A rationale of the laws of cerebral vision : comprising the laws of single and of erect vision, deduced upon the principles of dioptrics / by John Fearn.

PLATE *to illustrate* SECTION FIFTH.

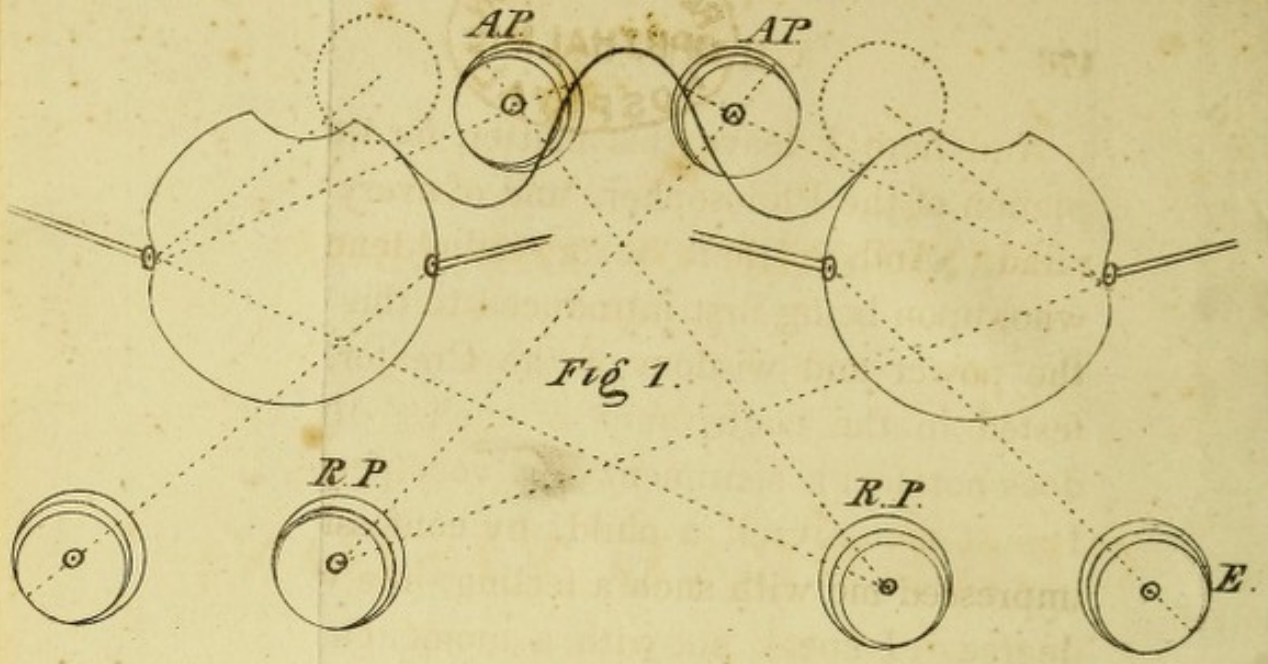


Fig. 1.

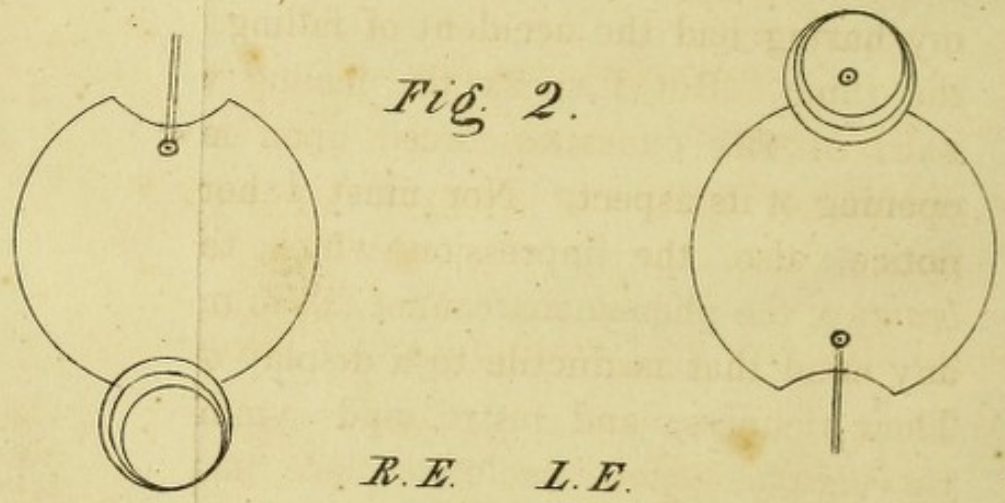
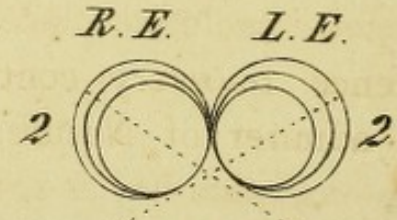


Fig. 2.



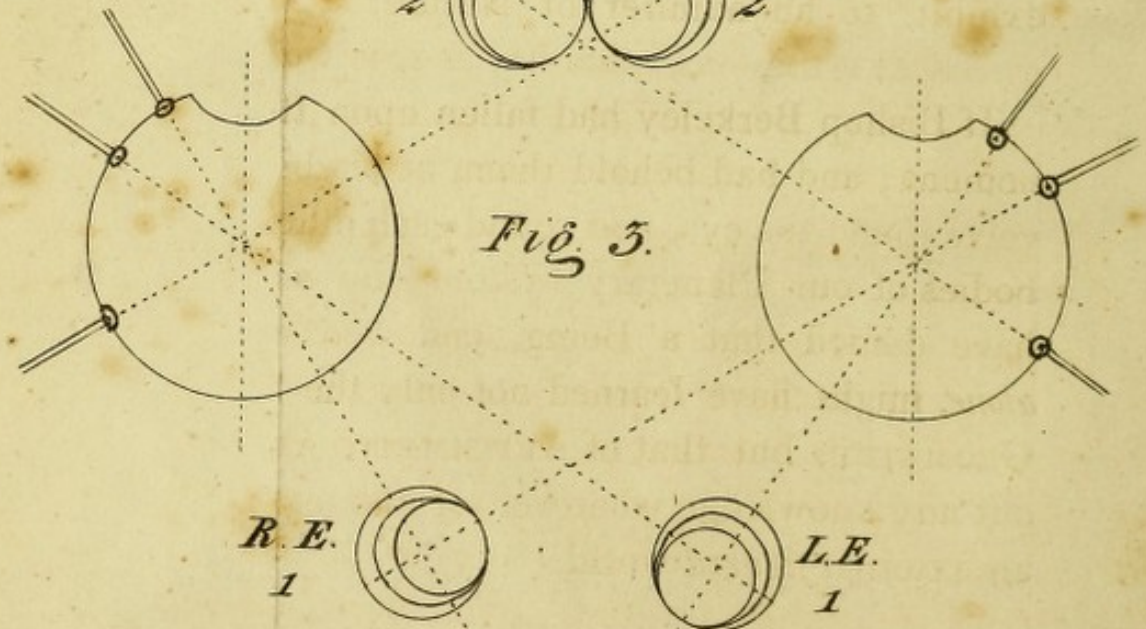
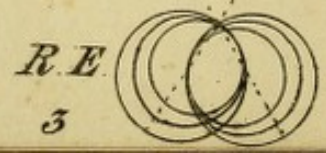


Fig. 3.



R. Carturight, Lithog.r
Warwick Place, Bedford Row

RATIONALE OF THE LAWS

OF

CEREBRAL VISION;

COMPRISING THE LAWS OF

SINGLE AND OF ERECT VISION,

DEDUCED UPON THE PRINCIPLES OF DIOPTRICS.

BY JOHN FEARN, ESQ.

HE THAT FORMED THE EYE; SHALL HE NOT SEE?

LONDON:

PUBLISHED BY MESSRS. LONGMAN, REES, ORME, BROWN, AND GREEN, PATERNOSTER ROW; AND ROWLAND HUNTER, ST. PAUL'S CHURCH YARD.

1830.

PRINTED BY A. J. VALPY,
RED LION COURT, FLEET STREET, LONDON.

TO THE

PHILOSOPHERS OF FRANCE.

GENTLEMEN,

AFTER having passed the latter half of a life in studies, concerning which there are at least ample vouchers that I did not mistake the propensity; I find myself compelled to appeal the following Essay, from the anticipated neglect of my Country, to the scientific justice of a Foreign Nation—the Nation of MONS. DE LA HIRE and of a Constellation of Philosophers of the Mechanism of Vision.

That I am driven to this appeal, would certainly be ignominious to my intellectual pretensions, were it not a fact too well known, that the apathy of living Englishmen toward abstruse science in general has become a theme in the mouths of reflecting persons, both at home and abroad. Nor is the general apathy the sole external cause of the predicament in which I stand; since I, together with the Subject, suffer rather from obstacles that form a barrier between me and the Public, than from the prevailing indisposition toward such walks of research. The brief truth of the matter is, (and the present limits oblige me to announce it with the utmost brevity,) a hurtful difference has subsisted between myself and a Name that (owing to a combination of circumstances) is of a Colossal Influence in this Country in those departments in which I have been occupied, and especially in the estimation of almost the whole of the arbiters of philosophical criticism among us: And this difference, consisting in a two-fold matter,—namely—of philosophical views, and of personal concern, has operated in closing up against my labors all the principal avenues of periodical notice; insomuch that, it must be

impossible for works of their description to reach the eye of Europe under such proscription, unless through the intervention of some fortunate accident, or extraordinary recourse.

From a stranger, and a foreigner, you will peremptorily demand some credential of the assertion now advanced. I wish it were possible for me only to refer you to the various publications in which its vouchers are to be found. But, as this may not be; I supply that which follows, since it involves, in the smallest room, much of the nature of the case; and is far more essentially explicit than any other single passage which could be afforded. The testimony to which I now allude came forth in consequence of my having, some time back, deemed it expedient to have a full statement of the matter in question laid before the public: an opportunity of doing which was spontaneously afforded me in a work that was expected to prove of general favor; which, however, on its appearance, was made obnoxious to much adverse criticism; but, of the tenor of which I had not any previous knowledge; while the subsequent production of a Second Volume shows at least its Author's feeling with regard to it. Among the criticisms which it occasioned; One Periodical Work, whose respectability has long been sufficiently acknowledged, but of any of the Gentlemen concerned in which I know not so much as the name, has expressed itself in the following terms, which I here yield to transcribe under the imperative necessity of the case; while I must not omit to add that, the Publication to which it refers contains a genuine statement of the matter in question, which must always form a record of the case, and will be matter of interest in the history of the subject.*

"The only portion of its contents that can be consi-
"dered of any real importance," (says the Writer of the Article,) "is the account furnished by Mr. Fearn of his

---

* "*Parriana, or Notices of Dr. Parr.*"

" correspondence with the late Professor Dugald Stewart,
" which might certainly, however, have been laid before
" the world through the medium of any other publication
" of the season, with quite as much appropriateness as
" through that of the present. We shall be glad, how-
" ever, if even this rather awkward proclamation of his
" existence should have the effect of calling any measure
" of public attention to the speculations of a philosopher,
" who has shown at least as high powers and as much
" originality as any other metaphysical inquirer of the age,
" while he has had to prosecute his investigations under
" the discouragement of a neglect that is any thing but
" creditable to the taste and discrimination of his country-
" men. This is not the place to enter into any discussion
" of Mr. Fearn's peculiar opinions; but we cannot help
" saying, that the treatment he experienced from Mr.
" Stewart, as here detailed, reflects no honor upon that
" distinguished writer. His claim to originality, in re-
" gard to the particular position which Mr. Stewart af-
" fected to consider as having so little merit in point either
" of novelty or importance, was long ago maintained in
" this Journal, and is put beyond the reach of controversy
" by the statements here published."*

MONTHLY REVIEW *for September*, 1828,—*Page* 88.

When it is added, here, that the late Professor Stewart,

---

* The more truth there may be in the remark on the *awkwardness* of my being fain to embrace a conveyance inappropriate to Pneumatological discussion; the more manifest is the state of Pneumatological labor in this Country.—The Vehicle, adopted, was embraced in consequence of its Author's application, that I should furnish him with any Letters I had of the late Dr. Parr. While, in complying with that Gentleman's request, the very Letters in question exhibited, in a confused way, several of the merits of the case: And I hope it will be deemed that few of the acts of Dr. Parr shed more lustre on the uprightness of his character, than his conduct in this controversy. I confess, therefore, that I really supposed the Vehicle would be deemed a suitable one.

(under whatever feeling,) in I believe the latest page of his latest work, though basking on a pinnacle of literary fame, chose to avail himself of the testimony of Dr. Parr to both the intellectual and the moral cast of his character; I trust, no honorable mind will deny that I am as justifiable, and more urgently called upon, to adduce the above testimonial in my own behalf. And, as I have been thus led to mention the Name of an Individual who was especially characterised by moral rectitude, as well as by erudition; and one who was the avowed friend and admirer of Professor Stewart, but who nevertheless expressed his disapprobation of his procedure; I shall add, to the foregoing testimony, a single expression of Dr. Parr, in one of his Letters to me, now before the public in the Work referred to. In that Letter, he says—" If Stewart deal out " a scanty portion of justice to you, leave him thus far to " the disapprobation of wise and good men."

Gentlemen. The late Professor Stewart left this World without dealing out to me, or at least without *acknowledging to the* PUBLIC, the smallest portion of justice. And, what is more; I must beg of you to be informed that the injustice, to which alone Dr. Parr alludes, was *only upon general philosophical* ground: for he, (I suppose from amicable considerations,) *did not expressly speak to the personal* claim in question; which last, however, was of the most vital importance in my case.

In closing this statement; I would not have it understood that I am less ready, than any one, to bear acknowledgment to the intellectual merits and high general character of the late Professor Stewart. Nor, on account of the Subject in question, would I have it supposed that there was any thing hostile in the conduct of our difference. The expressions of Mr. Stewart, in one of his letters to me now before the Public, are indeed of a tenor highly gratifying; and such as might have been eagerly caught at by any individual, who had not staked his life

to the attainment of an object incompatible with its exchange for the private friendship of any man.

In fine. The matter to which I would now immediately solicit the favor of your decision is—Whether the following Essay on Vision is, or is not, in any extent, a contribution to Science. If your answer should be in the affirmative; then, I may presume, it ought to be supposed, by the reading public, that the tenor of my former labors is not altogether such as would be for the interests of mankind to neglect. And, if the present specimen should merit your unqualified censure; I shall be content, (although its Preface will explain that the matter is *not my subject*,) to have it supposed that my previous writings are of no better complexion.

The evil to be rectified, is not merely if I am wronged of my philosophical rank or estimation in the community. For, when much has been written, there may be much to explain, or emend: And great detriment might arise to general truth from a want of such explanation. While I need not inform you how fatally life is undermined, and the power of thought itself paralysed, by the amount of obstruction against which I have had to labor.

I have the honor to subscribe myself,

Gentlemen,

With profound respect,

Your Most Obedient Servant,

THE AUTHOR.

To

HENRY BROUGHAM, ESQ. F.R.S. M.P.

&c. &c. &c.

SIR,

WHILE I am compelled to appeal the labor of a speculative life to the adjudication of enlightened foreigners; I ought not to forget that there are in our own country eminent individuals, who, in all probability, are not aware that such a case exists; and who, if distinctly called upon, would not have permitted its occurrence. And, while there is not any one who stands so distinguished for having given an impulse to the literary spirit of the country, or who possesses equal power to effect right in such a case, as yourself; I might be wanting in what is due to you, were I not to include you, in my imagination, among the number of those that are most liberal; though I sufficiently calculate upon the existence of considerations which, if possible, would incline you not to stir in the matter.

Be the result what it may; I will not lower the moral ground on which I have labored, to place myself in a posture of solicitation,—a course which various feelings forbid. But, with every due admission, of which I am by no means disposed to lose sight, I would look toward you, provided the selection be worth your acceptance, for an act of justice; in which, indeed, I am concerned especially beyond other men; but which, if the cause be that of general truth, is a cause of no private nature.

From the tenor of the address which precedes this, it appears that I complain of literary oppression, in the shape of a continued obstruction to the promulgation of my speculative views, by a marked and portentous silence in the higher Quarters of Criticism with regard to whatever comes forth under my name. As far as regards my Pneumatological writings; I may be told that mine is only a

common lot, in their not having been taken up in the leading Vehicles of Criticism. And I am so sensible of the truth of this, that I should never have made it a topic of specific complaint. But, a very different consideration urges the present appeal. The fact is that, my speculations in Pneumatology have formed not any thing like the whole of my labors. And a period of no less than seven years (including intervals of borne-down health) has been occupied in the exclusive prosecution of an Analysis of Language: which now, for some time, languishes before the Public, from a want of that aid which alone could bring to the notice of Europe any Philological work that diverges far from the usual track, especially when, as in my peculiar case, it is the production of an ungraduated author, and one who, more than any man, has been abstracted from the events, and the parties, which give security, or return, to literary exertion. Nor can the case be esteemed the less hard when the subject of Language, in every modification, and gradation of its treatment, is daily issuing from the press; and is deemed of sufficient importance to find effectual periodical notice.

It will be said that, what I have now advanced affords no proof that the work in question is deserving of better treatment than it has received. To this I answer, first; that I pledge myself, (without any previous intimation to the parties of my intention to do so,) that the houses which publish for me have had ample testimonies, from persons strangers to me, that the tenor of the work justifies my urging its claims to consideration.—But, besides these, there is, by a fortunate accident, *One* Public Criticism extant upon the work, although it is a locked-up one; to which I may refer.—Nearly the whole of the article *Philology*, in the CYCLOPÆDIA EDINENSIS, is occupied by an account of its *First Volume*, the Second not having then been published.—If, in this case, either the impartiality or the competency of the Writer of the article be questioned; it is for the "Society of Gentlemen" who have been engaged in that Cyclopædia (any one of whom, even by name, at the time I knew not, and now hardly know,) to answer to the Public that they did not intrust that depart-

ment of their undertaking to an improper hand. But, their defence is rendered unnecessary by the details of the criticism itself; which, to any person in the subject, will pronounce its own sentence, whether or not it is a fair, or a competent one.—I trust, I need go no farther, in order to satisfy any well-informed mind that the Monthly Review has spoken truth, in its assertion that I am a sufferer under some influence which does not raise the literary character of the country.

And here I avow the unshaken reliance that, what I have done is at least sufficiently known to secure justice from those who shall come after us. But much detriment to the subjects in question, as well as to me, will intervene if they can be made to wait till then. And, if this wrong shall be accomplished; I hope, I meet your own feeling of the matter in auguring that, there is no Contemporary Name, of which posterity will so primarily ask, whether or not justice was done at the time, as of yours.

Fortunately; the Principles of Dioptrics (*which I nowhere contradict,*) are not only long-established truths; but, in addition to this, they are understood by a comparatively large class of persons, in every country; insomuch that, any matter deduced legitimately upon them cannot, from any accident, remain long in obscurity.

