate for them to be led by the thoughts of others. But those who depart from the public rule and set up for themselves,. . . .if *they* don't think, what will men think of them? I don't claim to have made any discoveries that couldn't have been made by someone else who thought it worth the trouble; to which I add that without trouble and thought no man will ever understand the true nature of vision, or understand what I have written concerning it.

v71. Before I conclude, it may not be amiss to add this extract from the *Philosophical Transactions* concerning a man blind from his infancy and then as an adult made to see:

> 'When he first saw, he was so far from making any judgment about distances that he thought all objects whatever touched his eyes (as he expressed it) as what he felt did his skin, and thought no objects so agreeable as those which were smooth and regular, though he could form no judgment of their shape, or guess what it was in any object that was pleasing to him. He didn't know the shape of anything, and couldn't tell one thing from another, however different in shape or size. But when he was told what things were, whose shape he before knew from feeling, he would carefully observe them so as to know them again; but having too many objects to learn at once, he forgot many of them; and (as he said) at first he learned to know and then forgot a thousand things in a day. Several weeks after the operation that restored his sight, being deceived by pictures, he asked which was the lying sense, feeling or seeing? He was never able to *imagine* any lines beyond the bounds he saw. The room he was in, he said, he knew to be part of the house, but he couldn't conceive that the whole house could *look* bigger. He said that every new object was a new delight, and the pleasure was so great that he was at a loss for words to express it.'

Thus, by fact and experiment, those points of the theory that seem the most remote from common apprehension were considerably confirmed many years after I had been led to the discovery of them by reasoning.