Thus. as in fig 25, suppose two eyes looking at a single object, placed at *a*. *b*. or *c*. If the image of the point *b* fall in one eye on 6 and in the other on 7, the point 6 of the one retina being correspondent with the point 6 of the other retina, the distance of the two images seen will be equal to the distance between 6 and 7. Again, if images of *a* fall on 5 and 5, it will be seen single. Further, if the image of *b* fall on the left eye at 6 and on the right at 4, as these two points do not correspond, it will appear double. And so with regard to the other retinal points indicated by the numbers.

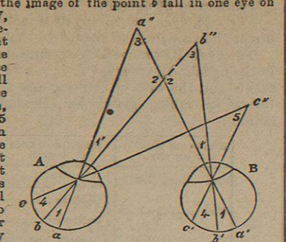

Fig. 26.—Diagram to illustrate the theory of corresponding retinal points. (Müller.)

The phenomena may also be studied with the aid of fig. 26. Any object at a'', or at b'', or at c'', will be seen simply by the two eyes A and B, as the images fall on corresponding points in the retinæ, namely, aa', bb', and cc'. It will be readily seen that, if the eye B were displaced, the images would not fall on corresponding points, and consequently two would be seen.

The name *horopter* has been given to a line connecting those points in the visual field which form their image on corresponding points of the retina The older physiologists first gave this name to "a straight line or plane, passing through the point of convergence of the axes of the eyes or the point to which the eyes are directed;" but Vieth and Müller showed that it cannot be a straight line or plane, but must have a circular form.

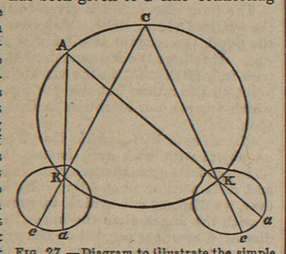

Fig. 27.—Diagram to illustrate the simple horopter.

Thus if the points *a*, *b*, *c* in fig. 26 correspond to the points a', b', c', the angles 4 and 1 in 4 and 1 in the other. Then $a\,b$ being equal to $a'\,b'$. the angle 1 in eye A equal to angle 1 in eye B, the angles 1′ and 1′ will be equal. Since the angles 2 and 2 are equal, the angles 3 and 3 must also be equal. In the same way, the angle 5 is equal to angle 5. For $b\,c = b'\,c'$, and angle 4 = angle 4. Thus the angles 3, 3, and 5 are equal, and $a''\,b''\,c''$ cannot lie in a straight line, for it is the property of a circle only that angles erected on the same chord, and reaching the periphery have at the periphery equal angles. (Muller's *Physiology*, vol. ii. p. 1195.) A line joining a'', b'', and c'' is therefore the simple horopter, and its form is illustrated by fig. 27. It is a circle, of which the chord is formed by the distance between the points of decussation of the rays of light in the eye (K A C K in fig 27). Its size is determined by the position of the two eyes, and the point toward which their axes converge. This is illustrated by fig 28. Thus if $a\,b$ be the distance of the eyes from each other, the circle *c* is the horopter for the object marked 1. the circle *d* for 2, and the circle *e* for 3.

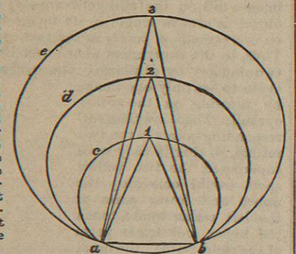

Fig. 28.—Diagram illustrating the simple horopter of objects at different distances from the eyes.

An object which is not found in the horopter, or, in other words, does not form an image on corresponding points of the retinæ, is seen double. When the eyeballs are so acted upon by their muscles as to secure images on non-corresponding points, and consequently double vision, the condition is termed *strabismus*, or squinting, of which there are several varieties treated of in works on ophthalmic surgery. It is important to observe that in the fusion of double images we must assume, not only the correctness of the theory of corresponding points of the retina, but also that there are corresponding points in the brain, at the central ends of the optic fibres. Such fusion of images may occur without consciousness,—at all events it is possible to imagine that the cerebral effect (except as regards consciousness) would be the same when a single object was placed before the two eyes, in the proper position, whether the individual were conscious or not. On the other hand, as we are habitually conscious of a single image, there is a psychical tendency to fuse double images when they are not too dissimilar.

