a quarter of an hour this terrier remained under the sofa without making a sound, but doubtless enduring an agony of contending feelings. Eventually, however, conscience came off victorious, for, emerging from his place of concealment, and carrying in his mouth the stolen chop, he came across the room and laid the tempting morsel at my feet. The moment he dropped the stolen property he bolted again under the sofa, and from this retreat no coaxing could charm him for several hours afterwards. Moreover, when during that time he was spoken to or patted, he always turned away his head in a ludicrously conscience-stricken manner. Altogether I do not think it would be possible to imagine a more satisfactory exhibition of conscience by an animal than this; for it must be remembered, as already stated, that the particular animal in question was never beaten in its life.

The Theory of Vision.

The following extract is from an article on the Theory of Vision in the "Revue Scientifique" of March, 1877:—

The rarer the instances are of the cure of those born blind, the more is it to the interests of science to record them, and to study them carefully; and it is a fortunate occurrence for science when an operation of this kind is made by a skilful operator, and one who is at the same time an intelligent, well informed, and attentive observer. This combination has been twice fulfilled within some years, at the Ophthalmic Hospital, Lausanne. A born-blind was cured in 1852, by Dr. Recordon, and another twenty-three years later by his colleague, Dr. Marc Dufour. Here are the particulars of the second case.

A young Savoyard, *Noé M.*, was born blind in the village of Contamine, on the road Du Col du Bonhomme (Haute Savoie). He grew up in this secluded part of the Alps, in the midst of a population who had probably no idea that his cure was possible. Dr. Martin, of Saint Gervais les Bains, met him one day, perceived the curability of his malady, and sent him to Lausanne; he was then twenty years of age. *Noé M.* was afflicted with a congenital cataract of both eyes, he had besides a corneal opacity, more particularly of the left eye, and a marked movement of nystagmus or spasmodic winking. His right eye was operated upon on the 14th of June, 1875. The operation did not present any remarkable incident, and succeeded well. The cure was normal. As soon as it became possible, M. Dufour carried on a series of observations and experiments, employing convex glasses adapted to obtain retinal images as distinct as possible. In order to appreciate the results of these observations and experiments from a psychological point of view, it is necessary to enter into some considerations on the general state of the question.

Numerous observations and easy experiments show that the object of the direct perception of sight is, and always remains, a simple surface

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

upon which forms are determined according to the different degrees of light and shades of colours. Sight does not perceive directly the relief of bodies, nor their distance beyond a surface; their relief is only perceived in a secondary and acquired manner when the person who sees has learned the signification of shades and of light; it is a judgment of habit resulting from experience. This judgment, from the very fact that it does not result from the immediate and direct action of the sense of sight, is liable to be deceived; it is the essential source of the ordinary illusions of sight, illusions so frequent, and which are not properly speaking errors of the visual perception; but errors of the judgment occurring on the occasion of this perception. The facts in support of the preceding theory are numerous. It is difficult, and sometimes impossible, to distinguish on a lofty ceiling carvings in relief, from those which are designed on a smooth surface by a skilful artist. It is very difficult, even for a practiced eye, to discern in a good theatre decoration the point where the side scenes end from that at which the drop scene commences. Habit and a practical judgment are necessary for that. I remember to have seen in a picture gallery the works of a clever painter who had made it his speciality to deceive the eye by paintings in relief; the illusion was so great that to recognise it, it was necessary to bring the eye close to the painting, and the moment one withdrew a step or two the illusion was reproduced as vividly as ever. The eye, however, becomes able to perceive, and in the greater number of cases without error, the relief of bodies, and in a certain degree their relative distance in a direction perpendicular to the surface which is the object of direct perception; this is the result of the education of one sense by means of another. The relief of a body which can be taken in the hand is established primitively by the touch; their distance, when known objects are concerned, is calculated by their distinctness, and above all by their apparent dimensions. Intelligence intervenes in the end, armed by the processes of science, in the first instance to extend the uses of sight, and then to rectify its persistent illusions. La Fontaine writes,

"Si l'eau courbe un bâton ma raison le redresse."