I have the honor to be,

Sir,

Your Most Obedient Servant,

JOHN FEARN.

PREFACE.

If the Series of Propositions, laid down and argued in the following essay, be found legitimately deduced from their data; it will appear that the Chain of Visual Mechanism which connects a perceiving mind with the sun, or with any other luminous or light-reflecting body, consists of two very different parts;—the one being continued, in a line from the other, by what may be called a *visual articulation* between the two, consisting in the *retina* of the eye:—And the process carried on in the ANTERIOR part of this chain will demand the appellation of LUCERNAL Vision; while that which takes place in the POSTERIOR part will require the distinctive term—CEREBRAL.—Hence, the choice of the Title prefixed to these pages; and to explain which, this introductory remark forms the leading suggestion.

The nature of that half—(for such it may be called)—of the visual chain which exists and operates anterior to the eye, has been investigated with the most brilliant success during the course of the last two centuries. But a very different fate has hitherto befallen the other.—Cerebral Vision (in the hidden recesses of which, most certainly, are contained the mechanism and process of *Single and Erect Vision*) has, in a most astonishing manner, remained an arcanum in philosophy. And it would seem as if the failure of Newton, in his endeavor to throw any light upon the subject, had rendered it altogether hopeless in the eyes of other inquirers, since nothing notable of the kind appears to have been attempted after the hypotheses left by him, and by Dr. Briggs.

It has formed a characteristic feature, in the scientific spirit of the last age, to *pay no regard to a general con-*

summation or consistency of knowledge. But it may with confidence be anticipated, that, when Truth is violated by assumptions, or positions, in one science; which run counter to the immutability of her nature, as manifested in another; She will, sooner or later, do right to herself, with a re-action proportioned to the wrong which had been offered to her.—I suppose that the principal assisting reason why I have not been anticipated, in the investigation of a field which is of a nature as strictly demonstrable as the Laws of Dioptrics, has been a procedure to which I have adverted in a recent publication—namely—that, when Natural Philosophers are exhibiting their experiments, explanatory of the radiation, the refraction, or the reflection of light;—(that is, in other words, explanatory of the *very existence* of light, together with that of its *composition* and *decomposition,*)—they *never advert to a fact,* which however not one of them would for a moment attempt to deny—namely—that they *do not, and never in any case can,* PERCEIVE light; which means that they *never perceive the facts or phenomena which they profess to demonstrate;* and the ONLY THING which they DO perceive in this case,—*and* PERCEIVE IT DECOMPOSED, *and* RECOMPOSED, as often as they employ a prism,—is a SENSATION, *or* A COMPANY OF SENSATIONS, OF COLORS IN THEIR OWN MINDS. From this cause appears to have arisen the universal assumption of Natural Philosophers, that the *Object of our Sight is* "LIGHT," as well as COLOR. And, by this nomenclature and classification of subjects, those who have held the beaten track have been prevented from all attempts to discern any physical mechanism of vision, *except only in the external laws of* LIGHT; because this external agent has been confounded under one same general name with the modifications of the Mind itself, in the fact that *Colors* are estimated as being the *Various Species of Light.*

It would be vain, here, to attempt to put in a plea on the score of the *ambiguity of language.* For, although the

fact of the ambiguity of language, if alleged, is by far too true; and, though the existence of it has proved a stumbling-block in the subject which indispensably requires to be removed; it is in great part *an effect*, rather than *the cause*, of the confusion which obtains with regard to the subject. And the real evil in question consists in a confounding in men's CONCEPTIONS of the *external physical cause* of color, with *color itself*.

To the Philosopher, and to all other men, Light is an Object of Sight in the same sense as the Unseen Pole is an Object of the Mariner: Which so-called object the Mariner *never perceives;* but which he knows as an OBJECT OF HIS REASON OR UNDERSTANDING, which tells him that the Pole *exists*, and *how it bears from him;* while, all that he *actually perceives* with regard to it is the *Magnetic Compass in his Binocle;* by observation of which, he steers toward, or from, or wide of, his unperceived object. According to the fact, now asserted; it will form a stated, and I trust a demonstrated Proposition in the course of the following essay, that, "*A Spectator* "*perceives external objects, as the Mariner perceives the* "*Pole; and each steers toward, or from, or wide of, his* "*object, upon one and the same principle.*"

It is far from being intended here to assert that the confusion in the conception of inquirers has been either *total*, or in any extent *continual*, or *in equal degree in all* Writers on the subject. I should have no objection, even, if it were affirmed that some Writers have, *in one sense*, never at all lost sight of the distinction necessary to be made between the *things*, if not between the *names*, in question. But, I must nevertheless insist, it has been sufficient in *all*, to prevent any one from discerning that the dioptrical laws of light indicate, *as matter of indisputable logical necessity, a perfectly analogous train of mathematical reasoning, as being equally applicable to* LUCERNAL *and to* CEREBRAL *Vision*. While it is a fact, sufficiently recognised, that a Mechanism within the

Brain is, *in some way or other*, instrumental in the visual process.

Although the considerations, here suggested, impress me so strongly *now:* Still, I acknowledge, the nature of Cerebral, or of Erect vision, has never, until of late, been an object of my serious investigation. Not having supposed that any considerable path could have been left untrodden, in a field so repeatedly explored as that of the several Modes or General Cases of Vision, including all their various ordinary phenomena; I was all along led to take Optical expositions as I found them. And, although I was by no means satisfied with that violent hypothesis which assumes the evidence of Sight to be reversed by the Judgment; and this, without its being pretended that the Judgment is at all aware of its own arbitrary infliction; I considered any advance in the matter as being hopeless, insomuch as to have felt little, or no relish for the inquiry.

The only exception to this usual state of my mind, with regard to the subject, was that, occasionally, my attention was drawn to a certain Mode or General Case of my own vision; which struck me as being very different from any of those that are usually recognised by Optical Writers. But, always supposing that this different case must have been adverted to, and have been found to lead to *no consequences* worthy of having its specific difference described; I as repeatedly suffered the thing to pass from my mind, without farther regard. Indeed, during all this time, I had been so completely absorbed in attention to the phenomena of *mind only;* including the number of years I was occupied with the prosecution of my Analysis of Language, and during which I have had continually and almost hopelessly to struggle against a morbid incapability of application; that I might here offer a true and a serious apology for having suffered various objects of my wish to remain in a state equivalent to non-entity, as well as having neglected that now in question.

At length, the conviction forced upon my mind by the

rationale of the laws of the *Mutual Interlimitations of our Sensations of Colors by each other;* (which Interlimitations, it will appear in their statement, are no other than the things we call *Visual Outline or Figure;*) led me to observe a certain analogy, of SIZE *at least;* and, when duly understood, of *superficial magnitude and arrangement;* of the Cerebral Masses called the *Beds of the Optic Nerves,* in correspondence with the superficial extent of the *retinæ of the eyes;*—a mere hint of which analogy I expressed, recently, in my Manual of the Mind. And the train of thought, consequent upon observing the correspondence in question, recalled to my attention, with some interest, that Mode or General Case of Vision which I had before noted as being different from any of those that are usually recognised.—In brief; I had hardly directed my attention in this extent to the matter, when I was greatly surprised to find that it afforded a remarkable contradiction of the existing doctrine concerning erect vision.

Such is the history of the following Rationale; and the explanation why it was so late in the course of my speculations that the thing in question has been advanced.

The admirable structure and utility of the eye has been a theme of wonder with the best men and wisest Philosophers; who have held its contrivance as being, of itself alone, a sufficient barrier against the errors of Atheism. What has been said of Anatomy, taken as a whole, may indeed be truly affirmed of this one minute part of it—namely—that it is a Hymn to the Creator.—If the steps of the following reasonings are legitimately deduced; or, rather, if three, or four, of the principal propositions are true; (and, I confess, I am not able to discern that there was any room for mistake in the deduction of them;) they possess the very same species and degree of proof, as those we have for the truth of the Dioptrical Laws of Light, that the *External or Cranial Eye,* wonderful as it is, is *only a Porch,* (of which two are bountifully supplied, to guard against accident to one of them,) before the Temple of

Vision: *in whose Interior is a* THIRD EYE,—the recipient of impressions first sustained by one or both of the external eyes;—and, by the medium of which, the mind perceives, *or at least steers with regard to,* external objects, in the way already hinted.

THE ARCHITECT OF THE EYE, most certainly, can see. But, if the proofs of the subject hold, he can do much more; for he can make his creatures wonderfully *believe that they see, what they see not;*—a deception which he beneficently confers upon both brutes and men *as a law of their mere animal nature,* because they must all exist and be preserved without the aid of philosophy; while he leaves it open to the possible attainment of human beings to discern the truth that, they can never *actually perceive* any thing exterior to their own modifications.

The proofs of the fact of our MEDIATE PERCEPTION OF EXTERNAL OBJECTS, which will here be drawn from Optical Science, form only another confirmation of what has been abundantly proved by the Science of Pneumatology.

That consistency, between the Sciences, the neglect of which was alluded to here in the beginning, will be found to be a matter of the very first moment to the existence of Philosophy. And the certain violation of it, in the incompatibility which subsists between the Pneumatological Creed of the present age and Optical Science as established since the days of Newton, will be pointed out in the sequel, as a fact of the most vital consequence to be held up in a proper light, for our future guidance.

Torrington Square, London,
15*th July,* 1830.

NOTE OF PRINCIPAL CONTENTS.

Section First.

Initiatory reasoning upon Data and Method.

Section Second.

Of Single Vision from Two Ocular Impressions.

Section Third.

Of Erect Vision with Two Eyes, *involving the crossing and reforming of images behind both eyes.*

Sub-section to Section Third.

Of the Principle of the Visual Direction of Objects.

Section Fourth.

Of Erect Vision with a Single Eye; involving the crossing and reforming of images behind that eye.

Section Fifth.

Of Vision without External Objects.

A

RATIONALE,

&c.

INTRODUCTION.

OF THE SCOPE AND LIMITS OF CEREBRAL VISION.

It is a fact universally acknowledged since the reasoning *à priori* of Bishop Berkeley and its confirmation by the results of surgical operations, that we *never perceive distance or outness from the eye*. And, hence, the Phenomena and Judgments of Vision become divided into *Primary* and *Secondary;* the former comprising Vision properly so called; and the latter forming a distinct and very different Science, in consisting of a collection of judgments consequent upon proper vision; which judgments, also, admit not of any rationale in their proofs, but rest for their evidence on mere experience,—a character which renders Secondary Vision in a great measure merely empirical.

It is true, however, that Bishop Berkeley, in the course of his speculations on Secondary Vision, has suggested and laid out an assumed exposition of the cause of Erect Vision. And his hypothesis, if it should be found unsolid, is at least very ingenious, and in some points specious. At any rate, it has, from the beginning,

formed the prevailing, and indeed almost the only notable scheme of the subject extant.

With regard to the universality of the recognition that we never primarily see or perceive distance from the eye; the only exception to be named, as being avowed by any Writer of eminence on the subject, is that of Dr. Potterfield. And, upon his singular assumption, and reasoning on that assumption, that the distance of an object is in any case SEEN, there is a necessity to pronounce, it is sufficient to impeach the general philosophical calibre of any writer who should either advance, or countenance it. As such, that assumption was justly condemned by Dr. Reid; who was otherwise a sufficient admirer of Dr. Potterfield. And the oversight certainly detracts from the great general merits of the latter; or, at least, renders his other positions liable to a dubiety proportioned to the magnitude of the mistake.

With respect to the fact now in question, the agreement is so general, that it can hardly be requisite to offer an experimental proof of it here. Yet, on account of the single dissent of such a writer as Dr. Potterfield, I may state the following as a formal test of it: although a more strict and analytical test is comprised in the rationale of Visible Figure, which will be found in its proper place in this Essay.

If we look at a hoop, held in a position in which any of its diameters is co-incident with the axis of the eye, it will appear a *straight line;* no

curve or projection from the eye being at all discernible in it. In like manner, if a pair of compasses be opened, until its legs are four, or five inches asunder; and if the compasses be held horizontally, with the points of the legs toward the eyes, they will present to sight no angle or depth: And, if each of the legs, including the joint between them, be covered with white paper, the whole will appear as *one straight stripe of white*, subtending the spread of the compasses.

This introductory consideration being entertained here for the sake of mere form, in an investigation which has avowedly for its object a course of strict proof, when not of demonstrative reasoning; I proceed to the divisions of the work.

SECTION FIRST.

INITIATORY REASONING UPON DATA AND METHOD.

PROPOSITION 1.—NATURE OF THE EYE.

An impression or image in the eye, of light projected from any external object, is a TACTUAL, *and and is* NOT A VISUAL *image, in the primary and strict import of that word.*

PROOFS AND ILLUSTRATIONS.—It is self-evident, from the dioptrical laws of light, that if the retina of the eye were a *card, or a surface of any adapted consistency;* and if the rays of light projected upon it, from any external object, were pointed pins, striking upon it with various degrees of force corresponding with the different sorts of light; the result would be a *stamped image,* which would form an object of our *Touch.* And it is equally evident that, the same principle must hold true at every point of space, between the eye and the most distant object, even to the sun, or stars: For, if the rays of light were intercepted at any point, in all that distance from the eye, by whatever medium, they must form, in that medium, a *tactual* image of the nature described.

It is, at the same time a fact, concerning which

there is no dispute in philosophy, that any such *tactual* image is NOT ALSO A VISUAL image, in the primary and proper import of the word visual: because, besides other proofs, it is universally agreed that those beautiful things which we call TINTS *and* HUES, and which appear to us to make up the *fields of the different features of any object or image* exhibited by the eye of a dead animal, are *nothing but sensations in the mind of a spectator.* This fact, indeed, has been very usually, and very mischievously, *overlooked at different stages in the course of optical inquiries:* but every optical inquirer, and every other philosopher, admits it the moment his imagination is chastened by having it called to his recollection. For the *convenience of reasoning,* the term—*visual image*—may be employed *in a secondary import,* as I shall currently employ it in the course of this Essay; because all the mechanism and operations that are *subservient* to vision may, in this secondary sense, be called visual. But a *Visual Image,* in the *primary and strict* import of the term, is *no other than a Sensation of Color, or a company of sensations of colors:* And VISION ITSELF is the PERCEPTION, BY THE MIND, *of those sensations.*

It follows, from this proposition, that, in the sense now explained, a Tactual Visual image on the retina, being that by which the *known dioptrical laws of light terminate their known operation,* is the *first fact in Cerebral Vision.* And the Retina is a *Common Surface and Articulation of Visual Mechanism,* between Lucernal Vision and Cerebral.

Proposition 2.

The prepared eye of a dead animal, including its retina, when looked through from behind, is a MERE REFRACTING OR DIOPTRICAL, *and is* NOT A REFLECTING OR CATOPTRICAL *instrument.*

Proof.—The fact of our seeing (*as it is called*) in the eye of a dead animal, when we look at it *from behind*, an image of an external object which is in *front* of that eye, (when this fact is connected with that of the foregoing proposition,) renders the truth of the present one self-evident. And the illustration of this fact must be manifestly satisfactory; since any one, of a variety of familiar instruments, makes a very tolerable artificial eye, as will here be described.

A common opera glass, opened to its focus and inverted, forms an artificial eye: In which, any object *appears at a distance to an adept only;* for, to a *mere novice*, the object would, at the nearest, appear to be in the *eye-lens at the end of the telescope farthest from him:* and, by the contrivance of dimming the large lens, it may be brought to appear, even to an adept, as if "*painted*" *upon that lens*, precisely as it appears to be in the prepared eye of a dead animal.

Also, when a lighted candle is placed very near a muslin blind, in a bed-room window, (as it is often seen from the street, or from an opposite house,) this simple apparatus makes a very tolerable artificial eye for the purpose of shewing the

general principle in question. For the flame of the candle *appears* to the spectator just as if it were painted upon the muslin blind. As far as regards the general principle, therefore, the Optician—Huygens—need not have been at the trouble to *invent* an artificial eye: for the image, in such an eye, or in a dead animal eye, is *no more painted in that eye*, than the flame of a candle is painted upon a muslin curtain. In a word; whoever was the discoverer of the telescopic principle, whether it was a philosopher, or a child, he made the very same discovery, a very little modified, as Kepler did when he first observed an image apparently in the eye of a dead animal. And, from all such examples, it is manifest, that the eye of a dead animal is a *mere refracting or dioptrical, and is not a reflecting or catoptrical instrument.*

PROPOSITION 3.

A human living eye, including its retina, can possess no visual mechanism, or property, other than is exhibited by a dead animal-eye when we look through it: Therefore, the human eye is NOT A CAMERA OBSCURA *or* REFLECTING *telescope; but is a mere refracting or dioptric telescope.*

PROOF, &c.—1. Those philosophers, who have supposed the *choroides* to be the immediate organ of vision, must admit this organ of vision, at least in all cases wherein the choroides is *black*, is an *absorber*, and is *not a reflector* of light. Hence,

according to those writers, the eye is not a reflecting telescope.

2. Those, again, who suppose the *retina* to be the organ in question, assume it as acting the part of a *white screen*, which *reflects* the images that are impressed upon it. But, if this be for argument's sake assumed for the moment; it must follow that, in order to constitute the eye a reflecting telescope or camera obscura, we must *get into, or at least* LOOK *into*, the eye; with our back toward the light, and our face toward the retina; which is impossible, and, moreover, is *manifestly contrary to the way in which we employ the eye*. Therefore, on the supposition last considered, the eye is not a catoptric or reflecting instrument.

This reasoning is fully confirmed, also, by the fact of our seeing directly, through a dead eye, any object beyond that eye, in the same sense that we see any object when we look merely with our own eye: for, it is impossible there should be any visual property in the last mentioned instrument, that is not in the first. Thus, a dead eye, being a compound lens, or refracting telescope made up of three conjoined lenses; when we look through a dead eye, in addition to our own eye, we look through *two* telescopes, joined in one continued line, instead of looking through one.

3. There is *yet a Third* supposition, to be adverted to here:—namely,—That the *choroides* is to the *retina*, what quicksilver is to a looking-glass; by which supposition, both the retina and the choroides become equally instrumental in vision.

But this conjecture cannot be tenable: because, it would not hold at all in any choroides that is *black:* And, if the choroides be supposed to be of any other color, so as to be able to reflect the rays of light; the retina, which, like an unsilvered glass, permitted the rays to pass through to the choroides, must equally be supposed to let the rays, reflected from the choroides, repass toward the pupil of the eye, instead of serving, by its posterior surface, as a screen to intercept them. And, lastly; if the retina be even supposed to *intercept* the rays with its posterior surface; and thus to reflect them *toward the perceiving mind, residing in the head;* the mind, thus situated, cannot possibly perceive in *immediate* consequence of an image expanded on the *retina, because the Bony Socket of the Eye is directly between it and the image.*

PROPOSITION 4. RELATIVE PLACE OF THE PERCIPIENT.