(3.) *Binocular Perception of Colour.*—This may be studied as follows. Take two No. 3 eye-pieces of a Hartnack's microscope, or two eye pieces of the same optical value from any microscope, placee on in front of each eye, direct them to a clear window in daylight, keep them parallel, and two luminous fields will be seen, one corresponding to each eye. Then converge the two eye-pieces, until the two luminous circles cross, and the central part, like a bi-convex lens, will appear clear and bright, while the outer segments will be much less intense, and may appear even of a dim grey colour. Here, evidently, the sensation is due to a fusion of impressions in the brain. With a similar arrangement, blue light may be admitted by the one eye-piece and red by the other, and on the convergence of the two, a resultant colour, purple, will be observed. This may be termed the binocular vision of colours. It is remarkable that by a mental effort this sensation of a compound colour may be decomposed into its constituents, so that one eye will again see blue and the other red.

6. The Psychical Relations of Visual Perceptions.

(1.) *General Characters of Visual Perceptions.*—All visual perceptions, if they last for a sufficient length of time, appear to be external to ourselves, erect, localized in a position in space, and more or less continuous.

(*a*) *Visual Sensations are referred to the Exterior.*—This appears to be due, to a large extent, to habit. Those who have been born blind, on obtaining eye-sight by an operation, have imagined objects to be in close proximity to the eye, and have not had the distinct sense of exteriority which most individuals possess. Slowly, and by a process of education, in which the sense of touch played an important part, they gained the knowledge of the external relations of objects. Again, phosgenes, when first produced, appear to be in the eye, but when conscious of them, by an effort of imagination, we may transport them into space, although they never appear very far off.

(*b*) *Visual Sensations are referred to Erect Objects.*—Although the images of objects are *inverted* on the retina we see them erect. The explanation of the effect is that we are conscious not of the image on the retina, but of the luminous object from which the rays proceed, and we refer the sensation in the *direction* of these rays. Again, in running the eye over the object, say a tall pole, from base to apex, we are not conscious of the different images on the retina, but of the muscular movements necessary to bring the parts successively on the yellow spot.

(*c*) *Visual Sensations are referred to a Position in Space.*—The localization of a luminous point in space can only be determined by observing its relations to other luminous points with a given position of the head and of the eye. For example, in a perfectly dark room, if we look at a single luminous point, we cannot fix its exact position in space, but we may get some information of a vague character by moving the head or the eye. If, however, a second luminous point appears in the darkness, we can tell whether it is nearer or farther distant, above or below the first. So with regard to other luminous points we observe their reciprocal relations, and thus we localize a number of visual impressions. There are three principal directions in space—(1) the *transverse* (breadth), the *vertical* (height), and the *sagittal* (depth). Luminous points may be localized either in the transverse or vertical directions. Here we have to do simply with localization on a surface. A number of points may be observed simultaneously (as when the eye is fixed) or successively (as when the eye moves). If the movement of the eye be made rapidly, the series of impressions from different points may be fused together, and we are conscious of a *line*, the direction of which is indicated chiefly by the muscular sensations felt in following it. The case is different as regards points in the sagittal direction. We see only a single point of this line at a time; it may be a transverse series of retinal elements A, B, and each of these formed by a number of smaller elements 1, 2, 3, 4 situated in the axis of each principal element; it may be, on the other hand, the transverse line $a\,b$ situated in space and formed by a series of points in juxtaposition. Each of these points will impress a retinal element, and the result will be the perception of a transverse line; but this will not be the same for the points *c*, *d*, *e*, *f*, *g*, situated in space in a linear series, in the sagittal direction; only one of those points *c* will impress the corresponding retinal element, and we can see only *one* point at a time in the line $c\,g$. By accommodating successively, however, for the various points at different and considerable distances along the line $c\,g$, we may excite retinal elements in rapid succession. Thus, partly by the fusion of the successive impressions on the retina, and partly from the muscular sensations caused by repeated accommodations and possibly of ocular movements, we obtain a notion of *depth* in space, even with the use of only one eye. It is, however, one of the chief effects of binocular vision to give precision to the notion of space in the sagittal direction.

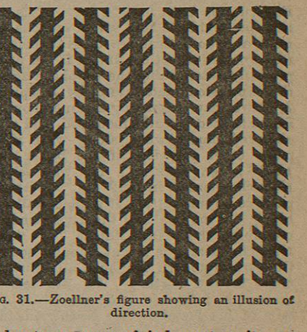

Fig. 29.—Diagram illustrating the localization of visual perceptions.