In the case supposed in the fable, the intervention of reason is not necessary, because the sense of touch could rectify the false judgment occasioned by the visual perceptions; but it is to science alone that it appertains to establish the true dimensions of bodies placed beyond our reach, to give us the idea of the size of the sun, to set at an enormous distance, sometimes to relegate to an incommensurable distance, stars which will remain always to the direct perception of sight as luminous fixed points on the uniform surface of the heavens.

In relation with the necessary education of the sight by touch, the experiments made upon the born-blind confirm the results of the observation of ordinary facts. Cheselden has operated upon many born-blind; he has given an account of what he considered the most

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

important of his observations; this was the case of a boy of thirteen years of age, upon whom he operated in 1728. When this child recovered its sight, everything appeared to him as a smooth surface, which seemed close to his eye. The blind person upon whom M. Recordon operated in the autumn of 1852, judged two houses to be equally distant, which were far apart from each other. It very evidently results from the observations of M. Dufour that *Noé M.* did not, in the first instance, judge in any degree of the relief of bodies by the impressions of sight. He beheld, without recognising them, objects which were the most familiar to him, but he knew them the instant he could touch them; and it is beyond doubt that it was after a series of experiences that he learnt to translate his visual impressions into perceptions of relief. He touched everything, as little children do when allowed to follow the instincts of their nature. His attendant remarked that when he thought himself unobserved he handled all the objects around him, and examined them on every side, at the same time passing his hand all about them. The education of the sight by touch is not less striking in the other cases that have been observed. The boy operated upon by Cheselden could not at first distinguish by sight the dog and the cat belonging to the house. He was seen one day to catch the cat, which he recognised by touch, and after having regarded it attentively, while he felt it, he let it go, saying, "Go, Minet, I shall recognise you in future." The lady operated upon by Wardrop, before having made sufficient trials, stretched her arm to grasp an object close to her eyes, or, on the contrary, searched near her for objects that were at some considerable distance. *Noé M.* was brought before the Société Vaudoise de Médecine, at its *séance* of the 5th August, 1875, that is to say nearly two months after the operation. At this epoch he no longer made mistakes as to the relief of objects which he knew, nor in his appreciation of their distance. He understood then the signification of the diminution in the size of an image which results from the distance of an object; but when he had to do with considerable distances, and with objects which he did not know, his notions were still excessively confused, and the sight of a landscape seemed to bewilder all his ideas.

We can then affirm, whether on the grounds of observations and experiments easy to be made at any time, or upon the observations of born-blind who have been cured, that the object of the direct perception of sight is only a coloured surface. The fact being held for established, and the question whether sight perceives directly relief and distance being resolved negatively, a second question presents itself. Does sight perceive directly forms not in relief? The problem was propounded by Molyneux, an Irish savant of the end of the seventeenth century, specially devoted to the study of mathematics and optics. Madame Molyneux became blind shortly after her marriage. This circumstance, combined with the nature of her husband's studies, contributed probably to direct his attention to

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

questions relating to blindness. After having reflected upon the subject, he put the following question to his friend Locke—"Suppose a man blind from his birth, and now grown up, who had been taught to distinguish by touch a cube and a globe of the same metal and nearly of the same size, so that when he touched the one or the other he could say which was the cube and which was the globe; suppose that the cube and the globe being placed upon a table, this blind person became able to see, the question is asked whether on seeing without touching them, he would be able to distinguish them, and to say which is the globe and which is the cube?"

This question appears in the annals of science under the title of *Problem of Molyneux.* This savant himself replies in these terms: "No, for although this blind person has learnt by experience in what manner the globe and the cube affect his touch, he nevertheless does not yet know that what affects his touch in such or such a manner must produce such and such an impression upon his sight." Locke accepted his friend's solution of the problem. The question thus propounded became the occasion of Cheselden's experiments. The relation of this surgeon does not appear to me nevertheless to establish experimentally quite certainly that his cured patient did not discern forms not in relief, while it establishes, in the most positive manner, that he had not any primitive perception of relief, and consequently did not recognise objects until he had touched them. Condillac accepted and simplified the theory of Locke and Molyneux. He affirmed that sight only furnishes us directly with pure sensations which do not bring with them any objective perception, no more of objects not in relief than of those in relief. Under the combined influence of Locke and of Condillac, the prevailing opinion of the seventeenth century was that all knowledge of forms in visual perception rests on experience and on comparison with touch. This theory was energetically opposed by John Müller, not as to what concerned relief (with regard to that the discussion appears closed), but as regarded smooth surfaces. Müller is so resolved in his opinion that, not content with having declared himself for the direct perception of objects not in relief, he declares himself unable to understand how Locke and Molyneux could have pronounced in the negative. In this state of the scientific controversy, the observations made upon *Noé M.* are of great interest. It is necessary to state that M. Dufour's remarks upon them are not favourable to the theory of Müller, and seem to confirm that of Molyneux.