The Percipient Essence, considered with regard to its place in relativeness to any visual image in the eye, must be in an OPPOSITE DIRECTION *to that of the external object which occasions the image; that is to say, the* IMAGE MUST *be* BETWEEN *the Percipient and the external object.*

PROOF.—This proposition is only the expression of a CERTAIN AXIOM, which is *tacitly assumed in all the dioptrical laws of light; and it is the sole foundation of the rationality of those laws:* For, unless it be regarded as such, the whole doctrine of

the radiation, and refraction, and reflection, of light becomes a mass of unintelligible expressions.

And here we have the important consideration of fact, that, it is *not only sound Pneumatological Science* (as I have asserted on former occasions) that explodes a doctrine of the mind, which cannot possess so much as a moment's plausibility unless its advocates will go the length of denying that the Percipient Essence has *this, or that, or any other locality, whether absolute or relative.* The doctrine of the *inextension* of the mind, *which is the same thing as that of its non-relation to place,* has not only possessed an era in our own country; but, it has even begun to be disseminated and relished on the Continent of Europe. The consideration of OPTICAL SCIENCE ALONE OUGHT *to have been sufficient to save the intellectual character of the age from falling into such a predicament,* had that consideration but duly occurred to those concerned. If the genius of Newton could revisit the scene; and, were to witness his own assumed pneumatological disgrace, in having his Lockeian notions of mind held up, as a foil to the supposed luminous conclusions of his successors; Can there exist a doubt, but he would reply to them in some such language as that which follows?—And where is the Philosopher so profound, or so hardy, as could gainsay him were he to employ such terms:—"You have introduced a new and mys-
"tical doctrine of mind, unheard of, and uncon-
"ceived by any one, from the days of Plato
"down to your own time. You have not only
"agreed to sweep away the *Species of Aristotle,*

" and the *Ideas of Berkeley;* for which Philo-
" sophy might have owed obligation to you, al-
" though in fact, Locke had already done this to
" your hand: But you have, *most untruly, and*
" *astonishingly, confounded* the SENSATIONS *of*
" *Locke;* (which he asserted as being NOT IDEAS
" *in the scholastic and fallacious import of that word,*
" *but as* MODIFICATIONS OF THE MIND ITSELF;)
" and have stigmatised these as being *parcel of the*
" *'Ideal Theory;'* Than which, when duly under-
" stood, no two schemes could be more foreign to
" each other. And, exulting upon this imagined
" pinnacle of attainment, you have exhibited with
" derision my Optical query concerning visual
" perception, in which I virtually own the belief
" that the *species of things, (always meaning* SEN-
" SATIONS *occasioned by external things,) are pre-*
" *sent to the mind in the Sensorium:* Although, in-
" deed, you did this with expressions of a general
" veneration for my philosophical capacity; and
" leniently seemed to rest the fault, not upon the
" man, but upon the age in which he lived,—a
" courtesy which only vaunts your own superior
" genius.—But: Which of the two following
" predicaments is fit;—namely,—That we em-
" brace your doctrine of the mind; and thereby
" explode Optical Science as a mere chimera;
" in doing which, you will observe, we must also
" annihilate, as if they had never been, all the
" Optical inventions which have shed such light
" upon the other sciences, and have embalmed
" the truth of the laws of light to all future time:
" OR, else, adopt the Lockeian doctrine of per-

" ception and sensations, purged as it was by him " of that fallacy which alone you can properly " call the '*Ideal Theory*;' and, by so doing, pre- " serve to the Sciences, and the Arts, the Diop- " trical Laws of Light, by preserving the MENTAL " CONDITIONS *in which alone they are founded?* " The most ingenious reasoner of your School, " I was about to say, will not pretend that there " is *any alternative*, in this case. But, I had " forgot the tacit understanding, in your age, to " afford *no thought to a general consummation of* " *knowledge, or consistency between the Sciences:* " And, upon *this* score, you have indeed an alter- " native, if you deem it expedient to resort to it: " which matter I shall mention here, in order that " Europe, in the Nineteenth Century, may have " from this single point of view a distinct discern- " ment of the fact, How far a following of your " Scheme would be turning the face, or the back, " upon Philosophy.—The result, to which I allude " is, if you will only assure your generation that " the Mind is to be considered as being of ONE " kind of Essence when we are in the SCIENCE " OF OPTICS; AND ALTOGETHER OF ANOTHER " AND INCOMPATIBLE KIND when we are in that " of PNEUMATOLOGY!"

In order to judge of the *force* of the reply which I have here presumed to put into the mouth of Newton; we have only for a moment to consider that, *without either expressly or tacitly assuming the* RELATIVE LOCALITY OF THE MIND, during every optical act, it is impossible to give intelligibility to the language we must employ concerning it.

To CONTRADICT this truth,—(a truth so certain and important that I shall make it the subject of another set proposition, farther on,)—would be IMPOSSIBLE: And, NOT TO BE AWARE *that we proceed continually on this assumption*, would be a reproach to every understanding that is employed on Optics.—How, then, is it possible to support a Doctrine of the Mind that is utterly incompatible with it?

Altogether apart from Optical Science, I may assume on general ground that, if there is a position which, more than any other, is requisite to preserve the human understanding from general and utter contempt; it is that asserted by Newton—namely—that, if it be necessary for a thing to exist WHEN it acts; it must be equally necessary that it exist WHERE it acts. The consideration which, since Newton's time, has been seized upon by the advocates of the Reideian Theory, that all *supposed contact of bodies is unreal;* is a plea which to the superficial reader must appear to possess much weight: And it has been valued upon accordingly. But that it is altogether nugatory, when duly considered, is perfectly manifest: because, no person will deny that, in every case of supposed collision of two bodies, there is a CERTAIN AND INVARIABLE PROXIMITY of the two bodies: and PROXIMITY IS A RELATION OF PLACE; so that we may believe there is a *real* contact of the unsolid elementary spheres which constitute the bodies; although we have no means of detecting this ultimate and real contact. It is beyond the possibility of

a cavil that, unless the advocates of the Reideian doctrine could deny the INVARIABLE PROXIMITY which takes place in the case of physical action by collision, any attempt to deny real contact can avail them nothing in the judgment of those who are competent to the subject.

If, then, the answer upon Optical ground, assigned here to Newton, appear unanswerable as it stands; With what force must it be confirmed when we come, presently, to contemplate the Seventh and Eighth Propositions: which, among other data, state the rationale of Visual Figure as being constituted by the Interlimitation of our Sensations of Colors by each other? Can it, in such case, be imagined that England, or that France, will not before long revolt from the situation in which the doctrine of the Mind now alluded to has placed the intellectual character of the age; and, inevitably demand a re-union between Pneumatological and Optical Science, whose existing and unnatural divorce, from each other, form an exhibition of absurdity that cannot fail, of itself alone, to render the philosophical name of this era a proverb in the mouths of future generations?

In the mean time, as being of notable cogency in this place, I shall cite the Optical query of Newton, with regard to one point at least of Cerebral Vision.—"Is not vision" (says he) "performed chiefly by the vibrations of this me-"dium, excited in the bottom of the eye by the "rays of light, and propagated through the solid, "pellucid, and uniform capillaments of the optic

" nerves, into the place of sensation?"—And, having quoted this query, I confidently propose; Let those, who have in a later day treated it as chimerical, either declare that OPTICS ALSO, *together with that* AXIOM OF MENTAL PLACE AND POSITION WHICH ALONE SUPPORTS *Optics*, are chimerical: Or, if they will not do this; Let them, then, explain why no farther cast towards Cerebral Vision has been manifested by Philosophers, after the hint which Newton had afforded to them? The answer to this last question, I shall furnish in PROP. 7., from the writings of Dr. Reid himself, in adverting to his criticism of the notion of Briggs and of Newton concerning Cerebral Vision. The momentous truth, however, in this case is, that CEREBRAL VISION *and* THE REIDEIAN THEORY OF THE MIND ARE UTTERLY INCOMPATIBLE: *although* they are *not one jot more incompatible than the* REIDEIAN THEORY *and* OPTICAL SCIENCE. But, assuredly, Dr. Reid *did not discern* this utter incompatibility of his Theory with the laws of Optics. And, *if he had* discerned it, Optics was already built upon a rock, which he could not hope to assail. But (I repeat,) *he assuredly did not discern* this Optical dilemma, in which his Theory of the Mind has involved him. And, as Cerebral Vision had yet no citadel, or regular strong-hold, to withstand him; he thought that the battlements of his Theory might laugh, or frown, as they pleased, upon the solitary and unprosecuted conjecture of Newton. But, in the scrutiny now to be instituted, the Reideian Theory and Optical Science will be brought duly, and as

they required to be, into comparison and collision: which, owing to the course of accidents, is a matter that has never before been brought to the consideration of the philosophical community: and, of which comparison and collision, the above objection, founded on the *certain necessity of setting out* in Optics with the admission of a LOCAL SEAT OF PERCIPIENCE, forms only the first fruit. And, if the Theory in question survive the issue; we shall certainly at least have cause of edification, one way or another. The merits of this case, however, will be farther discussed in the Seventh and Eighth Propositions, just alluded to. And it is impossible to lay too much stress upon its importance, not only to Optics, but also to the Philosophy of Mind.

PROPOSITION 5.

A primary, that is a proper visual image or that made up of sensations of colors, is manifestly about equal in magnitude to the tactual visual image on the retina which occasions it. And, by reason of the Bony Socket of the eye, which is situated immediately between the retinal image and the perceiving mind, it is impossible that the expanded image on the retina can be the ultimate and equally-expanded image in consequence of which the mind perceives a Visible Figure during that act.

PROOF, &c.—Taking our stand upon the Optical Axiom asserted in the last proposition; it is manifest that the situation and nature of the Bony Socket of the eye precludes the possibility that

any organ EXTERIOR to that Socket, whether it be supposed to be the *Retina* or the *Choroides*, or *both these acting together*, can be the immediate or ultimate organ of vision. And this fact, if it had been adverted to, *must* have driven inquirers to seek *within* the Cranium, for the ultimate organ in question. It seems curious that this objection—namely—of the DEGREE OF EXPANSION OR RELATIVE MAGNITUDE of a retinal image—should not have struck the disputants on this question; since it is, plainly, as easy for a camel to pass through the eye of a needle, as for the expanded retinal image to pass, *in all the magnitude of its own expansion*, along the *optic trunk*. It was in consequence of my having viewed, in accordance with this fact, what appeared to me as being a manifest analogy, of *size at least;* and, when duly considered, *not only of size, but also of situation and superficial arrangement;* between the capacity of the *Retina*, and that of the *Two Optic Beds considered as one organ;*—that I was led to afford it a farther consideration:—a mere hint concerning which, I expressed in my Manual of the Mind, without then prosecuting the matter farther.

At this moment, I consider the objection against the Eye itself, on account of the Barrier presented by the wall of the Cranium behind it, as being unanswerable. But all that I shall add with regard to it, here, is that, in case any person should suppose that a *tactual visual image reproduced within, and transmitted along the diameter of the optic trunk*, is a thing very little probable; he has only to reflect that the image of a whole land-

scape can enter the eye in a diameter less than that of a pin-hole. Nor is it at all necessary to suppose that a tactual visual image, while travelling along the optic trunk, *preserves the exact proportions or features of that on the retina,* any more than it must preserve the *magnitude* of a retinal image.

Proposition 6. Nature of Light.

Light *is an* external *substance, or medium: And this medium is* never perceived.

Proof.—Light, whatever else it is, in an *external* physical medium, or agent. It is never perceived,—it not being an object of sight, but an object of our reason or understanding: Its *radiation, refraction,* or *reflection,* is never known to us but as a fact entirely hypothetical; neither of these properties ever being *detected* by us in any of the *phenomena;* but these hypotheses rest wholly for their support upon *an agreement with perceived phenomena,* connected with the hypotheses by mathematical deductions.

But, although the *hypothetical* origin of the laws and of the existence of light is not for a moment to be denied; we shall not on that account hold their truth to be at all disputable. As long as the inventions of the Optician shall exist; and Astronomy, and Navigation, and the Arts, shall owe their perfection, if not their very existence, to the operation of these deduced laws; mankind must smile at the imputation of an hypothetical descent, when applied to facts thus supported. It

remains only to suggest here that, we are LOGICALLY BOUND TO BE CONSISTENT, *in employing* SIMILAR HYPOTHESES, (*provided they admit of similar and equal proof,*) *when we come to inquire concerning* CEREBRAL VISION.

PROPOSITION 7. NATURE OF COLOR.

COLOR *is a* SENSATION, *that is an occasional* MODIFICATION AND STATE OF THE MIND; *and is* NOT AN EXTERNAL THING.

The only reason for making a formal proposition, here, of a fact so universally acknowledged by philosophers, as that now asserted, is a regard to the mischief which, it will be shewn, has accrued from an occasional confounding of the conception of COLOR, with that of LIGHT, in the minds of optical inquirers. Previously, therefore, to shewing that such mischief *has* accrued, I shall here cite the doctrine of Sir Isaac Newton, when speaking as a *Natural Philosopher*, concerning color: which, also, is no other than the *Pneumatological* doctrine of Locke with regard to it. Under the express name of a "DEFINITION" of the subject; Newton, in his Optics, says—"The "homogenial light and rays which appear red, or "rather make objects appear so, I call rubrific or "red-making; and those which make objects ap-"pear yellow, green, &c., I call yellow-making, "green-making: and so on of the rest. And if at "times I speak of light and rays as coloured, or "endowed with colour, I would be understood to "speak not philosophically and properly, but

" grossly and according to the conceptions of " vulgar people. For the rays, to speak properly, " are not coloured. In them is nothing else than " a certain power and disposition to stir up a " sensation of this or that colour."

Such is the doctrine of color which, since the time of Locke, has known no dissent, except in the case of a small and harmless *nominal* divergence on the part of Dr. Reid; whose peculiar doctrine of the mind led him to argue that, *color is the name of the external quality which occasions* our Visual Sensations: while, on the other hand, he acknowledges that the " *sensation may be called the* " *appearance of color to the mind,*"—a confession which amounts to a fullness of consent with the otherwise universal agreement on the subject. When, therefore, we find Opticians, and Philosophers in general, affirming, as they almost universally do, that LIGHT *and* COLORS are the *objects of Sight;* and, continually talking of *colored rays,* and of " *pictures painted* on the retina;"—we must duly and always take note that, they are only speaking " grossly and according to the concep- " tions of vulgar people:" Which practice, manifestly, has arisen for the sake of convenience in the *saving of circumlocution;* especially, as no person has invented an appropriate and abbreviated phraseology of the subject, corresponding with Newton's device of employing the terms *red-making, yellow-making, &c.*

It is now requisite only to produce a remarkable and sufficient example of the fact, that Light and Colors HAVE, on very serious occasions, been con-

founded, not only in the phraseology, *but in the conception also,* of very eminent writers on the subject. The case, to which I shall advert, is that of Dr. Reid; who had read, and written, and doubtless thought, much on the visual properties of the eye, in his "*Inquiry into the Mind.*" And it is to *his* case that I alluded, in the close of the Fourth Proposition, on account of the importance to Philosophy of the consequences which it involves.

In the first place, it is proper to observe that Dr. Reid, in introducing some strictures upon Newton's query with regard to cerebral vision, affords a full share of praise to his *modesty*, as well as to his genius. For my own part, however, although I am nothing short in veneration for both the genius and the modesty of Newton, I never could make out a moral distinction, between his employing the word "QUERY" and if he had said *I think, or suppose:* While, certainly, either of these last mentioned terms amounts, virtually, to what would incur a *philosophical loss of cast* in the eyes of Dr. Reid, and from which sin he altogether absolves Newton—namely—an HYPOTHESIS. Dr. Reid, however, after stating the query in question, (which need not here be re-quoted,) remarks upon it as follows:—"I beg leave to dis-"tinguish this query into two, which are of two "very different natures; one being purely anato-"mical, the other relating to the carrying species "or pictures of visible objects to the *sensorium.*"

The distinction of questions, thus made by Dr. Reid, is a very just one. Let us see, therefore, in what manner he follows it out: while we

also keep sight of the ridicule with which he had previously treated the conjecture of Dr. Briggs,—namely—that, in certain cases of vision, the *optic nerves* "*having the same length and tension*,"—"*will present one and the same image to the mind*:" although I do not at all mean it to follow that we are to embrace this hypothesis of Briggs.—In the course of much pleasantry on Briggs' conjecture, Dr. Reid says:—"Since, therefore, a "blind man may guess as well in the dark as one "that sees, I beg leave to offer another conjecture "touching the nervous system: which I hope," &c.—"Why may not the optic nerves be made "up of empty tubes opening their mouths wide "enough to receive the rays of light which form "the image upon the *retina*, and quietly con-"veying them safe, and in proper order, to the "very seat of the soul, until they flash in her "face," &c. &c. It is after indulging in this strain, with regard to Briggs' conception of the matter, that Dr. Reid, in examining the *second* member of Newton's query expresses himself as follows:—"Here it seems natural to put the pre-"vious question,—What reason have we to be-"lieve that pictures of objects are at all carried "into the *sensorium*, either by the optic nerves or "by any other nerves?"—"I confess this was my "own case for a considerable part of my life: "But since I was led by accident to think "seriously, what reason I had to believe it, I "could find none at all."—"I am not conscious "of any pictures of external objects in my

" *sensorium*, any more than in my stomach."
" INQUIRY, *chap.* 6. *Sect.* 19."

Here, *by the way*, I must remark; One of the wonderful things exhibited in this quotation is the fact that, Dr. Reid informs us, *in effect*, that he was CONSCIOUS that pictures of extended objects WERE in his sensorium, or rather in his MIND: which *case of belief, (for, to be sure, he does not at the moment* CALL *it consciousness) he imputes to* " EDUCATION;" and *supposes the same cause may have misled* NEWTON. Is it not wonderful that a man,—and that man a *Philosopher*,—should for a considerable part of his life,—*that is even until he had attained the age of forming philosophical opinions*,—have BELIEVED that the Sensations of Colors in his Mind were *extended and figured:* and yet, AFTERWARDS *come into court and declare them all to be nothing of the kind, for that* EDUCATION *had deceived him?*

EDUCATION, it is certain, can make us *prefer bitter to sweet:* but, education can never make us *believe that bitter is sweet.* And, if Dr. Reid was mistaken in believing, from his consciousness, for so many years, *with Locke and Newton and all mankind except Reideians*, that his Sensations of Colors are extended; it is deplorable; and, indeed, it is more than deplorable, because it is intolerable; that afterwards, upon believing the contrary, he should saddle EDUCATION with the false imputation of its previously deceiving him.