(*d*) *Visual Sensations are continuous.*—Suppose the image of a luminous line falls on the retina, it will appear as a line although it is placed on perhaps 200 cones or rods, each of which may be separately excited, so as to cause a *distinct* sensation. Again, on the same principle, the impression of a superficial surface may be regarded as a kind of *mosaic*, made up of individual portions corresponding to the rods or cones on which the image of the surface falls. But in both cases, the sensation is continuous, so that we see a line or a surface. The individual images are fused together.

(2.) *Notions derived from Visual Perceptions.*—When we look at any object, we judge of its size, the direction of its surfaces (unless it be a point), its distance from the eye, its apparent movement or fixedness, and its appearance of solidity.

(*a*) *Apparent Size.*—This, so far as regards a comparatively small object, depends on the size of the retinal image, as determined by the visual angle. With a very large object, there is an appreciation of size from the muscular sensations derived from the movements of the eyeball, as we "range" the eye over it. It is difficult to appreciate the distance separating two points between which there are other points, as contrasted with an apparently similar distance without intermediate points. For example, the distance A to B appears to be greater than from B to C, in fig. 30.

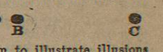

Fig. 30.—Diagram to illustrate illusions of size and distance.

(*b*) *Direction.*—As the retina is a curved surface, a long straight line, especially when seen from a distance, appears curved. In fig. 31 a curious illusion of direction, first shown by Zoellner, is depicted. If these lines be looked at somewhat obliquely, say from one corner, they will appear to converge or diverge, and the oblique lines, on each side of the vertical lines, will appear not to be exactly opposite each other. But the vertical lines are parallel, and the oblique lines are continuous across them. The effect is evidently due to an error of judgment, as it may be controlled by an intense effort, when the lines will be seen as they really are.

Fig. 31.—Zoellner's figure showing an illusion of direction.

(*c*) *Apparent Distance.*—We judge of distance, as regards large objects at a great distance from the eye—(1) from their apparent size, which depends on the dimensions of the visual angle, and (2) from the interposition of other objects between the eye and the distant object. Thus, at sea, we cannot form, without great experience, an accurate estimate of how many miles we are off the coast, and all know how difficult it is to estimate accurately the width of a river. But if objects be interposed between the eye and the distant object, say a few vessels at different distances at sea, or a boat in the river, then we have certain materials on which to form a judgment, the accuracy of which, however, even with these aids, will depend on experience. When we look at a near object, we judge of its distance chiefly by the sense of effort put forth in bringing the two lines of regard to converge upon it.

(*d*) *The Movement of a Body.*—If the eye be fixed, we judge of movement by successive portions of the retina being affected, and possibly also, by a feeling of an *absence* of muscular contractions necessary to move the eye-balls. When the eye moves, so as to "follow" the object, there is a sense of muscular effort, which is increased when, in addition we require to move the head.

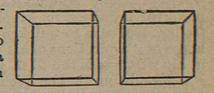
Fig. 32.—Illustrating stereoscopic vision.

(*e*) *The Apparent Solidity of an Object.*—If we look at an object, say a cube, first with the right eye and then with the left, it will be found that the two images of the object are somewhat different, as in fig. 32. If, then, by means of a stereoscope, or by holding

a card between the two eyes, and causing a slight convergence of the eyes, the two images are brought upon corresponding points of the two retinæ, the image will at once be seen in relief.

Consult regarding the physiology of the eye, as the most complete treatise on the subject, Helmholtz's *Optique Physiologique*, 1867; one of the best of the older treatises is Mackenzie *On the Eye and Vision*, 1841; in the first-mentioned treatise, a full list is given at the end of each section of all the more important works and monographs bearing on the physiology and optical arrangements of the eye, up to 1867. A very valuable bibliographical account is one recently published by J. Plateau, entitled *Bibliographie analytique des principaux phénomènes subjective de la Vision depuis les temps anciens jusqu'à la fin du XVIIIe siècle, suivie d'une bibliographie simple pour la partie écoulée du siècle actuel: extrait du tome xlii. des Mémoires de l'Académie royale des sciences, des lettres, et des beaux-arts de Belgique*, 1877. (J. G. M.)