In fact, the operation having been successfully accomplished, *Noé M.* continued to move like a blind person; so much so, that Dr. Dufour thought for a moment that the cure was not effected. The second day of experiments, after having proved by the opthalmoscope the integrity of the bottom of the eye, the doctor made his patient sit down, and held his watch before him, turning the face towards him, at about a step from him. *Noé* said without hesitating: "*I see some-*

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

thing white." The visual sensation was then established, but how much of it was perception? To the question, "*Is it something round or square?*" *Noé* made no reply. He was asked "*Do you know what a square is?*" He showed by a movement of his hands that he understood very well the meaning of the question. He replied in a similar manner to the question if he knew what was a round by forming a ring with his hand. He had then, as far as concerned tangible form, a clear idea of square and round; but sight did not enable him to recognise whether the objects placed before him had the one or the other of these shapes. He looked steadily, however, at the watch. The next day, that is to say the third day after the operation, the experiment was renewed with precisely the same result; but this time, which had not been done on the previous day, *Noé M.* was made to touch the watch. As soon as he had grasped it with his hand, he said: "*It is round; it is a watch.*" To recognise the form of the watch by the simple use of sight, it was then necessary for him to interpret a visual sensation by the aid of touch.

This belief was strongly confirmed by the following experiment, which Dr. Dufour relates in these terms; "I showed him two pieces of very white paper like paste-board. These two pieces formed two elongated rectangles; the one about ten centimetres long, the other twenty centimetres, of the same breadth. "What do you see?—*Some white objects.*—Are they of the same size?" He replied with hesitation: *No.* Is one longer than the other?" A pause. "Which is the longest?" No reply. Pressed by me, he declared that he could not tell. He touched it, and passing his hand along the longest rectangle, he indicated immediately which was of the largest dimensions, and then looked attentively at the one and the other. He was then given two pieces of the same white paper, the one square, the other somewhat oval. "Do you see a difference between these papers?—*Yes.* "What difference?" No reply. "Well, one of these papers is square, and the other is round.—Which is square?" *Noé M.* did not reply for a moment, and ended by saying that he was unable to designate it. I told him to put out his hands and touch them. He touched the square piece first, and feeling one of the angles in his hand, he said with a vivacity to which his replies had not accustomed us: *This is the square.* He afterwards touched the round piece, then examined them both, and from that moment he has always been capable of distinguishing round objects by visual sensation alone. It will be remembered, indeed, that in a preceding experiment, in examining the face of the watch, the patient had already seen a round object, and had verified this sensation by touch. But whether the form was not imprinted on his memory, or that the experiment had been too short, and that, not having the contrast of any other than the round shape at the time that he felt the watch, the difference of the outlines appeared less striking to him, that first experiment was not sufficient to impress on *Noé M.'s* mind the particular visual sensation that affects

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

us when we see something round. The experiment of the two papers, on the contrary, completely sufficed to give him the knowledge of these simple forms. The round paper was about 10 centimetres in diameter.

The unequal length of the two papers, the difference in the outline of a square and of a round shape, are manifested independently of all relief. *Noé M.* did not then distinguish forms not in relief, simply by vision, before the experience in which touch intervened.