There is one great mistake, into which Education might certainly lead us, in this subject: It

might, unless counteracted by due reflection, hide from us the momentous fact that, the pictured images which we perceive in the mind are *modifications or states of the mind itself;* since it might make us believe that these pictures are *only "species," let in by the channels of the nerves, from external objects,* and that, at the nearest, they are *never more near than being* PRESENT TO, *instead of being* ACTUALLY IN, *or an* ACTUAL STATE OF, the mind. This, in fact, was the mistake of the earlier inquirers. And it has taken two thousand years to bring all Philosophers to an agreement which forms the modern and sure Starting-post of Pneumatological Science—namely—that the things formerly called *species, or ideas,* are in reality STATES OF THE MIND ITSELF, BEING ITS OWN SENSATIONS OR MODIFICATIONS. But the mistake of the Ancients, now adverted to, was altogether foreign to that which Dr. Reid confesses he had entertained on the subject for a considerable part of his life. Nor does he oppose Newton upon *this* ground: because, although both Newton and Locke gave in to the scholastic PHRASEOLOGY of *species,* and of their being *present to* the mind; it is quite certain that neither of them would for a moment *defend* this phraseology *as being strictly expressive of the fact;* for Newton, (as well as Locke,) in his Definition of Color above quoted, has completely purged himself of this fault. And certain it is that EDUCATION could never have made Dr. Reid, or any other man, *grow up to manhood* in any false belief with regard to the *superficial spread, or not spread,* of his sensations of colors. IS IT NOT

therefore wonderful that the frank and repeated avowals of the Founder of Reideian Theory, in various parts of his writings, of his having come to his doctrine of the mind *in the very face of his own previous consciousness confided in up to his manhood,* should not have saved Europe from the predicament of having that doctrine at this moment in a state of growth and promulgation, through some of its most enlightened countries. The candour of Dr. Reid, to his praise be it recorded, is here above all ordinary value; since it completely redeems HIS mistake, by proving an infallible antidote to his Theory of Inextended Sensations, involving that of an Unlocal Mind: For it is impossible ever to separate these two things, as properties of mind: And, *either,* Optical Science which demands a local mind must be exploded as being a chimera; or, if not, the Reideian Theory of the mind is a reproach to the human understanding. But, to return to the case of Dr. Briggs and of Newton's conception. The principal, and the only important reason for citing the case of Dr. Reid, or his Strictures upon this subject, is *to show by what course* Philosophers, especially since Dr. Reid began to publish his pneumatological views, *have been deterred from casting at all in the direction of Cerebral Vision: And, still more importantly, to show how completely void were the strictures of Reid, of any foundation in philosophy.*

Dr. Reid brings the strictures in question to a close, in the following words:—"The conclusion "from all that hath been said, in no less than "seven sections, upon our seeing objects single

" with two eyes, is this, That, by an original pro-
" perty of human eyes, objects painted upon the
" centres of the two *retinæ*, or upon parts similarly
" situated with regard to the centres, appear in
" the same visible place; that the most plausible
" attempts to account for this property of the
" eyes have been unsuccessful; and therefore,
" that it must be a primary law of our consti-
" tution, the consequence of some more general
" law which is not yet discovered."

Now, as for this last mentioned conclusion; I beg leave to put in my confident dissent from its being true that the fact of single vision from a double impression is a primary, or, what he means, an *inexplicable* law of our nature; for the justification of which dissent, I shall trust to the sequel. But, what is here for our principal consideration is the expression, in the passage above quoted,—namely—that of "objects PAINTED upon the retina." And, first, the phrase—"objects"—(they are often called *pictures*) "*painted on the retina*,"—is as usual and as favorite an expression with Dr. Reid, writing *as a* PNEUMATOLOGIST, as it ever is with any other writer *as a mere* OPTICIAN. Now, therefore, the whole weight of ridicule, which Reid had playfully heaped upon the query of Newton, recoils upon himself with a force which no one can desire to be augmented; since it is *only upon the assumption, as an actual and literal fact, that the images on the retinæ* are "PAINTED" OR COLORED images, that it was possible for him to throw any ridicule upon the conjecture of "*carrying species of objects to the Sensorium*," along

the trunks of the optic nerves. That a *tactual unpainted image, (which we know is the sort of image that is formed in the eye,)* should be transmitted, in a *contracted size,* along the optic nerves; and thereafter be *expanded in the brain to about its original size;* and that, consequently upon an impression of this tactual visual image, we should have a PAINTED image—*i. e. a* SET OF SENSATIONS OF COLORS—*in the mind;* is a supposition *so natural; (although it is altogether hypothetical and unproved in this place;* and is not even supposed by Newton to exist in *this modification;)* that nothing but ridicule can fall upon any attempt to ridicule it. At the same time, Dr. Reid, whenever he thought of it, knew as well as any man, and freely acknowledged, that images on the retina are *neither painted or colored, nor yet perceived by us.* Could it, then, be any other than a temporary oversight, or a momentary lapse altogether surprising, that could have tempted Dr. Reid to hold up the conjecture of Newton, or yet that of Briggs, to philosophical contempt? Each of the conjectures in question *might be, and indeed were, false in point of particularity.* But there is an infinite difference between missing a precisely true conjecture; and a *dealing in chimeras whose very* KIND *ought to be scouted from philosophy,* which last was, certainly, the procedure imputed by Reid to Briggs, and to Newton.

The fact in question is, by far, too important to Philosophy, to allow me to dismiss it without letting Dr. Reid speak for himself, beyond the possibility of any opening for cavil. In the 12th Sect. of the 6th chap. of his INQUIRY, page 252, 3,

speaking on the subject, he says—"There is not "the least probability, that there is any picture "or image of the object either in the optic nerves "or brain. The pictures on the *retina* are formed "by the rays of light; and whether we suppose, "with some, that their impulse upon the *retina* "causes some vibration of the fibres of the optic "nerve; or, with others, that it gives motion to "some subtile fluid in the nerve, neither that vibra- "tion nor this motion can resemble the visible ob- "ject which is presented to the mind."—Now, in all this passage, (which goes farther than is here quoted,) Dr. Reid proceeds upon a wonderful *confounding* of the word *picture*, with the word *image*; and he manifestly forgets that an image on the retina is NOT A PICTURE OR PAINTED thing, but is *in its own nature a* MERE TACTUAL image, as if it had been pricked out by points of pins. Arguing continually on this, his mistake, he in the next page says:—"If any man will shew "how the mind perceives images in the brain, I "will undertake to shew how it may perceive "the most distinct objects; for if we give eyes "to the mind to perceive what is transacted at "home in its dark chamber, why may we not "make those eyes a little longer sighted?" Now, here, the phrase—"DARK CHAMBER"—presents us with a *climax* of absurdity; which must render any farther illustration of it out of the question. No man, who knows that the only visual things he perceives are his own *sensations of colors together with their interlimitations* (for the analytical proof or rationale of which, see the Eighth pro-

position,) can for a moment believe that the mind PERCEIVES ANY images in the nerves, or brain. But, nevertheless, every man must believe that the mind perceives its own visual modification *consequent upon some* TACTUAL *images* in the nerves and brain. And here it is lamentably manifest that Dr. Reid puts in, *as a bar to this supposition*, that the mind is in a "DARK CHAMBER;"—an objection which, indeed, would be cogent enough if an image in the nerve, or brain, were a PICTURE OR PAINTED image; but which presents an antidote to all serious thought when we recollect that the images, any where in THEIR PASSAGE SHORT OF THE MIND, must be ALL TACTUAL images, and therefore that "DARKNESS" can no more affect them, than light could if they had it.

In professing to exhibit, in this inquiry, a rationale of the Cerebral laws of Vision, I was manifestly under necessity to show that the reasonings which have been employed by Dr. Reid, to make any attempt at such a matter appear unphilosophical, were totally nugatory and such as recoil upon the genius of their Author. And, I trust, I have completely made out the case desired. At the same time, when we consider the growing influence of Dr. Reid's opinions, since the time they were first broached; it is pretty clearly accounted for why those inquirers, who have kept in the ordinary creed of their generation, have been scared from any thought of exploring a region of Cerebral Vision,—a region which has been marked out by Dr. Reid's School as being *philosophically worse than contemptible*.

But I must not conclude the topic, now in question, without farther evidence. The case of Dr. Reid, though it is singular in degree, is far from being singular in kind: for other eminent Writers have fallen into the same sort of oversight. Thus, Dr. Potterfield, in his endeavours to establish a chimerical assumption, (which will be disproved in its proper place,) that we SEE *external direction;* and see it *perpendicularly to the impressed points of the retina;* says that—"in seeing any object, the "mind, by virtue of a connate immutable law, "traces back its own sensations, from the senso-"rium, to the retina, and from thence outwards, "along right lines drawn perpendicularly from "every point of the retina." Now Dr. Potterfield, in other parts of the same Work, asserts as strongly as any Writer need do that our sensations are NOT *in the retina, and far less outwards from the retina.* Is it not then lamentable, that, in a moment of bias toward a chimerical principle, such a Writer should thus turn round in the face of his own asserted truth, and talk of "TRACING OUR SENSATIONS *backward to the retina, and to an external object?*"

Nor is this example all that might be adduced on the subject. No less a Writer than Dr. Smith in his Optics, in the very face of Newton's Principles, talks about what is "requisite to excite in our minds the Sensation of light:" which is a Sensation that is impossible for us to have. The same Writer, also, expresses himself as follows:—"Now, if it be asked why in seeing with both "eyes we do not always see double because of a

" double sensation ; I think it is a sufficient reason " to say that, in the ordinary use of our eyes, in " which the pictures are constantly painted upon " corresponding places of the retinas," &c.—And here I must beg leave to observe that, the phrase—" *double sensation*"—is nonsense : for the Writer *meant only a double tactual visual impression ; which thing is not in the mind.* And, no less, the phrase—" *pictures painted on the retinas*"—expresses a most mischievous optical misconception. Have we not then, here, a plenitude of proof, of the existence and mischief of that species of misconception which I affirm has stood in the way, to prevent a Science of Cerebral Vision? And, Can any thing more demand notice, and reform, than such a *continual exhibition of vacillation and inconsistency* in the most eminent Writers on Optics ?

I shall conclude these reflections by observing that, it has altogether been put in proof, that the phraseology usually employed in Optics, and especially the phrase of—" PICTURES PAINTED *upon the retina,*"—*has some times seriously affected the* CONCEPTIONS of inquirers; as it most certainly has done in the cases above adduced. And, having stated so remarkable examples of this fact; I trust we shall never run a risk of being betrayed, by the same means, in the course of the following essay : *For, it is essential to a rationale of cerebral vision,* that we never should fall into this sort of deception.

In fine. I am far from supposing that the query of Newton *must necessarily* have led to any systematic attempt to erect a science of Cerebral

Vision, even if Dr. Reid had never criticised that query. Because, it is long known, *or believed*, that the Optic nerves do not cross *in mass*, as he supposed them to do. Nor does he, as I shall show hereafter, *at all recognise that Mode or General Case of Vision* upon which a Science of Cerebral Vision can be founded. And it will clearly appear, that my own direction to the subject arose from no thought of his query. But it is altogether beyond a question, that a large proportion of persons *may naturally* have been scared from the attempt by the *strictures of Dr. Reid* on that query. And, above all, setting those particular strictures apart, it is certain that the *Reideian doctrine of the Mind, as far as it has been received*, has presented a wall of adamant against any thought of Cerebral Vision: While, at the same time, the Reideians have overlooked, and have slept soundly upon the fact that, EITHER *the Dioptrical Law of Light, or the Reideian Theory*, MUST be to the last degree chimerical, since the LOCALITY *and* RELATIVE POSITION of a *perceiving mind* is a POSTULATE OR AXIOM NECESSARY TO THE VERY EXISTENCE OF THESE LAWS.

As the Laws of Light thus demand, for their existence, the Postulate of the Locality of every mind that perceives by light; It may be presumed, no Philosopher in future will place himself in the situation of *declaiming upon the* PHYSICAL SIMPLICITY *of the mind;* since the assumption of *simplicity*, in a mind that *has locality*, would be a position above all gravity in philosophy. At an epoch of general knowledge, therefore, at which

very few readers can understand the merits of a pure Pneumatological discussion; but in which thousands are acquainted with the Principles of Optics, and with the cogency of the Laws of Light; the best means, perhaps, that ever could be employed to disenchant the age, from the growing spell of the Reideian doctrine, may be that of insisting upon its incompatibility with Optical Science.

I may be told, by those who duly apprehend the subject; and I am sufficiently aware of the fact; that *all the other* Sciences, and Arts, and all the ordinary affairs of life also, afford an *equally real* antidote against the doctrine in question, *provided only mankind be allowed to judge* of the subject "ON THE PRINCIPLES OF COMMON SENSE." But the superior efficacy, which I suppose resides in the antidote now insisted upon, *when it is applied to the minds of readers in general, is this:*— that *in no science, or business of life, except in* OPTICS, IS THE LOCALITY AND POSITION OF THE PERCIPIENT made a STRICT MATHEMATICAL OR RATIONATIVE POSTULATE, *without assuming which, as an essential part of the Science, that Science cannot exist, or even so much as put forth its first step. In Chemistry,* for example, any more than in dining, or drinking tea, it is *never formally stated as a postulate,* that a man's mind must be where his body is. And the Reideian theory laughs at those ordinary persons who labor under the "BIAS" of *tacitly* assuming this postulate.—That it does so laugh is certain: For, if Dr. Reid were alive, and were to affirm that, by an INEXTENDED mind,

he does *not mean an* UNLOCAL mind; the Ghosts of all antiquity, and the Spirit of all sound Philosophy, would rise and join to resent the insult offered to their understanding; or else, at least, to wonder at the fatuity which a "BIAS" could work in the mind of a Philosopher. But, to do justice to Dr. Reid, he has not (*whatever his successors have done*) at all attempted to deny that inextension of mind, *and non-locality of mind,* are one same principle: because he continually designates the "*Sensorium*" in *italics,* in order to stamp it with ridicule.

By the renewed endeavour, as it certainly is, which I have here, standing upon the ground of Optical Science, made to convey to the eye of Europe the refutation of that doctrine which I have through the whole course of my pneumatological speculations earnestly and from strong conviction labored, I confess, to overthrow, as being in its certain tendency, though not in the intention of its founders, most pernicious to human happiness, because it is every way and palpably baseless in reality, and cannot but leave open one knows not how many roads to Scepticism, to Atheism, or to any other Chimera of men's imaginations; I feel confident, if this labor, like former ones, should remain for a time but partially influential, its full time, nevertheless, must come; and the result must be that of a re-union of Philosophers on the Lockeian ground above asserted. With this forecast of the event; I would put the following case to the reflection of those who think for futurity. At the moment I am now writing, an

association of enlightened minds have advanced to the founding of Two Universities in the Metropolis of Britain; in one at least of which, (it is already made public,) there will be lectures on OPTICS, and lectures on MIND,—a new epoch in the literary character of the Country, and one which would seem to invite to a new system of procedure in the *advancement* of Science, no less than in the *diffusion of what is already known.* What a Spectacle will it not then present; if a cluster of warm and ductile Aspirants for knowledge, after having, in the Theatre of the Optical Professor, fixed and built themselves upon the Dioptrical Postulate that, when a *Radiant or Visible Object is on* ONE side of a lens, the *Perceiving Mind must be on the* OTHER! What a spectacle will it not present to posterity, if, upon the mere change of lecture-rooms, from the presence of the Optical, to that of the Pneumatological dispenser of their philosophical faith, these now unfledged learners, but future teachers of mankind, (unless they rebel in the last mentioned station) must *bow their knee to the doctrine that it is a philosophical abomination to suppose* MIND A THING LIABLE TO PLACE!

As one grown old in affording his unpaid labor to the subject; I may perhaps be permitted to lay claim to as large a share of a sense of *duty,* mixed in with the other usual ingredients in human motives, as can fairly be pleaded by most men. And, if this plea be judged to constitute a privilege; I would use this privilege, earnestly to entreat the attention of the founders and proprietors of our recent Universities, to observe, and to *calculate the*

consequence of the event, if the spectacle I have above imagined should in reality present itself. It is far from my intention to have this construed into a *prediction that such a thing will* happen. But, no one will deny that such *has happened.* Nor will any competent judge deny the magnitude of the absurdity which it fixes upon the human understanding; or, the growing mischief which MUST follow, if the learned classes of the community should sanction an UTTER AND COLLEGIATE RECKLESSNESS OF ALL COMPATIBILITY AND CONSISTENCY BETWEEN THE SCIENCES.*

---

* On the publication of the precursory Essay of the Pneumatological Professor in the University of London, I took it to myself, as matter of duty, to have an interview with that Gentleman; and found, he had already under his perusal such of my writings on the subject as are in the Library of that College. I feel bound to add that, although his Essay bears decided evidence of the influence of the Reideian School, he, in the course of touching upon some principal points, manifested an impartial and liberal disposition to embrace truth, on which ever side he should find it to be, according to his judgment, in his approach to the opening of his course. And I here intimate that I shall, immediately after its publication, send to his address a copy of this Rationale; in order that he may be in full time aware of my objections against the Reideian Theory on OPTICAL grounds.

I embrace this occasion to signify, that I shall also forward a copy of the Rationale to the Professor of *Natural Philosophy*, in the same University. And I cannot do less than calculate upon his concurrence and recognition of this work, if he be the Gentleman who, in the "LIBRARY OF USEFUL KNOWLEDGE," has supplied that Compendium of *Newton's Optics*, at the close of which he introduces, with such warm eulogium, the query of Newton, in which that great man virtually avows the

PROP. 8. THE LAWS OF VISUAL FIGURE.

VISUAL FIGURE,—*otherwise called* VISIBLE,—*is the Mutual Interlimitation of our Sensations of Colors by each other, when more than one unvaried Sensation of Color is present in the mind.*

PROOF.—The Rationale of Visual Figure is comprised in the four following self-evident propositions.

FIRST LAW.—UNFORMATIVE:—When we have *only one uniform or unvaried* sensation, that is a Sensation of *any one full or unblending color*, in the mind; we then have no perception of *any figure, any line, or any sensible point*. And, besides this being a *fact perceived, i. e. a mere law of nature*, it is a self-evident *necessary truth, of the nature of a mathe-*

---

belief that the INFINITE MIND has *Infinite Space for his* SENSORIUM; and that, our human minds have, each its own "*little Sensorium which receives the images of things.*"—The reputation of Dr. Lardner, as a man of science, must ensure the consistency of the result, as a matter due to himself, and of which I cannot doubt the issue. It comes not within my view to enter into solicitation for assents. But I consider it fit it should be named, that the assents of the more eminent persons in this department; (in which, Dr. Lardner, in his Professorial, as well as in his Literary capacity; and Dr. Brewster of Edinburgh, from his researches in Optical Phenomena; certainly stand conspicuous,) are rendered a matter which, if the withholding of it be not justifiable, the world will deem they are especially called upon to avow.

matical axiom, that it is impossible any other result should happen.—For an example of this law, we have only to contemplate an *unclouded sky*, on a fine day: in doing which, it is impossible we should, *from this datum or phenomenon,* have a perception of any figure, any line, or any sensible point.

SECOND LAW.—FORMATIVE:—When we have *any two sensations, of different full and unblending* colors, in the mind; they MUST MEET, and their *common line of meeting* is the thing we call a VISIBLE LINE. Thus, a VISIBLE LINE IS NOTHING BUT A CONTRAST *of two different Sensations of Colors,* perceived by a judgment or act of our understanding or intuitive faculty; WHICH faculty, during a sensation of blue and a sensation of yellow, judges that *blue is not yellow,* and that *yellow is not blue;* but that the CONTIGUITY AND CONTRAST, between this blue and this yellow, is a LINE OF DEMARCATION PERCEIVED BETWEEN these two sensations. An example of this law is had when we contemplate the sea and the sky together, when their different colors present a contrast: for the perception of this contrast is the *visible line we call the horizon.* The like phenomenon is perceived in the Sensations of colors which we have when we look at a chess board, as it appears chequered with *black* and with *white* squares.