EZEKIEL (יְחֶזְקְאֵל *i.e.*, יְחֻזַּק אֵל, God will strengthen, or אֵל יָחֹזֵק, God will prevail; Ἰεζεκιήλ; *Ezechiel*) was the son of Buzi a priest, probably of the line of Zadok, who appears to have lived in Jerusalem, and to have held a position of some prominence there. According to an ancient and not impossible interpretation of his own words (chap. i. 1), Ezekiel was born in 624 B.C. This interpretation is at least preferable to that which reckons "the thirtieth year" from a hypothetical era of Nabopolassar; but it is not free from all objection, and if it fail us we have no data for precisely determining the prophet's age. Notwithstanding the expression made use of by Josephus (παῖς ὤν, *Ant.*, x. 7, 3) we may reasonably assume, however, that he had at least attained to early manhood, and already had read and observed much, when, along with King Jehoiachin and many other prisoners of the better class (2 Kings xxiv. 12–16; Jer. xxix. 1) he was carried into exile by Nebuchadnezzar in 599 B.C. With others of his compatriots he was settled at a place called Tel-Abib ("Cornhill"), on the banks of the river Chebar, by which most probably the Nahr-Malcha or "Grand" Canal of Nebuchadnezzar is meant, though some still think of the Chaboras (modern Khabur), an affluent of the Euphrates more to the north.[1] We are left almost wholly to precarious inference and conjecture for all further details of his history. We learn incidentally, indeed, from his writings that he was a married man living in a house of his own, and that his wife died in the ninth year of his exile. But of the nature of his ordinary employments, if he had any, we are not informed. His life, as a priest whose heart was thoroughly absorbed in priestly work, could hardly fail to be tinged with sadness, condemned as it was to be spent in an "unclean land" far away from "the inheritance of the Lord." He seems to have been of a brooding temperament, and to have passed much of his time in silence and solitude. A recent writer (in the *Studien u. Kritiken* for 1877) has ingeniously suggested and endeavoured to show that he was an invalid, suffering much from some chronic nervous malady. In the fifth year of his exile (594 B.C.) he had a remarkable vision, of which he has given a very full description in the opening chapters of his book. On this occasion he was divinely called to the prophetic office. Thenceforward, for a period of at least 22 years, both orally and in writing, he continued to discharge prophetic functions at frequent if somewhat irregular intervals; and whatever may have been the force and bitterness of the opposition he originally had to face, he ultimately, as a "watchman" and acknowledged leader of public opinion, came to exercise an incalculably powerful influence in keeping alive the Jewish national feeling, and also in quickening and purifying the religious hopes and aspirations of his time. The last date mentioned in his writings is the 27th year of his exile (572 B.C.). It is not probable that he lived long after that time. Nothing authentic, however, has been handed down to us as to the time, place, or manner of his death. Several unimportant traditions may be found in the work of the Pseudo-Epiphanius, *De vit. et mort. proph.*, in the *Itinerary* of Benjamin of Tudela, and elsewhere.

In the present Massoretic canon the book of Ezekiel stands third in order among those of the so-called Nebî'îm Aharônîm (latter prophets), being preceded by those of Isaiah and Jeremiah, and followed by that of the twelve minor prophets. In the list of canonical books given in the Talmud (*Baba bathra*, 14, 2) it is the second of the four, being followed by "Isaiah" and "the twelve." Its arrangement is unusually simple, the chronological corresponding for the most part with the natural order. Its three divisions date respectively from before, during, and after the siege of Jerusalem.