Here is a third question: Does the eye perceive primitively and before any experience surface movement? To the question thus proposed, Condillac had given theoretically an entirely negative reply; he had insisted that knowledge of movement does not belong naturally to sight, and demands the exercise of touch. The experimental verification of this hypothesis has seldom engaged the attention of observers; this gives special importance to the experiments of M. Dufour. The question is to learn whether the displacement of visual impressions on the retina immediately gives rise to the idea of the displacement of objects. In the case of *Noé M.*, the reply is in the negative. One of the experiments tried on the first day was this: the doctor made the patient sit down, with his back to the window; then placing himself at a distance of two steps from him, he told him to look, and made with his hand, which was in a strong light, oscillations of about 40 centimetres against a black coat. To the question: "Do you see anything?" *Noé* replied: *I see something light.* It will be remembered, that in his blind state, he distinguished a bright light from darkness; he possessed thus the notion of light, and even some notion of colours, as we shall see later. To the question: "Do you not see something which moves?" He could not reply, although the movement was several times stopped and then renewed. Pressed with questions, he never arrived at any other answer than this: "*It is something light.*"

The third day the doctor swung about a watch chain in front of him. He said, "*It is yellow, it moves.*" He had seen the movement. What had occurred between these two experiments? Dr. Dufour acknowledges that he has no precise data with regard to this; he cannot seize upon the exact moment when *Noé M.* learnt to distinguish movement from rest, nor consequently determine the conditions of the progress; therefore, with the prudence of a true scientific spirit, he offers the following conclusions:—"The examination of *Noé M.* has not the character of a definitive experiment. . . . I have retained from his examination the impression that the distinction of rest from movement by the means of vision is something which must be learned. Evidently the image of the body which moves is displaced upon the retina of the observer; but this displacement, or the successive irritation of the different retinal elements, does not give at the first outset the notion of movement. If the patient looked fixedly, he would be obliged, in order to follow a moving body, to move his eyes; and the consciousness he would have of this ocular movement would

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press

perhaps give him the notion of the mobility of the observed body. Excepting in this way, I see only co-ordination with touch which could give this knowledge, or it may be a known sound with the help of other knowledge previously acquired by experience. It was not possible to know how *Noé M.* had acquired the knowledge of movement."

To sum up: the observation of Dr. Dufour confirms previous observations made in analogous cases, completes and extends them. It establishes that, in many cases at least, when a born-blind acquires the use of sight, he acquires the sensation of colours, but that the use of sight alone does not furnish him immediately with any element of localisation, that is to say, of distances, of forms, and of movements. Such are the facts.

The following are references to cases of cures of born-blind; indicating the date of the operation, and who was the operator, and the special malady of the patient; also the source from whence the particulars are derived :—

1728. Cheselden.—Enfant de treize ans, cataracte congénitale. *Philosophical Transactions*, année 1728, page 447.

1806. Home.—Enfant de douze ans, cataracte congénitale. *Philosophical Transactions*, 1807, page 88.

Id. id. Enfant de douze ans. Id., id.

1826. Wardrop.—Dame de quarante-six ans, adhérences iritiques obstruant la pupille. *Philosophical Transactions*, 1826, page 529.

1840. Franz.—Jeune homme de, dix-sept ans, cataracte congénitale. *Philosophical Transactions*, 1841, page 59.

(?) Trinchinetti.—Enfant de dix ans, cataracte congénitale. *Archives des Sciences Physiques et Naturelle de la Bibliothèque Universelle*, 1847, page 336.

(?) Id. Enfant de onze ans, id., id.

1852. Recordon.—Jeune homme de dix-huits ans, cataracte congénitale. *Bulletin de la Société Médicale de la Suisse romande*, 1876.

1874. Hirschberg.—Enfant de sept ans, cataracte congénitale. *Archives de Graefe*, xxi, 1.

1874. Hippel.—Enfant de quatre ans, cataracte congénitale. *Archives de Graefe*, xxi, 2.

1875. Dufour.—Jeune-homme de vingt ans, cataracte congénitale. *Bulletin de la Société Médicale de la Suisse romande*, 1876.

1876. Hirschberg.—Enfant de quatre ans, occlusion pupillaire. *Archives de Graefe*, xxii, 4.

En 1801, Ware a opéré la cataracte d'un enfant de sept ans (*Philosophical Transactions*, 1801, page 382); mais la cataracte était probablement acquise.

https://doi.org/10.1192/bjp.23.102.257 Published online by Cambridge University Press