THIRD LAW.—FORMATIVE:—When any one sensation, of full color, *surrounds or embraces* any other; the line of meeting and of contrast, which they must create, *returns into itself,* and thus cre-

ates the *Outline of some Figure*, such as that of a square, a circle, a triangle, or any other shape. This THIRD Law *is, manifestly, only a different case of the* SECOND. And we have an example of it in the sensation of *white*, EMBRACED by a sensation of *blue*, which we experience when we look at the moon in the clear vault of the heaven.

FOURTH LAW.—UNFORMATIVE :—When we have any two sensations of different colors in the mind; if the color of either sensation *soften, so as to blend with the other gently*, and to leave *no possible perception of contrast between the two where they meet;* it is impossible they should afford us any perception of any figure, any line, or any sensible point, even if their distant sides were of two opposite colors, or black and white. An example of this is had when we look at a piece of shot silk, or at the dawning of day, or at any other case of the *melting of two colors into each other.*

In the operation of these laws, we are to observe, a *sense of* BLACK, *i. e.* a sense of the TOTAL ABSENCE OF SENSATION OF COLOR, *if experienced at the same time that any sensation of color is present in the mind, is equivalent to a sensation of color.* And a Sensation of WHITE, is equivalent to a sensation of ONE color.

These Laws of Visual Figure are stated here as *constituting a link*,—namely—the *final link*—in the chain of Cerebral Vision; this final link being that which during an act of vision *exists in the mind itself*, and which, consequently, exists ULTERIOR *to the last cerebral fact or tactual visual impression.* This mental link, therefore, is the *only* fact, of the

whole visual chain, or process, that can be called VISION, *strictly speaking*. And it is manifestly in the highest degree indispensable that the rationale of Visual Figure be contemplated, and reasoned upon, in order for the possibility of either raising or understanding a Science of Cerebral Vision. AS LAWS OF MIND, these principles have been recognised, both virtually and expressly, in various quarters; and most conspicuously, though not formally, so by the late Professor Stewart. Indeed, it was manifest, from their first proposal, that any thought of *denying* their validity was out of the question. But, owing to the existing state of Pneumatological Science in these Countries, they have in effect remained a dead letter during the fifteen years which have elapsed since the first suggestion of them. The more general promulgation of them must depend upon their being recognised, (as the growing exigences of knowledge shall require,) as being links in the chain of *some other Science which appears to be more an object of general interest than that of Pneumatology; and the true principles of which, when set forth, happen to be generally understood. And both these circumstances, doubtless, exist together in the case of* OPTICAL Science; insomuch, that a corresponding result may fairly be anticipated.

As these laws of Primary Vision present the remarkable case of a re-union, *or identity rather*, of the Subjects of Physical Science with those of Mathematical; it may be of considersble moment to render this fact generally understood,—a fact, indeed, which readers in general will be apt to

apprehend but tardily, unless it be repeatedly called to their attention. On this account I observe that the *Mathematical* nature of these laws consists in the fact, that their *truth and necessity does not depend*, like those of the propositions of Geometry, upon *any precise relativeness of magnitude, proportion, or direction:* which relative proportions (though, as Dr. Barrow truly asserts, they certainly exist in external space,) can neither be truly marked out in a diagram, nor yet depicted in our imagination. But the Mathematical nature of the Laws of Vision depends SOLELY upon the NECESSITY OF THE MEETING of our Sensations of colors, when any two, or more sensations of various colors are present in the mind; and, upon the NECESSITY OF THE RESULT OF THAT MEETING, which RESULT IS A VISIBLE LINE. From this, therefore, it is self-evident that, while the *Diagrams* of geometry are *false*, and its Definitions are *mere hypotheses* whose realities we can never depict; our *Sensations of colors, on the contrary, are facts that* DO *exist depicted in our minds;* and it matters not how large, or how small, they are, or *what difference of shape* they take on, since it is *equally and eternally necessary that their* MEETINGS *are* VISIBLE LINES, *and are the only visible lines ever apprehended by the human mind.*

No objection can be laid against this exposition on the score of the *imperfection of sense, i. e.* on a plea that *sense cannot apprehend a mathematical or breadthless* line. For, if we employ any number of magnifying glasses, of successively augmenting powers, one after another, in perceiving a line between any two colors; all the results will be that

we shall, at every augmentation of power, perceive a *breadthless line of a new or different shape* from all the former: because a line that appears *straight, or smooth,* to the naked eye, will appear rough or *serrated* when we employ a glass upon it; and so on. But the *constant result, in every one* of these experiments, must be a BREADTHLESS VISIBLE LINE, that is to say a MEETING between two sensations of color. And, if we could repeat, or alter this process, to infinity; the last result would be a MEETING, as in all the former cases.

The Mathematical nature of these Laws of Vision, moreover, is the more deserving of notice, since they open to us a very curious field of PHYSICAL REAL EFFICIENCY: Though this consideration is not an object of the present inquiry.

In fine.—As the laws of the Interlimitation of our Sensations of Colors, most certainly, and beyond all attempt at denial, (whatever may have been hoped from evasion,) place the whole scheme of the inextension of our sensations, and of the mind, out of the pale of philosophy; and show, by a strict rationale, that Mind is an Essence which occupies space; I may here, with peculiar force introduce the Optical creed of Newton, involving his creed of the nature of mind.—"Is "not," says he, "the sensory of animals that place "to which the sensitive substance is present, and "into which the sensible species of things are "carried through the nerves and brain, that there "they may be perceived by their immediate pre-"sence to that substance? And these things be-"ing rightly despatched, does it not appear from

" phenomena, that there is a Being incorporeal, " living, intelligent, omnipresent, who in infinite " space, as it were in his sensory, sees the things " themselves, intimately and thoroughly perceives " them, and comprehends them wholly by their " immediate presence to himself."—And here, if we except the word—" *species*,"—which, I have shown, Newton employed only in compliance with the scholastic phraseology of his day; the Creed, which he has avowed, is completely in accordance with the principles of mind which I have proposed and urged throughout my pneumatological writings. And I attach the more value to this coincidence from the reflection that, I had not therein the least thought of squaring my speculations to the opinions of Newton, more than to those of any lesser philosopher.

With regard to the *history*, as well as to the nature and merits, of the doctrine of the inextension of our sensations; which doctrine, the late Professor Stewart has owned, owed its origin to a half-blind or random guess of Dr. Hutcheson; as I have bestowed much and repeated study upon this part of our constitution, I have put the last hand of scrutiny, and of objection, to it in my Manual of the Mind: The particulars of which I would certainly wish to be perused with attention, by all those who are seriously interested in the Philosophy of Mind; because I cannot doubt the result, in any unprejudiced mind that is competent to apprehend the nature of the subject. In that work, which is so properly a companion to the present one that I intend, in the case of future

impressions, the two shall not be separated; I have admitted the truth of the conception hit upon by Dr. Hutcheson, as being that of a *certain modification of our idea of extension;* and I have therein stated the *rationale* of that modification of the idea: whereas, Professor Stewart admits that Dr. Hutcheson's conception,—namely—*that our idea of extension* "is a *notion accompanying* sensations of "sight and touch, *rather than a mere sensation of* "*either of these senses,*"—was a mere incipient light; insomuch that, Mr. Stewart says of Hutcheson,— "*nor does it appear that he was at all aware of* "*the importance of the criticism on which he had* "*stumbled.*" And here I put, for the most earnest attention of philosophical readers, the remark which Professor Stewart makes, immediately after ascribing this blindness to Hutcheson.—"The "fact," (says Mr. Stewart) "as I shall have occa- "sion to shew in another Essay, is he had antici- "pated the very instances which were afterwards "appealed to by Reid, as furnishing an *experi- "mentum crucis* in support of his own reasonings "against the ideal theory."

"PHIL. ESSAYS, *Es.* 1. *chap.* 3."

Now I have in my Manual, in a very particular manner, shown that the Scheme of Reid found its cradle in a most egregious misconception of his, with regard to the meaning of Cheselden; who had asserted, with strict truth, that the eyes of persons laboring under a cataract enable them to *perceive color, without perceiving the figures* OF EXTERNAL OBJECTS: Which fact, Dr. Reid, in the then state of his mind, interpreted to mean that

any such person can perceive color, *without perceiving it to be* SHAPED OR EXTENDED AT ALL,—*an interpretation in the very face of Cheselden's meaning;* who relates that, *on first receiving sight,* his patient *saw all colored objects as things touching his eye.* And here as it is plainly, and beyond all doubt, in evidence that, *besides this erroneous misconception of Cheselden's meaning,* the ONLY OTHER argument which Dr. Reid had to appeal to, "as an *experi-*" *mentum crucis* in support of his own reasonings "against the Ideal Theory," was the fact which Dr. Hutcheson had "*stumbled upon;*" AND, *as the real nature of this fact is, certainly, of the last moment to the cause of Philosophy;* I shall now transcribe a passage, from what I have said in the Manual with regard to it: which, I repeat, I suppose to amount to a *rationale;* because the modification of the idea of extension, now in question, is a *notion of our judgment* and *admits* of a rationale. I cannot refrain from adding that, there is hardly any step of analysis, in the whole philosophy of the mind, that I would more strongly commend to the serious and strict scrutiny of readers than this one, on account of the *consequences* which in part may depend upon it.

"To proceed now, therefore, to consider the "Subject of Extension under a *more advanced* "*aspect,* as has already just been hinted, I alto-"gether agree that there is a *certain and a very* "*frequent modification* of the Idea of Extension, "in which the Idea of Extension IS INDEED '*a* "*notion accompanying* Sensations of Sight, and "Touch, *rather than a mere sensation of either of*

" *these senses*,'—namely,—it is certain that *every* " *perception, or idea, of extension that exceeds the* " *magnitude of a sensible point*, either of Color or of " Touch, is an idea NOT ENTIRELY *of Sense or* " *mere Consciousness*, but is an idea or notion of the " *Understanding;* it being formed by our *discern-* " *ment or judgment of the* CO-EXISTENCE OF MANY, " OR SEVERAL, sensible points of Color, or of " Touch, on the mind at any one time. This fact I " have duly adverted to in my First Lines, as being " preparatory to my treating the process of the " perception of Figure or Outline: In which place " I suggested that, *any ordinary-sized* patch of color " is not, as is generally supposed, A sensation,— " that is *not a simple or single* sensation or object " of *mere consciousness;*—but it is *an assemblage of* " *many elementary sensations,—i. e. of many sensible* " *points of color,*—CO-EXISTING LOCALLY SIDE BY " SIDE ONE ANOTHER IN THE MIND; *and is dis-* " *cerned by our Judgment as such.*"

In continuation of the same argument, I have urged that, *every single sensible part or element* of Sensation of Color is an *extended surface;* and, consequently, that *Sensations* of color, and therefore our *sensible ideas* of color, are extended things. While it was also insisted that, our *notion or judgment of the co-existence of several* of these extended points of sensation of color, in the mind, *is so far from being a contradiction*, that *it is an* ANALYTICAL PROOF AND CONFIRMATION of the fact that Mind and its Ideas of sensation are extended things.

Having supplied thus much of explanation, concerning the history of our idea of Extension; I feel

urged by the strongest conviction to put the following questions:—Will it be believed in after times, when the Reideian Theory shall be named in history as one which trod immediately upon the heel of the Newtonian age; and which, during a century of what may be called the literary, if not the philosophical estimation of the period, *dimmed the lustre of the genius of Newton, together with that of Locke;* that this Theory had NO OTHER ORIGIN, OR FOUNDATION, than the illusion of Reid with regard to the fact related by Cheselden, together with that vague conception of the idea of extension which (in the words of Professor Stewart) Dr. Hutcheson had "*stumbled upon?*" And will it be believed that, THESE TWO SUPPORTS FORM THE SOLE EVIDENCE, AND AUTHORITY, upon which the Philosophers of the Reideian School have calmly, and continually, reiterated, as if it soared above all denial, or question, the assumption that *it is a "bias" in mankind to conceive blue and yellow as things spread out or extended?*

PROPOSITION 9. OF METHOD.

There is logically indicated a STRICT ANALOGY OF REASONING, *which* MUST *be employed in the Propositions that concern Cerebral Vision; precisely corresponding with the reasonings employed concerning the Laws of Light in Dioptrics.*

It being settled, by the rationale of Visual Figure, that SENSATIONS OF COLORS, *including their* MUTUAL INTERLIMITATIONS BY EACH OTHER, form the

SOLE DATA, OR PHENOMENA, from whence we are to reason in any department of Primary or Proper Visual Perception; it becomes self-evident that the two fields of Visual research, now in question—namely—the LUCERNAL and the CEREBRAL—are precisely analogous, and upon a footing as objects of our investigation. In other words; As we never perceive light at any time, (either its reflection, its refraction, or its radiation;): But, on the contrary, without any perception thereof, we have erected a rationative Science of light called the Laws of Dioptrics, the *sole physical datum or foundation of which is* SENSATION AND INTERLIMITATION OF COLOR; So, on the other hand, we are equally bound to employ this sole datum of physical fact—namely—SENSATION AND INTERLIMITATION OF COLOR,—from which to reason, and thereon to raise a rationative science of Cerebral Vision; the deductions of which *must, in this case, possess the very same cogency* as those of Dioptrics.

It is manifestly intended to be conceded here that, if any Propositions should occur, either in this or in any other treatise of the subject, *the proofs of which shall not be legitimately deduced from the data;* or, that the data themselves could be disputed as facts; in so far, the reasonings in question would be vitiated as *rationative* propositions, that is they could not stand upon the *same* footing as the acknowledged reasonings on light in Dioptrics. Any such Proposition, therefore; (and some such will of course occur, if we enter the regions of Anatomical inquiry; or appeal to its light on the subject;) will have to stand upon their own distinct

foundation. But, as far as no deviation of this nature arises ; it is altogether beyond dispute that, ONE SOLE DATUM—namely—*Sensation of Color*—stands in the *very same degree of logical affinity* to the already-recognised Visual Mechanism of Light, and to the yet-unrecognised Visual Mechanism of the Nerves and Brain : Each of which systems of mechanism is equally unperceived ; and each equally and certainly known to perform *some* part in the physical concatenation of Vision.

Confiding in this estimate of the subject, as being one which, I think, cannot possibly fail, or be obnoxious to any possible objection ; I shall proceed, in the following Sections, to reason on the phenomena, in the prosecution of a rationale of Cerebral Vision, agreeably with the method laid down.

SECTION SECOND.

OF SINGLE VISION FROM TWO OCULAR IMPRESSIONS.

INTRODUCTORY STATEMENT.

The several Modes or General Cases, into which Ordinary Vision divides itself, appear to be FOUR. And they may be enumerated as follows.

1. We may see an object *double* when there is an impression of light, from it, on the uncorresponding points of each eye.

2. We may see an object *single* when there is an impression of light, from it, on the uncorresponding points of each eye.

3. We may see an object *single* when there is an impression of light, from it, on the corresponding points of each eye.

4. And, lastly, We may see an object *single* when there is an impression of light, from it, one half, or part, of which is on one eye, and the other half, or part, of it on the other.

The Three first mentioned of these cases are generally known; and, to a certain extent, understood. The *First* case happens when the affected points of the retina, or ocular organ in each eye, are equally sensitive; and when, together with this condition, the attention of the mind is equally given to the visual impression in each eye: for, in this case, if an object impress the uncorresponding

points of each retina, we always see it double. The *Second* happens when, either the affected points of the organ of the one eye, are less sensitive than the respective points of the other eye, or the attention of the mind is given more to one impression than to the other. This Second Mode or Case of Vision is one of the most ordinary that we ever experience: although no persons, except Philosophers, are aware of the fact.—The *Third* case happens when an impression of light, from an external object, upon each eye, falls on the corresponding points of each; and when, together with this condition, two other conditions co-exist,—namely—that the affected points in each eye are equally sensitive, and that they are equally attended to by the mind.

Allusions to each of these Three Modes of Vision will occur incidentally, as we proceed. Though it may be mentioned, here, that the enumerated causes and results of these modes may be variously compounded, or modified, in a number of ways, and degrees; which require the attention and recollection of an experimenter. But, the THIRD Mode, although it is *known to a certain extent,* appears to involve Visual *consequences* which have not been adverted to, or discussed, in any of the extant Treatises on Optics; and which it is one of the principal objects of this inquiry to investigate: Which consideration, therefore, will form the subject of the present Section.

In this place it may be observed, as a general remark or caution, to those who may require it in order to prevent their being led into any mistake,

that, in the experiments which may be employed in the subject, especially those which afford examples of the fact of Single Vision from Two Ocular Impressions, it demands not only objects that are *vivid*, and *equally vivid;* and eyes that are *nearly equal* in their sensitive conditions; but, together with these, a considerable *intension of the mind;* to enable us to perceive or discern the phenomena accurately, or sufficiently: And the perceptions, or discernments, in question will, at the best, be *only occasional;* with frequent failures of one, or more, of the conditions required. It is owing to the operation and modification of these facts, that the phenomena of single and double vision cannot fail to puzzle, or embarrass, the judgment of ordinary observers; so as, in a great degrèe, to veil from them the real nature of the subject. But any caution with regard to them must be unnecessary to those who are practised in carefully observing the phenomena.

It may also be noticed here, although it was implied in the beginning, that the Four Modes of vision enumerated above, as being all those into which *Ordinary* Vision divides itself, are *exclusive* of any Mode, or Case, that happens in result of *extraordinary* causes, either in the structure or situation of the eyes, the nerves, or the brain, of a spectator: Although extraordinary vision will be resorted and appealed to, in the sequel, as affording the most conclusive and beautiful confirmations of the Principles deduced from the Ordinary Modes. Thus, it is an extraordinary case of vision when, by employing two tubes as a bi-

nocular, and putting a cap upon the farther end of each tube, we can *force* the object that is depicted upon one of these caps, into the same perceived field as that depicted on the other; and, by these means, can make two real external objects be seen as one same object. And the possibility, and easy practicability, of this device, and of modifying it in various ways, is a most valuable fact, in furnishing us with crucial experiments on the subject. There are yet other cases, and results, of extraordinary vision; which will be considered in their proper place, and which are of the last importance in the investigation of the laws of cerebral vision.

It remains to state that, what I have here enumerated as being the FOURTH MODE OF VISION, appears to be a clear field of unoccupied ground; there not being the least evidence of its having ever been noticed, and far less discussed, in any extant Treatise on Optics that has fallen in my way. On the contrary; the total neglect or oversight of this Mode; *or, rather, the avowed denial of it in the case of human vision;* is plainly implied, in a variety of ways, in the extant Treatises on the subject. With regard to the *reality* of this Mode, however, I do not anticipate the smallest possibility of an objection when it comes to be fully described in its proper place. And, as it will form, by far, the most important subject entertained in this inquiry; I shall devote the THIRD SECTION to the investigation of it.