1. The first 24 chapters carry the reader from the time of the prophet's consecration down to the beginning of the siege of Jerusalem, *i.e.*, from 594 to 590 B.C. They are made up of some 29 distinct oracles, all of which, with the trifling exception of xxi. 33–37 [28–32], have direct reference to the religious and political condition of Ezekiel's compatriots in Babylonia and in Palestine. First in order stands the famous "chariot" (comp. 1 Ch. xxviii. 18) vision, which has been so variously estimated, both from the æsthetic and from the theological point of view, by different critics. Rightly interpreted, as a mere description, it cannot justly be called vague or obscure, and it is hard to account for the strange stories told of the difficulties felt by the Jews in expounding it. The prophet sees in a storm-cloud coming out of the north a group of four living creatures (cherubs), each with four wings and four different faces. Together they are borne upon four wheels which are full of eyes. Resting upon their heads is a firmament, supporting a sapphire throne, whereon is seated a man-like figure, which is almost hidden in a blaze of light. Hereupon Ezekiel receives and eats the bitter-sweet roll in which are written "lamentations and mourning and woe;" he is now ready to go forth to his fellow-countrymen fearlessly declaring the truth as it is revealed to him, however unwelcome it may be. The recorded oracles that follow belong to the fifth, sixth, seventh, and ninth years of his exile. They can be understood only when viewed in connexion with the general history of that period. Soon after his accession to the throne, Zedekiah, the uncle and successor of Jehoiachin, had begun to intrigue against his suzerain the king of Babylon, and had entered into secret relations with the king of Egypt. Ezekiel, like his older contemporary Jeremiah, had insight and sagacity enough to see the unwisdom of such a policy. By various symbolical actions (iv. 1–8; iv. 9–17; v. 1–4; vi. 11; xii. 1–16; xxi. 11 [6]), and also by unequivocal words, he repeatedly declared the certainty of the doom that was impending over Jerusalem, Judah, and all the mountains of Israel; he insisted on the uselessness of any struggle against Babylon, and distinctly predicted Zedekiah's captivity, blindness, and death. In language of the severest invective he rebuked the sins and idolatries, worse than those of Sodom, which had brought this inevitable ruin upon the land and people of the Lord; at the same time he held forth the hope of ultimate restoration and final happiness for both Judah and Ephraim at the end of "forty years," under the guidance of the coming prince

[1] Bleek (*Einl.* § 221, note) is probably wrong in identifying both כְּבָר and Chaboras with the חָבוֹר of 2 Kings xvii. 6, which is most probably the Khabur, a tributary of the Tigris (Delitzsch, *Jesaja*, p. 16, note).

"whose right it is" (chaps. xi. 14–21; xvii. 22–24; xx. 40–44; xxi. 32 [27]).

2. The eight chapters which follow (xxv.–xxxii.) belong to the period which elapsed between the beginning of the siege and the announcement of the capture of Jerusalem; xxix. 17–21 is an exception, belonging to the 27th year of the prophet's exile, and perhaps also chap. xxv., which has no date. During this period the prophet had no word to speak concerning Judah and Israel.[1] In these chapters the divine woe is pronounced against the seven neighbouring nations which had shown most hostility to Judah and Israel, namely, Ammon, Moab, Edom, Philistia, Tyre, Sidon, and Egypt. The oracles relating to Tyre and Egypt are of great length. The others are comparatively brief. With regard to Tyre its capture and ruin by Nebuchadnezzar are foretold; and it is predicted that within a very short time Egypt shall be desolate forty years. The addition (xxix. 17–21) made seventeen years afterwards is apparently due to the fact that the earlier prediction regarding Tyre (xxvi. 7–14) had not been literally fulfilled. This section contains several passages that are specially interesting from a literary point of view. The description of the great merchant city in chap. xxvii. is noticeable for the richness of its details, and also for the vigour with which the comparison to a ship is carried out in ver. 5–9, 26–36. Striking also is the dirge (chap. xxviii. 12–19) upon the king: "Thou deftly made signet-ring, full of wisdom, and perfect in beauty—thou hast been in Eden, the garden of God; every precious stone was thy covering, the sardius, the topaz, and the diamond. . . . Beside the overshadowing cherub did I place thee; thou wast upon the holy mountain of God; thou walkedst up and down in the midst of stones of fire. Thou wast perfect in thy ways from the day that thou wast created, till iniquity was found in thee. By the multitude of thy merchandise they have filled the midst of thee with violence, and thou hast sinned; therefore I will cast thee as profane out of the mountain of God, and the overshadowing cherub shall destroy thee from the midst of the stones of fire." As Tyre had been likened to a ship, so is Egypt with great minuteness of detail likened to a cedar in chap. xxxi. In chap. xxxii. follows a corresponding dirge, in which the assembled nations are represented as mourning women singing their lament over Egypt's grave.