These preliminary considerations being adverted

to; I proceed, in the present Section, to consider the Visual Phenomena of the THIRD MODE.

PROP. 10. THE FUNDAMENTAL POSTULATE OF OPTICS.

It being the certain result of the rationale of Visual Figure, laid down in the Eighth Proposition, that the only elements or phenomena therein are SENSATIONS OF COLORS IN THE PERCEIVING MIND, *forming between themselves the local limitations called Visible Figures; it follows that any Tactual Visual impression occasioned by any external object, whether it be of light, or of any other medium, which precedes and thereby occasions vision, must be* SITUATED SOMEWHERE LOCALLY BETWEEN *the external object and the perceiving mind.*

This proposition, being a self-evident mathematical truth or axiom, requires, and admits, of no proof from reasoning: And its consequences have already been insisted upon, in the Eighth Proposition. Therefore, it is only formally laid down here, as being the Fundamental Postulate of Optics, and the Position without which this Science must be utterly impossible. It is a position which can never for a moment be lost sight of, or violated, in the whole course of optical investigation. At the same time, there is one remark with regard to it, which is of material importance to be suggested here—namely—that, although this Postulate is manifestly, and of necessity, assumed *tacitly* in every stage, and every speculation in Optics;

yet, the want of its being FORMALLY *laid down,* and thus made a DULY-PROMINENT consideration, has doubtless been a great assisting cause of men's never having discerned the logical fitness, and existence, of a system of *Cerebral Vision.* The fact is that, this Postulate has hitherto been treated by Natural Philosophers, as some Pneumatologists have treated certain original laws or faculties of the mind; whose existence is of necessity *implied* in all the subsequent principles which are admitted and reasoned upon; but, to which they afford *no formal* recognition, nor pay to them any express attention: the consequence of which has been a frequent overlooking, and not seldom a mischievous violation, of some of the most important truths in philosophy. As a most striking example of the consequence of not having always made a formal recognition of the Optical Axiom, now in question; I have, in the Seventh and Eighth Propositions, sufficiently shown that its due statement and estimation would, of itself alone, have rendered the Scheme of *Mental Non-relation to Place* an object of the last degree of rational dissent. And here, with regard to Optical Science, I may observe that, the recognition of this Postulate is necessary, alike, to the maintaining of the laws of Lucernal, and to the raising of a Science of Cerebral Vision.

PROPOSITION 11.

By parity of reasoning from the Dioptrical Laws of Light, and proceeding upon the Postulate of the

Tenth Proposition, it is demonstrably IMPOSSIBLE *that the* UNION OR COINCIDENCE *of any two ocular impressions, one in each eye, occasioned by light from an external object,* CAN BE ANY WHERE ON THE ANTERIOR *side of the Cranium; and, consequently, it is impossible that any external object, seen by means of these impressions, can be seen any where in the common axis of the eyes on their* ANTERIOR *side: But any object, seen from two such ocular impressions, must be seen somewhere in, or near, the common axis produced* BACKWARD INTO THE CRANIUM:—*And since it is certain, nevertheless, that we do invariably, upon investigation by the Touch, find any such object to be in the common axis produced* FORWARD; *and do* ALWAYS CALCULATE UPON *its being so situated; it follows that such calculation, when consolidated into a conclusion, is* PURELY A JUDGMENT OF THE UNDERSTANDING *by habit rendered instantaneous, as will be explained in a future proposition;* AND IS NOT AN ACT OF VISION.

PROOF.—If we apply, as we are under a logical necessity to do, the mathematical reasonings which have founded and established the laws of light, *(the subject itself of which laws we never perceive;)* to the action of the retina, optic nerves, and brain, *(which subject or action we equally, but no more than equally, never perceive;)* it is a self-evident absurdity to suppose a confounded image, arising from the union of an impression on each eye, to be any where on the *anterior* side of the eyes;—since no *rationated argument can be assigned why* the ocular impressions should converge, or unite,

before the eyes.—Thus, in Dioptrics, we conclude, on the *sole authority of certain Visual Sensations*, and of a *change* of these sensations, (that is to say, for example, on the sole evidence of a change from a *uniform sensation of solar white*, to a *company of varied sensations which we call the seven primary colors,)* that a known external optical instrument called a prism, which we have employed for the purpose, has mechanically occasioned certain component parts, of a certain assumed, *but unperceived* thing called light, to divide themselves, by a process of refraction and divergence, so as to form seven distinct and extended superficial impressions *in separate parts of space on a wall.* And *since, on the authority of the same laws of light*, there are, in the case of two-eyed vision, *two considerably-separated impressions of light in our eyes*, that is to say, one in each separate eye ; which impressions, therefore, in point of *correlative locality to each other, are precisely on a footing with any two separate impressions of light on a wall in what is called a Spectrum of the sun* occasioned by means of a prism ; we are, most surely, equally bound to conclude that a known internal optical instrument called nerves, or brain, must possess an office of CONVERGING *certain rays, or lines, of some unperceived thing*, until these rays or lines become *co-incident*, and so form one same impression or tactual visual image, in some part of the brain, POSTERIOR TO THE EYES, on the interior side of the cranium.

If, as it is certainly true, the last mentioned of these two conclusions deserves no better name

than that of an HYPOTHESIS; then, most certainly, the first mentioned also—namely—the Dioptrical Law of Light—equally deserves no better name than that of an hypothesis. And I may presume that, no hypothesis need be ashamed, that is found in company, and accurately of the same class, with those of the decomposition and recomposition of light.

The Proposition, now had in proof, explains on a strict rationative principle the mistake of those writers who have assumed that, in the case of two-eyed vision, we see the external object *in the direction of the common axis of both eyes*. This assumption, indeed, if it were true, would be *no explanation* of the fact: it would be only an *assertion* of it. But that, the assertion of the fact itself is a manifest mathematical absurdity, if we proceed upon the assumption of the laws of light, is self-evident: because, whatever is seen *before* each eye, must be seen *through* each eye *as through two collateral telescopes whose fields are separated in space;* and, in the case of two-eyed vision, it is self-evident that *each eye in some degree contradicts* the assertion of the other; insomuch that, though it is true that the object is CONSIDERED to be in *some place in front*, and in a *direction between* both eyes, this is ONLY A CONCLUSION OF THE MIND, and is *not at all an ocular phenomenon*, for, as to *Mere Vision*, we certainly SEE things *directly before* EITHER EYE, and *never before our* NOSE.

But the whole mistake is cleared up the moment we recognise that, according to the Proposition above demonstrated, two corresponding

companies of rays, or lines of something, from any two ocular impressions, *must converge;* and *at last* MEET *and* BECOME CO-INCIDENT in some part of the cerebral mass situate in the POSTERIOR POLE of the *common axis,*—that is in the pole of the common axis *when this axis is produced* BACKWARD *into the cranium.*

PROPOSITION 12.

It being a settled fact that, the only constituent element (beside that of sensation of color in its varieties,) in SINGLENESS OF VISUAL OBJECT, *is* SINGLENESS OF VISUAL SITE *of sensation of color; it is thereby farther manifested to be impossible that any two* CO-INCIDENT *visual impressions, which occasion in us the perception of a single object when we see it with both eyes, can be any where* ANTERIOR TO THE TWO SEPARATE *impressions in our eyes which, by their co-operation, somehow occasion the single vision.*

It being a self-evident and acknowledged Principle in Optics, that our whole field of vision is a portion of a Concave Sphere, of which the eye, or retina, is the centre; it becomes an axiom that the only element, which constitutes AN OBJECT, consists in the POINT, *or* POINTS, of VISUAL SITE, of any sensation, or sensations, of color; and this axiom must hold, with mathematical precision, from the whole extent of the possible field of vision, down to a mere sensible point of color; in all which extent, VISUAL SITE of sensation of

color, (in its local correlativeness to the site, or sites, of other co-existing sensations of colors,) is the SOLE MARK OR CHARACTER which constitutes A VISIBLE OBJECT. This, therefore, being an axiom, admits of no reasoning to prove its truth. But the following observations, to which it gives rise, are very material in the way of illustrating its *consequences*.

The Principle, now adverted to, is recognised in a way, by Writers on the subject: but it is *so* recognised, as to amount to a very serious fallacy in the accredited doctrine concerning it; insomuch, that the refutation of that fallacy will form a considerable feature in a future Section of this inquiry. Of the truth of this remark, I can at present hardly adduce a more fit example, than by quoting a neat and recent little Treatise on Optics, which has been furnished in the popular work entitled the "LIBRARY OF USEFUL KNOWLEDGE;" and which, of course, contains the latest accredited doctrine of the subject: In doing which, I desire it may be understood, I do not at all impute the error in question to the Writer of that Treatise; who, in a Work of that kind, had only to embody Principles that happened to be in agreement with the knowledge of other Writers of the day. In the Treatise, now alluded to, it is said:—"The "subject of Single Vision with two eyes has "excited much needless discussion, as it is the "necessary consequence of the law of visible direc-"tion."—"Because the lines of visible direction "from similar points of one image meet the lines "of direction from similar points of the other

" image, each pair of similar points must be seen " as one point, and the aperture seen by one eye " will exactly correspond with the aperture seen " by the other eye."

Now, with regard to the first of these two passages; it is the mere assertion of a fact; which also, as a fact, will be in the fullest manner disproved farther on, by showing that *visible direction* is a mere chimerical principle, and by demonstrating that the very different Principle of VISUAL SITE must be adopted in its stead. And, even supposing visible direction to be a true principle, it *does not in the least* EXPLAIN WHY TWO SEPARATE impressions in the eyes afford SINGLENESS of visible DIRECTION. And, as for the explanation contained in the second passage; it is first to be observed that, nothing is more manifest than that it *would* be mathematically true and precise *were it only therein asserted, as a self-evident necessary truth,* that *rays of something must be produced, and must converge, from* the two separate impressions, one in each eye; and, at length, MUST CROSS AND BECOME CO-INCIDENT *at some spot* POSTERIOR to the eyes: While, upon the other hand, nothing is more manifest than the mathematical absurdity of supposing that we perceive owing to the fact that " lines of visible direction from similar points of " the one image, meet lines of visible direction " from similar points of the other image;" *since it is impossible we should perceive the meeting of any lines* AT ANY SPOT ANTERIOR *to the eyes,* because it is a certain and an acknowledged fact that we NEVER PERCEIVE ANY EXTERNAL OBJECT ITSELF,

but perceive it *only through the* INTERVENTION of the impression, or impressions, in one, or in both eyes; and it is another certain fact that *lines of visible direction, when considered as such, are nothing but figments:* they are real things, indeed, considered *as rays of light;* but, *as we never perceive rays of light,* we *never can perceive* them as *lines of direction.* It will be shown, I trust most satisfactorily, in its proper place, that the man of mere nature labors not under a more profound deception in thinking that he SEES any *External Object,* than Philosophers do in thinking they SEE *External direction;* since, by applying the laws of light to the cerebral process, it will be demonstrated that a Being, endowed with Sight, steers towards an external object by the Eye, as the Mariner steers by his Compass. The thing here asserted against the seeing of External Direction is indeed already shown to be proved, in the brief Introduction to this work: because it was there asserted, from the reasoning of Berkeley and the surgery of Cheselden, that we NEVER SEE OUTNESS; which is only another way of saying we never see External Direction. But I shall, in its proper place, prove the same in a very different way, by proving the existence of a Principle of Vision which will be there suggested under the name of the Visual Principle of Co-incident Images; which, I propose to show, must be substituted for the supposed Visual Principle of External Direction.

The present Section may be allowed to end here: Because, although several other Propositions might have been added to the foregoing;

and several were in fact at first inserted in this Section; they have been purposely transposed to a future Division of the Work, where they will come in with much more effect. Additional arguments, indeed, might have been brought into the present Proposition: But I conceive they will be rendered altogether unnecessary, by the consideration of what will appear in the respective Sections that are to follow.

SECTION THIRD.

OF ERECT VISION WITH TWO EYES.

INVOLVING THE CROSSING AND REFORMING OF IMAGES BEHIND BOTH EYES.

Introduction.

The Three Modes of Vision already considered, are the only ones that have been recognised by Optical Writers as being comprised within the structure and capacity of the human frame. There is, indeed, another and very different Mode mentioned by writers, as belonging to many species of two-eyed animals: but this Mode is usually spoken of as *contradistinguished* from all those by which a human being, or any animal whose eyes are placed like those of a human being—namely—in the front of the head, can ever see objects.

As my own manner of Vision, however, very remarkably contradicts that view of the subject which excludes the *Fourth Mode* of Vision from being an endowment of the human species. And as, in consequence of attending to this Mode, I have been led to observe phenomena which demonstrably ought not to exist if the accredited doctrine of Erect Vision were true; I shall here, in the first place, describe the Mode in question, as

being preparatory to the reasonings and deductions to be drawn from it.

1.—When we are in any spot, contemplating a landscape; or, are walking in the street, and beholding the houses on each side of us; or, are sitting in a room, and gazing on the walls and pictures around it; if, then, we interpose a Septum of Paper, or any other large sheet of thin substance between the eyes, and hold it perpendicularly between the face and the middle of our field of view; we shall instantly, and without the least effort, but on the contrary as a matter of *unavoidable necessity*, perceive one half of the field of visual objects with one eye, and the other half with the other; and we shall be satisfied that we *usually* saw in the same manner, before the septum was interposed.

2.—Yet, the fact above described is not the most complete, although it is vastly the most *usual*, fact of this Mode of Vision: For, when I said—"*one-half* of the field,"—a deduction remained to be made for a small part in the middle of it; which part *may* be seen by *both eyes;* but which, indeed, *very rarely* is seen by both, the impression from it upon one, or upon the other eye, being very usually, either from inattention or from causes in the eye itself, neglected. In order therefore to exhibit this Fourth Mode in the most perfect sort of example; if we place ourselves at the distance of a foot, or more, in front of a large picture, or map; and then employ a visual septum of paste-board fitted close to the face, with its farther edge in contact with the picture, or map; we shall, in this case, *most accurately see* ONE-HALF

of the map with *one eye*, and the OTHER HALF with the *other;* and the two perceived halves will be *naturally*, as well as *accurately*, joined at their nearest edges, and so will form *One whole picture, or map.*

3.—What farther remarkably distinguishes this Fourth Mode of Vision, from every one of the Three preceding ones described, is that whereas, when we intentionally see an object double, from its making an impression on the corresponding points of each eye, it requires both a straining of the eyes and a lapse of time to effect our purpose. Thus, my own eyes being unequal in their effectiveness; if I hold up the blade of a pen-knife, or look through an opera-glass at an actor on the stage; in either of these cases I shall see the object in two places; but in the first case it takes a very considerable, and, in the last, a less considerable time, before I can gain sight of the duplicate object; and in each case there is a straining of the eyes, the former case requiring a greater strain than the latter. But in any of the cases of the Fourth Mode of Vision, now described, if we interpose a visual septum; (and the *mere hand itself* is fit, and is always ready to serve tolerably well for the purpose;) the *moment we do so*, the two halves of our whole field of vision stand revealed, one half to each of our eyes, and this not only without any effort, but in spite of our power to prevent it. This Fourth Mode, therefore, it is plain, is NATURAL ORDINARY VISION—NATURAL ORDINARY HUMAN VISION:—It is, in fact, *indisputably the most ordinary* of any mode of vision ever experienced by any human being endowed with two

effective eyes: In other words, and to speak more definitely; it is the ONLY *mode of human vision with two eyes, in the case of* ALL OBJECTS WHICH SUBTEND A LARGE VISUAL ANGLE, such as a landscape, a street seen by a passenger through it, or any scene which occupies any large portion of our visual hemisphere, at any moment of time.

4.—That as often as we open our eyes upon a scene around us, we *must* see in this Fourth Mode, even without employing *any artificial* septum to make us do so, is quite certain: because the *Nose itself*, although it projects but a very little way beyond the eyes, is a *natural, and a continual, and an indispensable septum*, which can never be unemployed; and, by reason of its interposition, each eye can embrace only about 135 degrees of our horizontal visual circle; whereas, the two eyes together can embrace about 180 degrees or one half of a horizontal visual circle; and, hence, there must be at least 45 degrees of every horizontal visual semicircle which must be seen by one single eye, at the same time that the remaining 135 degrees of the same circle are seen by the other. But the actual fact, in any such case, is that, of the whole portion of any visual field which impresses both eyes, we *never, unless in some very extraordinary cases*, perceive *any part with both eyes;* the impression upon one, or the other eye, being, from a want of some one, or more, of the known requisite conditions, *not felt or attended to.* And thus is the General Fact of our usually perceiving objects, or scenery, one half with one eye, and the other half with the other, described

and shown from experiments so familiar and conclusive, as can leave no fear of its reality being ever disputed.

Here I must not at all be considered as assuming that the suggestion of this Mode, in itself, is any *discovery;* or, that I have been the first to observe a general fact of vision which in reality is extremely obvious to the notice of all mankind. If it be, as indeed it would rather appear, a discovery to Philosophers; I can hardly think it is so to the Vulgar. But *what alone concerns Science,* in this case, is that the matter *has never been recognised by Writers on the Subject;* but has, as I have already said, been *to all intents denied* by the usual mention made by Writers of the vision of animals who have eyes on the opposite sides of the head, as forming a *contrast* to any of the modes of human vision. As, for example, not only Dr. Reid, but also Sir Isaac Newton, expressly contrasts the manner of human vision, with that of animals who have eyes situated as just mentioned. And, that this opinion of the subject has not notably changed since their time, may be gathered from the following observation in Mr. Wardropp's Treatise on the Eye, page 228; in which he says:—"Throughout the animal king-"dom, those animals who have two or more eyes "employ them to extend their sphere of vision: "but man makes use of both his eyes chiefly as "one organ: little advantage being derived from "his being endowed with a pair of eyes, except "that of diminishing the risk of injuries and dis-"eases."—Nor is the view of the subject enter-

tained by this Gentleman any other than in co-incidence with that of Dr. Potterfield, in his very elaborate and erudite Work on Vision. In that Work, (*Book* 2. *chap.* 4.) in enumerating the advantages of having two eyes; he says they are the following:—1st, "That the sight may be more strong and perfect."—2ndly, That, "When one of them is lost, the other officiates."—And, 3rdly, That, "they enable us to judge more certainly of the distance of objects."—Now, neither of these properties at all embraces the seeing of an object, one half, or part with one eye, and the other half, or part, with the other.

After such examples of the conception entertained by Writers, up to the present moment, of the Nature of HUMAN vision; I apprehend, the nature of the Fourth Mode of Vision, as above described, must strike every person as being remarkably different from any of the Three preceding ones: And it does indeed appear very surprising that no notice is found concerning it, in our extant Treatises on Optics. Were not such quotations, as those above given, so strong to the contrary; I must have supposed, the principal reason of the fact's not having been noticed by Writers on the Subject, has been the want of any suspicion that this Fourth Mode *involves any consequences* in Vision, that are not involved in some one of the Three Modes that are acknowledged. I proceed, however, to suggest, and to consider such consequences.

First.—It is sufficiently known, to those who

are at all in the subject, that the prevailing, and almost the only considerable hypothesis in order to account for our having erect vision from inverted impressions in the eyes, is the scheme of making the Sense of Sight submit to that of Touch as its paramount lord, that is by assuming that, after our birth we *learn to transpose* the parts of the image in the eye, or to make a supposed *reformation* of the image *(without our being at the moment, or at any time, aware that we do so,)* a sign to interpret, or accord with, the evidence of Touch. And here it may be granted that, some of the appearances are plausibly explained on this assumption ; while, also, certain analogies of the operations of the other senses are brought in, to corroborate the hypothesis.

But, notwithstanding any momentary plausibility in some of the features of the scheme just mentioned, the contemplation of so vast an imposition of the Sense of Sight upon itself is more than a rational and duly cautious mind can endure. Certain it is that, this hypothesis has failed to satisfy the minds of different Philosophers. I am not singular, therefore, in expressing my own preconceived dissatisfaction at it. But the matter has not rested here: because Anatomy and the Cases of Persons restored to, or rather endowed with, Sight by means of surgical operations, have completely decided against this hypothesis by the fact that such persons, on their first receiving sight, have found no contrariety, or discrepancy, between the evidences of Sight and those of Touch.

Still, it has happened that no better or more

notable hypothesis has been substituted, for that which was thus exploded. And such is the force of long-established opinion that, even, the Surgical decision of the fact might never have been sufficient to prevent an attachment, in many minds, to the Scheme disproved by it. In case, therefore, that any leaven of this really-exploded doctrine may have clung to the understanding of any person; it may not be altogether superfluous here to examine, in a brief way, the respective claims of Sight and of Touch to superiority on this subject: which, therefore, I shall do, previously to going into farther evidence from the Sight alone.

Comparative Visual claims of Sight and of Touch.

First, then; As it is, in effect, the reasoning of Bishop Berkeley that is employed to sustain the prevailing doctrine of Erect Vision, I shall here principally advert to his argument with regard to it. And, not only has it been justly acknowledged by Dr. Reid, that Bishop Berkeley was profoundly mistaken in asserting that our ideas of Sight are *not of the same genus* with those of Touch,—a mistake on the part of Berkeley which I have repeatedly pointed out, and have adverted to again circumstantially in my Manual of the Mind; but it has been proved on the actual evidence of persons restored to sight, who had never before perceived visual figure, that they recognised such figures, at once, as being of the same kind with those of Touch. So far as this fact goes,

therefore, Touch and Sight are shown to be upon a footing.

Secondly. Bishop Berkeley, with all his acknowledged acumen, has overlooked a *very material fact in the history* of our Sensations of Sight and of Touch. Thus, he assumes, for his subject, a being who has received his sight *after having learned the whole grammar of Tangible figure.* And, *even in this case,* as I have already said, the art of Surgery has proved the contrary of his conclusion of our making the Sense of Sight *succumb* to that of Touch. *But the real fact,* in the history of our Sensations notoriously is that *every infant, who has the gift of sight, has learned the whole alphabet and grammar of Visible objects,* BEFORE *his feet have taught him the a, b, c of Tactual* objects. An infant, of a year old, is quite intelligent with respect to the figures which it SEES, in all their varieties of form, and their *visual up, and down:* While, yet, he may never have essayed to use his *feet at all;* and, if he has, it is a *new,* and usually a *very vague,* medium of the perception of up, and of down. It would be wonderful indeed then, if, *after being experienced in visual* up, and down, he should *reverse the confirmed decrees of his Sight,* to subject them to those of his Touch!

Thirdly. It would be vain to allege, here, that *up,* and *down,* are *mere relative* terms; and that, Sight has *originally* no predilection for which bearing shall be called the one, or the other: For the very same affirmation holds, in the same degree, whether true or false, in the Sense of Touch. To a

fly upon the ceiling of a room, provided it had *never seen*, the ceiling would be *tactual down*. And, even, the tactual down of our human antipodes, is the up to us for no other reason than because we *cannot see* the opposite side of the earth. The only philosophical question, in this case is, whether, or not, our Touch causes our Mind or Judgment to reverse the sentence of our Sight, since it is certain and acknowledged that a visual impression in our eyes is inverted, from the position of the external object which occasions it. In other words; Do the SENSATIONS THEMSELVES, of the respective senses, *in reality give contrary evidences of the position of objects actually perceived by them:* And, Is the evidence of Sight reversed by an act of our Judgment, in favor of our sense of Touch; of which act of Judgment we are never aware? Or, Do not the sensations themselves, of the respective senses, give ONE SAME REPORT OF THE POSITION of any object perceived, as the vulgar believe, and as Surgery has proved they do?

Fourthly. Therefore, I suggest here, a matter which appears to be usually overlooked—namely—that the terms—*up*, and *down*,—*in any case* of a being endowed with sight, are NOT *the exclusive* property of the *Feet, or Touch;* although they are usually held to be so. The *natural* speech of man says—"*below our feet*," and "*above our head.*" And the term—UP—*refers as naturally and originally to our* EYES; as the term—DOWN—*does to our* FEET. Nor can it for a moment be denied

that, in point of priority the eyes have it over the feet, as I have already shown in speaking of Berkeley's hypothesis.

The real truth is that, one of the relative terms in question belongs as much to the Sight, as the other does to the Touch; as may easily be confirmed by actual experiment. For, if we sit upon a chair, and look backward between the legs of it; the legs will be *upright to the eyes;* while they are *down-right to the feet;*—that is, the *feet* of the chair will point to the *top of our head,* which point the eyes recognise as THEIR UP, although the Mind or Judgment knows that the evidence of the eyes at that moment contradicts the report of the feet.

Finally. The Touch is quite as ready to speak false on the subject, as the Sight. The *down of the feet,* is the thing the *feet rests upon:* and the feet would equally swear that this thing is *down,* if it were ever so truly *up.* The eyes, in their turn, are no less ready to swear that *their up,* (that is the direction above the head,) IS UP, though it were ever so truly *down.* These two Senses, therefore, when pitted in this manner against each other, equally put each other out of court: And it is *only in the employing of crucial experiments of* ONE EYE *as a* TEST FOR *or* AGAINST THE OTHER, that we can arrive at the truth we are in search of.

Fortunately here, the Fourth Mode of Vision puts it in our power to employ this crucial test of the subject:—the non-recognition of which mode has inevitably heretofore prevented the possibility

of our doing. Accordingly, therefore, I shall now proceed to state the nature and consequences of this Fourth Mode.*

FOR THE SAKE OF COMPARISON—PROP. 13.—FALLING IN THE THIRD MODE.

When we see the whole of an external object, either with one eye, or by the medium of an impression of the whole of it upon the corresponding points of each eye; the impression on one, or that in each eye, is known, from the laws of Dioptrics, to be an INVERTED *impression; and the upper part of the impression, with respect to the lower, is in a reversed position to those of the external object which occasions it; while, also, the impression is inverted* HORIZONTALLY, *as well as* VERTICALLY: *thus every point in the whole impression is transposed; and, hence, we see the object with all its features in a natural order of arrangement; and this phenomenon seems explained if we assume that the* MIND OR JUDGMENT REVERSES *the sentence of Sight, in favor of that of Touch.*

This Proposition, being an acknowledged fact in Optics, requires no present proof. And it is stated here merely for the purpose of illustration, by comparing and contrasting its result with that of the proposition next in succession.

---

* The tenor of this paragraph, (which I suffer to remain here,) will show that, when it was written, I had not then anticipated the important fact that an analagous, and still more crucial and beautiful test of the subject was attainable, from experiments which pit the distinct evidences of a *Single* Eye one against another, and demonstrate their perfect agreement.

Proposition 14.—Fourth Mode.

When we see an external object, one half of it with one eye, and the other half with the other; it is certain, from the laws of dioptrics, that an impression from ONLY ONE HALF *of this object is inverted in* ONE *eye, and an impression from the* OTHER HALF *of it is inverted in the* OTHER; *and the consequence of this is that we* OUGHT *to see,* NOT THE WHOLE OBJECT IN THE NATURAL *arrangement of its features; but this object in* TWO UNNATURAL HALVES, TURNED PREPOSTEROUSLY BACK TO BACK.—*But any such preposterous phenomenon as this we* NEVER WITNESS; *and, therefore, we do* NOT SEE IMMEDIATELY FROM THE INVERTED IMPRESSIONS IN THE EYES; *but these inverted impressions are* REFORMED, AND RECTIFIED TO A NATURAL ARRANGEMENT, BY SOME Cerebral Mechanism WITHIN THE Cranium.

Proofs and Illustrations.—An ocular proof of this Proposition will be had if we refer to the Plate, *Fig.* 1. For we there see that the image of the *half arrow* that is impressed in the *left eye,* is turned with the *barb* toward the nose; and the image of the *half arrow* that is impressed in the *right eye* is turned with the *feather* toward the nose. And, hence, if the impressions in the eyes were the ULTIMATE impressions, from which vision results; we *must* in this case see the two halves of the arrow *preposterously arranged*—BARB to FEATHER: But, any thing like this preposterous case we *never do see:* Therefore, the *ultimate* impres-

sion, from which vision results, must be a REFORMED AND RECTIFIED impression somewhere in the cerebral mass, behind the eyes, within the head.

The most partial of those who have believed in that hypothesis which makes the mind subject the Sense of Sight, to that of Touch, will not, I imagine, be inclined to suppose, *when the two eyes are acting distinctly in concert with each other as in the present case,* or in any case wherein they make the two halves of an object such as a map, a picture, or a landscape, fit together with mathematical precision in all their variety of features, *that each eye puts the false upon the other;* and that, BOTH eyes thus speak false to us; and all this in mere subjection to the Sense of Touch. I think it is not in the least to be anticipated that the prevailing hypothesis will find an advocate, who will hazard the going thus far in order to serve it. But, if there should be any such prejudiced person; there is (besides all the proofs that are to follow) a still farther and more critical phenomenon to be considered in this place; which must at any rate set the matter at rest, even in the estimation of that person.—In the interim; I shall dwell a little here upon the present case.

Perhaps one of the most easy experiments, which a reader could put in practice, in order to afford a striking example of the truth of this proposition, would be the following:—If we employ the hand as a visual septum, holding it perpendicularly, with one edge of it close to the face and the other edge in contact with a mirror; we

shall then see one half of our reflected face with one eye, and the other half with the other. But it is certain, from the laws of dioptrics, that *if the inverted images in the respective eyes were* NOT REFORMED AND RECTIFIED WITHIN THE HEAD, we must see the *two different halves of the reflected face* TURNED BACK TO BACK—*that is the two ears would seem to join together, in the most preposterous order.* But, any such phenomenon as this we never witness: and, therefore, the inverted images in the eyes ARE REFORMED AND RECTIFIED WITHIN THE HEAD.

In such cases as those now described, we are to observe, the half image in each eye is formed chiefly upon *what are called uncorresponding* points of the retina. But the points or correspondence thus meant, is meant only in the case of *two-eyed* vision; and, in strict propriety, they ought to have been called *not-corresponding*, but CONFOUNDING points of the retina; because they mean those points in consequence of the impressions of which the *two separate images* afterwards become *one same image*. But, in another and most proper sense, the image of the half arrow, or of the half face, above mentioned in one eye, is formed upon corresponding points of that eye to the points occupying the other half image; because, when the two halves are SEEN, they are seen *not* confounded or thrown upon each other, *though they are joined;* and, what is above all other considerations here, they are JOINED NATURALLY: whereas, it is certain, from the laws of dioptrics, that they MUST have been joined UNNATURALLY, *that is* PREPOS-

TEROUSLY, if they had not been reformed and rectified behind the eyes.

As a farther test of the crossing and rectifying of images, as above shown; we must observe that a part of the image of the *shaft* of each half arrow falls upon what are called corresponding points of the retinæ; and the consequence of this is, we *sometimes* see the arrow *shortened.* Though we may, indeed, vary the direction of the eyes, so as to make this shortening greater, or less, or even none at all: because, in fact, the two *image-half* arrows, on the retinæ, are *as much* LONGER than the image of the whole arrow would be in either single eye, as they are *afterwards rendered* SHORTER from a part of each co-inciding where they are reformed behind the eyes.

We may vary the subjects of experiment here, in a number of ways. As, for example, if instead of *one* arrow, seen half of it with each eye, we depict *two arrows, barb to barb,* and nearly in contact with each other; and look at one of them with each of our eyes; in this case, it is certain, if the images were not afterwards reformed behind the eyes, we must see the two arrows *feather to feather.* But this we shall *not* see; and, therefore, their images ARE reformed behind the eyes. And herein, as in the former case, we shall find, as the eyes vary their direction, that the *two barbs* shall appear to *cross* each other; but they will do this in the *same order as that of the external arrows;* whereas, they must cross in the *contrary* order if we saw them in result of the two inverted images on the retinæ.

It is finally to be observed here, that the phrase

of "*corresponding*" *points,* whether it be taken either in one sense, or in the other, *can have no meaning whatever unless it be taken to mean a correspondence which takes place* BEHIND THE EYES: because, any two images, one in each eye, can by no means be supposed to *correspond in those eyes.* The very *Principle of Corresponding Points, therefore;* which certainly is an original principle of vision, and is not an effect of custom; is of itself alone a demonstration that the Ocular Images, in two-eyed vision, are reformed and rectified behind the eyes.

In order to be duly sensible, how completely the phenomena of the two half arrows, one being seen with each eye, (and all other analogous phenomena,) explode the hypothesis of Berkeley; we are here particularly called upon to observe that, the only consideration which could render that hypothesis for a moment tolerable, is the plea that the INVERSION of an image on the retina does *not violate the order of nature in any manner, except merely in the inversion of the whole object, taken as a whole.* Thus, although the inverted image in the eye places the ground above a tree, or above a man who is walking upon it; it does not represent the branches of the tree as being in the office of the roots; nor does it make the man to walk upon his head; and, therefore, the advocates of that hypothesis think that all other disagreements may be reconciled at the expense of Sight, by supposing that the *Judgment* reverses and rectifies, without knowing that it does so, the sentence of the eyes. But when we, in the case

of all such phenomena as those of the two half arrows, contemplate the dioptrical certainty that the *inverted retinal images, one being in each eye,* DO TOGETHER *violate,* to the last and most preposterous degree, the order of the INTEGRAL PARTS *of the object,* CONSIDERED AS *integral parts of that object;* we have herein a complete demonstration that these inverted retinal images ARE RECTIFIED, by being changed into reformed tactual visual images posterior to the eyes; and are thus discharged upon the perceiving mind, reformed and erect.

Those who may require to have this illustration impressed vividly upon their imagination, may draw the outline of a man, walking on the ground; and, then, turning the picture so as to see the man with the left eye, and the ground with the right; it is certain, from the laws of dioptrics, that, if the inverted retinal image of each *were not reformed* posterior to the eyes, the man must be seen with his *head in contact* with the *base line of the ground,* (each object being preposterously situated with respect to the other,) and his *feet in the air!* But, any such absurdity as this is never seen; and, therefore, the picture we SEE is *a reformed and rectified* picture, after our having inverted images on the retinæ.

And thus it is, that the Fourth Mode of Vision first introduces us to a System of Visual Mechanism, which could not have been detected by any of the Modes of Sight heretofore recognised.

PROPOSITION 15.

When we see a different field of vision with each eye, in each of which fields the objects are of different and marked features, such as if a coach were outlined in one field, and a pair of horses for this coach in the other; if, in this case, we employ the artifice of binocular tubes, and force these two fields of objects to be co-incident in our vision; the FEATURES *of the respective objects will* CROSS EACH OTHER IN THE TWO CONFOUNDED FIELDS, *but they will do so in the* ORDER *of the external objects, as if the one had* OVERTAKEN *the other: But, it is certain that the impression in each eye is an* INVERTED *impression; if then these ocular impressions were the* ULTIMATE *ones which occasion vision, the* FEATURES *of the respective objects* OUGHT *to cross each other in an order, though natural, yet* CONTRARY *to that of the external objects, that is to say if the external coach and horses are going to the* RIGHT, *the seen coach and horses* OUGHT *to be going to the* LEFT. *But this sort of inversion we never do see: and, therefore, the inverted impressions in the eyes are* NOT THE ULTIMATE *impressions that occasion vision; but vision, in this case, is effected in consequence of* REFORMED AND RECTIFIED IMPRESSIONS WITHIN THE HEAD.

PROOFS.—In the proofs afforded by the last Proposition, (although, most certainly, those proofs might of themselves be rated as being conclusive,) we had only the evidence of a NATURAL JUXTAPOSITION IN THE MEETING of the two halves of an object; which meeting, it was shown, *would not have been thus* if the inverted impression of one

half of it in one eye, and that of the other half of it in the other, had been the *ultimate* impressions that occasioned the vision. But, in the proofs of the present Proposition, we have *much more than a meeting* of the objects, because we have the two objects ACTUALLY INTERWOVEN ONE WITH THE OTHER, the particular features of the one being interlaced with the particular features of the other, and yet, so interlaced as to prove, in the highest degree, that the scene is NOT MADE UP OF INVERTED features; because, if they had been so, they must have appeared *as if going, or looking, in a contrary direction* to that of the external objects.

In order to determine this:—If we roll two half-sheets of common post paper into two eye-tubes, of an inch in diameter, and about five inches in length; and if we fit the farther ends of the two tubes with an oil-paper cap on each, on one of which is *lined out in black ink a coach*, and *on the other a pair of horses;* we may then, by applying the two tubes to our two eyes, throw the coach upon the horses: And, in so doing, we shall perceive that the *seen* coach has *overtaken the horses going the same way* as that of the objects lined out on the paper: Whereas, if the *inverted image of the coach in the left eye*, and the *inverted image of the horses in the right eye*, had NOT *been reformed and rectified behind the eyes*, the seen coach must have overtaken the horses *going the contrary way*.

There is a practicable variation of the example just described; which, to some readers, may afford a still more rigorous conviction of the fact which it demonstrates.—If we depict an *arrow* upon

each cap of the tubes; and, if we throw the *barbs* of the two seen arrows upon each other, by making the caps approach each other with the BARBS *of the two external cap-arrows meeting each other;* it is certain that, *if they were not reformed within the head,* we must then see, NOT the two BARBS; but, *on the contrary,* the two FEATHERS; *crossed and interlaced with each other.* The reader will understand me when I explain that, if we were to throw the *whole* of each arrow, or object, upon the other, we should be *deprived of the test now depicted:* because, then, we should only, (as in the case of the coach and horses,) have the *direction of going, or of looking,* of each seen object, reversed from that of the external objects, and the seeing of BARB, *interlaced with* FEATHER, would NOT BE A FALSEHOOD IN ITSELF; BUT IT WOULD BE A FALSEHOOD IN ITSELF *if we saw according to the two image-arrows on the retinæ, which are certainly* FEATHER *to* FEATHER, while the two *external arrows are* BARB *to* BARB, *that is in the order in which we actually do see them.* This sort of experiment, indeed, or the phenomena which it exhibits, is the *most crucial sort* of evidence of the reforming of images: because the INTERLACING *of two seen* BARBS, *when an interlacing of two seen* FEATHERS *must have appeared if the images had not been reformed,* proves the most complete *exclusion of the images in the eyes, from the* ULTIMATE *process,* that is possible to be imagined. The Various Phenomena of INTERLACED VISION; which Sort of Vision, on account of its importance as a test of the Subject, well deserves a specific ap-

pellation to designate it; will claim attention in a very particular degree, in the sequel of the inquiry.