3. The remainder of the book (xxxiii.–xlviii.) dates from after the fall of Jerusalem. In chap. xxxiii. we read how the prophet's dumbness was taken away in the twelfth (more probably the eleventh[2]) year of his exile, on the day when tidings were brought of the ruin of the city. Thereupon chap. xxxiv. opens with a brief retrospect, in which the former avarice, idleness, and cruelty of Israel's shepherds which have led to such disaster are exposed and rebuked. But the future—the immediate and the distant—chiefly occupies the prophet's mind. He tells of a coming shepherd, "David," under whose rule great and uninterrupted prosperity is to be secured. Edom is to be finally destroyed, but the twelve tribes are to be resuscitated and gathered together in their own land once more. A final battle has yet to be fought with Gog from the land of Magog, who shall come up against the chosen people with a great army, but only to be utterly destroyed, that Israel may thenceforward dwell in safety, wholly secure from any possible repetition of former calamities. Then follow in detail the final arrangements of the reorganized theocracy. The new temple, its dimensions, construction, furniture, are described; new laws as to sacrifice and festival are given for the priests, prince, and people of the new commonwealth. Directions are given for the equitable partition of the Holy Land among the twelve tribes, and for the building of the new city, which is to be called by the new name Jahveh Shammah, "the Lord is there." In all these regulations a general formal resemblance to the Pentateuchal legislation is abundantly manifest; but the differences of detail are no less striking. The following may be mentioned among others. Ezekiel's temple is larger, but simpler, than that of Solomon. The distinction between the Holy and the Most Holy Place is much less marked. Both ark and high-priest are passed over in silence. The priesthood is specifically Zadokite. The "prince" has priestly functions assigned him. The morning burnt-offering is brought into special prominence; of the great festivals, the passover and the feast of tabernacles alone are noticed. The feast of pentecost is omitted, nor is any mention made of the great day of atonement, but an observance unknown in the Pentateuch, on the 1st and 7th of the first month, is proposed instead.

The genuineness of the book of Ezekiel has seldom been questioned. Some perplexity has been caused by the statement in the Talmud (*Baba bathra* 15, 1) that the men of the great synagogue "wrote" Ezekiel. This obscure expression, by which most probably mere editing was meant, has been deprived of some of its importance by Kuenen's demonstration of the unhistorical character of the entire tradition regarding the great synagogue. Towards the close of last century some doubts were expressed by Oeder, Vogel, and an anonymous English writer in the *Monthly Magazine* (1798), with regard to the genuineness of the last nine chapters, which were supposed rather to be of a Samaritan origin, and by Corodi with respect also to chaps. xxxviii. and xxxix.; but these doubts were unanimously set aside by the not too conservative critics of that period. Zunz (*Gottesdienstliche Vorträge*, 1832; also *Gesammelte Schriften*, i. 217 *f.*, 1875) was the first to impugn the genuineness of the entire work, his thesis, in its most recent form, being that no such prophet as Ezekiel ever existed, and that the present work bearing that fictitious name was written somewhere between the years 440 and 400 B.C. His arguments are partly of the *a priori* kind, such as that the special predictions contained in it (xvii. 16, xxiv. 2, 16, &c.) are inconsistent with the genuineness of the book, and that it is inconceivable that in 570 B.C. any prophet could ever have thought of suggesting a new division of the Holy Land, or of drafting a new law-book, or of sketching the plans of a new temple and city. He argues further from the silence of other scriptures, particularly of Jeremiah and of the book of Ezra, with regard to Ezekiel; from certain allusions in the book itself, such as those to Daniel, to the wine of Halybon, &c.; also from its grammatical and linguistic peculiarities. There is still practical unanimity, nevertheless, among critics of all schools in the opinion that the stamp of Ezekiel's individuality is unmistakably and even obtrusively visible in every page of the book that bears his name. Keil and Kuenen agree in holding him to have been its author, and its editor as well. He is believed indeed not to have reduced it to its present form till near the close of his life; and many have embraced the opinion of Ewald, that the earlier dates have in some cases been incorrectly given by him. The text, it ought to be remembered, however, has reached us in a somewhat impure state.

The question principally discussed in recent years, and likely to be discussed for some time to come, in connexion with Ezekiel's name is not whether he wrote less than tradition has assigned to him, but rather whether he may

[1] The language of xxiv. 27, taken along with that of xxxiii. 22, has led many to the conclusion that Ezekiel was literally dumb during this period, and that the oracles belonging to it must necessarily have been written, not spoken. But xxix. 21, dating from a much later period, requires to be also considered in this connexion. He may possibly have been speechless on certain subjects only.

[2] So the Peshito and a few of the MSS. See Ewald, Hitzig, Bleek.