While the phenomena now described, as being the result of employing two eye-tubes for the purpose, afford a conclusive proof of the fact that was required to be demonstrated; we have from them, as a corollary, the farther fact that, whensoever a visual image in each eye produces *one common field* of vision by the coincidence of their two images behind the eyes, if the *particular features* on each field be vividly marked, they *may with attention,* that is to say as often as both our eyes act effectively, *be seen as being different objects,* UNLESS THEY CO-INCIDE PERFECTLY, although they are interlaced, or ride upon each other in the same field. This, indeed, is a fact known to Optical Writers; and is mentioned, I think, by Dr. Smith, in his Treatise of the subject.

PROPOSITION 16.

When we see one half of an external object with one eye, and the other half of it with the other; the inverted impression occasioned by the one half in one eye, must fall upon an UNCORRESPONDING *part to that on which the impression from the other half falls upon the other eye; and, hence, if these images were* NOT REFORMED AFTERWARDS, *the consequence* MUST *be that, not only must the two halves of the object be seen* PREPOSTEROUSLY, BACK TO BACK, *but also they must be seen* APART FROM EACH OTHER. *But this last phenomenon, (any more than the phenomenon of the*

two halves of an object back to back) is never witnessed: and, therefore, the inverted impressions in the eyes are NOT THE ULTIMATE *impressions that occasion vision.*

By parity of reasoning from the dioptrical laws of light, and from the experiments of the phenomena which establish those laws, it is certain that an impression of light upon *each of two eyes, that are separated an inch, or more, from one another,* must present to the perceiving mind TWO SEPARATED VISIBLE OBJECTS, UNLESS the separate impressions were converged, and met together within the head: For this case is precisely analogous to that of two separated prepared eyes of a dead animal; which, if placed over against an external object, and looked through, must present *two separated* images of that object: And it is also precisely analogous to the two separated images, one at the top and the other at the bottom, or at any distinct part, of a spectrum of the sun, when the sun's light is divided by a prism.

The truth now insisted upon, moreover, is beautifully confirmed by this fact—namely—that, in the natural process of seeing an object, one half with one eye, and the other half with the other, the internal cerebral converging of the two separate impressions on the eyes brings the two seen halves of the object *exactly to meet and no farther;* Whereas, by the *unnatural force* of two tubes, we *can make them cross* each other; while, by the same reasoning, if they did not converge at all, posterior

to the eyes, the two halves *could not meet*, but must *appear separated some distance from each other*, which they never do.

Besides this, also, it is manifest that the two eyes, in any such case, are impressed as if they were *two parallel telescopes:* And two parallel telescopes always produce two images that are SEPARATED; and it is ONLY BY THE CONVERGING of the two tubes of a binocular telescope that they can make an object appear as one.

In a word; The mind perceives two separate impressions on the eyes, *as reduced to one object, by an inversion of the principle of a Binocular Telescope or Pair of Eye Tubes;*—a fact which will form the subject of the next set proposition.

PROPOSITION 17.

As it is by the DIVERGENCE *of the two tubes of a binocular, from the point, or points, of radiance of an external object, that that object is made to occasion* TWO SEPARATE *ocular impressions—namely—one on each eye;—So, by parity of reasoning from the laws of dioptrics, in order that these two separated ocular impressions should afford us a vision of the object as* ONE AND SINGLE, *they* MUST BE CONVERGED, AND MUST MEET *posterior to the eyes, in the head,* IN CORRESPONDENCE WITH THE PREVIOUS DIVERGENCE *of the light through the diverging tubes of the telescope.*

Without farther argument here; I may lay it down for a self-evident truth,—(provided the Visual Organ, here to be supposed, be for the

moment assumed to exist,)—that the Mind, by employing its two External or Cranial eyes, together with that internal Visual Organ in the head which may with strict propriety be called a THIRD OR CEREBRAL EYE, and whose existence and structure shall be insisted upon in the sequel; (the whole being considered together, as if they formed an external object, and we as holding a BINOCULAR TELESCOPE INVERTED towards it; while we *i. e. the Percipient Mind itself* is assumed, by the fundamental postulate of Optics, as being POSTERIOR TO THE WHOLE THREE EYES;) the Mind, I say, thus situated, sees (*as it is called*) an external object by the mediation of IMAGES IN ALL ITS THREE EYES; those in the *two Cranial Eyes being separate;* and those separate images being *afterwards converged and rendered* CO-INCIDENT IN THE CEREBRAL EYE.

The mathematical certainty of the *result* of such a convergence, in its fully explaining the phenomena in question, is in fact *One* of the proofs of the existence of the Organ just mentioned: Although, on the first suggestion of such an Internal and Cerebral Visual Organ, I am sufficiently aware, it is for every reader to receive it with a dubiety, or disbelief, proportioned to the novelty and singularity of its nature. But, as I may be allowed to have something at stake in the suggestion of it; I hope it may, for the moment, be supposed that I have not encountered such a hazard without clearly seeing the grounds on which, at least I feel confident, it can be established. At present, however, I shall content myself with saying that,

the existence of a Cerebral Eye will be demonstrated, from time to time, throughout the sequel, by a course of reasoning of the very same nature, and amount, as that by which the existence, and the distribution, of light upon a wall is demonstrated by the instrumentality of a prism: THE DISTRIBUTION, OR THE EXISTENCE, OF WHICH LIGHT WE NEVER PERCEIVE, *any more than we perceive the* STRUCTURE, OR OPERATION, OF OUR CEREBRAL EYE.

PROPOSITION 18.

OUR VISUAL SENSATIONS—*that is our Sensations of Colors—when excited in adapted circumstances, exhibit erect pictures when the external objects which had excited them are no longer before the eyes, nor at all present in our field of vision; in which case, it is manifest, the* IMAGES WHICH HAD BEEN PREVIOUSLY FORMED ON THE RETINÆ ARE EXCLUDED FROM ALL CO-OPERATION, *as much as if they had never existed; and the erect pictures, which we now see, form an object or case of Vision properly and strictly so called, each of them being a picture made up of a* COMPANY OF SENSATIONS OF COLORS, INTERLIMITED BY EACH OTHER.

The Phenomenon pointed out in this Proposition forms an additional and final step of proof, deducible from the co-operation of both eyes, that reformed tactual visual images of external objects are produced within the head; and that, consequently, *erect pictures*, made up of Sensations of Colors, are ultimately produced, and perceived by

the mind. I say, it is an *additional*, and *more critical* proof of the fact: For, although it is certain that, when all the former proofs are duly understood and appreciated, they are all equally conclusive, *inasmuch as* ALL *the pictures we* PROPERLY SEE *are made up of Sensation of Color in its varieties:* YET, *as a proof against certain extant doctrines with regard to our mental constitution*, the fact asserted in the present proposition is *more critical* than any of the preceding ones, as I shall here point out.

Thus all Philosophers, except Reideians, being united in the certainty that we never perceive external objects themselves, but perceive them only through the mediation of our Sensations; To all such reasoners, each of the foregoing proofs must be equally conclusive. But, as Reideians assert that we perceive the things of the external world *immediately*, and *not through any medium of sensation;* it follows that, when we have a picture of an object in the mind, and when, also, this picture is NOT OCCASIONED BY ANY EXTERNAL object, but exists in the mind after any external object which had occasioned it is withdrawn from the field of vision; a Reideian, were he the most prejudiced of men, can find no argument to put against this fact, *since the fact proves that we perceive an* EXTENDED WORLD OF FIGURED OBJECTS IMMEDIATELY; while it also proves that, when we perceive (as it is called) an EXTERNAL object, we do so NOT IMMEDIATELY, *but* ONLY MEDIATELY. To establish, therefore, so important and critical a fact, the following, as being one of the most ready and convenient, of a great variety of experiments

that would equally answer the purpose, may be put in practice by a reader.

With the face towards a window, in a strong light, hold a large septum between the eyes, so as to cut the window nearly into halves, (*Fig.* 2.) and, with intent to *identify afterwards* the half of the window that corresponds to each eye, hold the septum nearly, but not quite diagonally. Then, look stedfastly at the window, for a few minutes: and having, next, placed a book before the eyes to shield out the light; in a few minutes more will appear, a colored square, or two corresponding parts of a square.—And if, now, the eyes be shut and opened, alternately; there will appear, not a luminous, but a *black, or dark,* picture—namely—that occasioned by the two corresponding parts of the window. And this appearance, variously modified in colors, will appear alternately during a number of minutes. The pictures in this case, moreover, are so vivid, that the window frame which divides each pane of glass will appear, and will be of a bright color when the panes appear dark. The whole appearance will be both powerful and of long-continued intervals, giving ample time, and scope, for reflection upon it.

Every person, in the subject, knows that what is here related, is only a case of what has received the very unmeaning name of "*accidental* colors;" as if all color was not equally accidental, and of one same nature. It is surprising to observe what has been said, by different writers, of this class of Colors. Those who have noticed these phenomena, have confined themselves to conjecturing

on the *cause* of them, such as that of *some light*, remaining in the closed eye; or, an irritation of the nerves. But the really-momentous consideration, which is attached to them, is not by what action of light, or of the nerves, they are occasioned; which, however, admits of full explanation; BUT, WHAT IS THEIR NATURE IN THEMSELVES. And, here, it is beyond the reach of denial that they are SENSATIONS OF COLORS, *extended and interlimited into a visual object*. Nor is it possible to deny that ALL VISUAL OBJECTS ARE MADE UP OF THIS SAME MATERIAL—namely—*of Sensation of color, interlimited*. It may be affirmed, with the utmost certainty, that had this fact formed a part of any such Science as Chemistry; and, had the perfection of arts, or manufactures, involving the wealth of individuals, and of nations, depended upon the truth of the matter s being recognised; the doctrine of the *inextension of our sensations* would never at all have lifted its head. Without any other argument to aid them, the Sensations now in question, excited at our pleasure, render it wonderful that any doctrine in the face of them could have arisen in the philosophical world. But, I pass on to the Optical consequence of the experiment above described.

The two unequal but corresponding and nearly-half-images, which alternate in our mind long after the face is turned from the external object which had occasioned them, afford us the most complete certainty that they are no other than *reformed and erect images:* because, as it is certain that the image of each half is inverted in its

respective eye; it is certain that, if the half image in each eye *were not reformed within the head*, the two half images *must appear preposterously back to back, which they do not*. And, although this certainty is equally great in any case wherein we are looking at an *external object, present with us;* yet, it cannot but be *more impressive* to any reasoning mind, when it is formed by our own Sensations, *in the absence of the external object*. In a word; I deem this to be of the very highest class of evidence, which we could desire in the subject: although a still more curious confirmation, from this class of phenomena, will be brought forward when I come to treat of extraordinary vision.

SUB-SECTION TO SECTION THIRD.

OF THE PRINCIPLE OF VISIBLE PLACE OR DIRECTION OF OBJECTS.

Having, in the course of the foregoing Third Section, laid out the several proofs, which I suppose establish, beyond any anticipation of dissent, that we see by means of reformed and erect images in the brain; which proofs, in fact, place this Department of the Inquiry on the very same footing of evidence with that of the Laws of Dioptrics; and both which must stand, or fall, together; I should now proceed to enter upon another and advance field of Phenomena, in which, the reality of the General Subject in question is to be demonstrated from Data of a

still more curious and interesting description. But, previously to this, it appears proper to entertain the consideration of the very important Principle of the VISIBLE PLACE OR DIRECTION OF OBJECTS; because this Principle is involved in the Phenomena already examined. Of the Schemes, which have for their object the solution of the problem now in question, I shall here consider only two:—namely ONE, that has been advanced by Dr. Potterfield, and insisted on by Dr. Reid; and which, also, as far as I am aware, has not been contradicted by other writers, but is the present prevailing scheme of the subject; but, to which I shall specifically object:—AND ANOTHER, which, if the proofs of its reality should appear to be demonstrative, I apprehend must be admitted instead of that first mentioned.—That, which I shall first entertain, is the Principle advanced by Drs. Potterfield and Reid: And this may, perhaps, be the more effectually done by making it the subject of a set proposition.

OF EXTERNAL DIRECTION.—PROPOSITION 19.—EXTRANEOUS TO VISION.

The Principle of External Direction from the eye, is a REAL *principle; and it is employed whensoever we look at external objects, considered by us as such;* BUT IT IS NOT A PRINCIPLE OF VISION: *And, though it is a principle of what is called* SECONDARY *vision, which means a* JUDGMENT CONSEQUENT UPON *an act of vision; the doctrine of Philosophers that, we judge the place of an external visible object to be in a direction* PERPENDICULAR *to that part of the retina*

on which the image of it falls, is not true; because no ray of light can fall thus, except only that which falls on the axis of the eye.

PROOFS, &c.—It having been established, in a variety of ways;—namely—by the reasoning—*à priori*—of Berkeley;—by the operations of Surgery;—and by the Optics of Newton and of all other Writers on the Subject:—And, it being here in contemplation to prove this fact still farther, by demonstrating, as a contrary principle, that we judge of the place of an external visible object from *a Visual Principle of Co-incident Images*:—It remained to acknowledge, here, the Principle of External Direction, as being a real principle, though one that is *extraneous, and only auxiliary, to a proper act of vision:* and this is now done, accordingly, without deeming it necessary to enter into its details. It was at the same time requisite, in this place, to object to that Doctrine which asserts the Principle of PERPENDICULARITY, as above adverted to: Although the fact itself, whether or not this principle is true, is *not directly* in the way, so as to obstruct the proving of the Principle of Co-incident Images: And my principal reason for entertaining it here is that, it will greatly tend to prevent misconception in the mind of a reader, (when he comes to that part of the inquiry,) by showing that Drs. Reid and Potterfield were mistaken, in their reasonings upon our seeing an object double, with one eye. I proceed therefore to the merits of the fact.

And *First*.—I shall merely observe, with regard

to the Principle of External Direction; that, with whatever instincts the Deity may have endowed brute animals, it is certain that MAN would never move, in any visible direction, before he had *gained some notion that something was to be got by so doing*. Now, the reasonings of Berkeley, and the operations of Surgery, and the Rationale of the laws of Primary Vision, do all, with one accord, confirm the fact that no man, *prior to experience*, can ever know, from *sight*, that any object is *external* to his eye. Hence, it is no less than a demonstration that, the Principle of External Direction is *not a principle of vision*.

Secondly.—It is to be observed here that, Dr. Potterfield has certainly, by different expressions, given up the matter of External Direction as a principle of *Vision*. As, for example, in *Book* 5. *Chap*. 1., arguing against Berkeley's system, he says:—" In fine this is not to solve the problem " whether it be from custom or experience, or by " an original connate law, that by sight we come " to judge" (JUDGE) " of the situation of external " things, but by exterminating all external things " to make the problem absurd and ridiculous."— Now as, upon the one hand, this just use of the word — " *judgment* " — altogether co-incides with what I shall assert on the subject; so, upon the other, I altogether agree with Dr. Potterfield, that it is by a *connate* law of the mind, that is by an *original law of Vision prior to all judgment, though not by a law that is inexplicable*, that we see objects in a certain direction, as shall hereafter be explained. It would appear, indeed, from

repeated expressions that, Dr. Potterfield really meant that we ONLY JUDGE of External Direction; were this not contradicted, as has been shown in a former Proposition, by such assertions as that of *the mind's* "TRACING BACK ITS SENSATIONS OF "COLOR *to the* RETINA, *and thence to the* EXTERNAL "OBJECT."

Thirdly.—To come, now, to the *Principle of Perpendicularity;* it appears to me to be *impossible that any* ray, passing through the centre of the pupil, or that of the crystalline, straight to the retina, can fall *perpendicularly* upon that part of the retina which receives it, except only that ray which falls on the *axis* of the eye. And this, too, seems to be admitted by Dr. Potterfield himself, in the following passage from *Book* 3. *chap.* 7.— "When we look, for example, on the word— "*Mathematician*"—(says he) "if the eye be di- "rected to the first letter—*M*,—and keep itself "fixed thereon for observing it accurately, the "other letters, especially those toward the end of "the word, will not at the same time appear clear "and distinct: The reason of which is because "the pencils of rays that come thereupon fall too "obliquely on the eye to be accurately collected "on distinct points of the retina."—Now this is very just: but it plainly amounts to a virtual admission that all the rays *except one* DO FALL OBLIQUELY on the retina:—And, doubtless, Dr. P. would not deny that we judge every letter in the word to be in the direction of the rays of its coincidence on the retina. I must suppose, therefore, that the imaginary principle of *Perpendicu-*

larity has had its origin in a belief of *some mysterious virtue* in this so-called, but assuredly chimerical principle. As a single, but conclusive proof of its being chimerical; I shall merely mention here that, by the use of my right eye, I plainly judge of the external direction of a book which at this moment is on my right hand, and is so wide of my right eye *as to be nearly at a right angle with its axis;* so that the rays of light, from the book, strike on the side the retina next the nose *with the greatest obliquity possible.* Most evidently, then, I think, the assumption of the Principle of Perpendicularity is a mistake of those who assert it.

From the exclusive use of the phrase—"centre of the *eye*"—by both Potterfield and Reid; and, farther, from one of Dr. Potterfield's diagrams; it would appear that they both meant a *point half way between the front of the cornea and the back of the eye.* But, if they did so; the thing they assert is self-evidently absurd:—because, no ray can fall perpendicularly upon any part of the retina, except the single ray of the eye's axis; since, in order to do so, all the rays must be *radii of a circle whose centre is the centre of the globe* of the eye, which is *a point considerably farther back* than the point half way between the cornea and the back of the eye.

As the last consideration which I shall adduce here, it may be observed that, when we bend an eye upon any field of vision; all the objects in that field, which impress the eye at *any distance from the axis* of the eye *greater than about a third*

part toward the pupil, must impress the retina with an *obliquity so great*, that it is astonishing how any person could overlook so obvious a fact. And yet, Dr. Reid not only avows Dr. Potterfield's principle of Perpendicularity, as being a *connate or original and inexplicable law of the* mind; but also says, he "*honors him for the discovery.*" I leave the matter, now, in the hands of its judges, especially after they shall have taken into consideration the Visual Principle of Direction which will be proposed, and reasoned upon, in the next proposition.

PRINCIPLE OF CO-INCIDENT IMAGES.—PROP. 20. —HOW THE MIND STEERS.

The Mind steers towards an External Object, by making the SEEN IMAGES OF BOTH EXTREMES *of its path co-incident with the* SEEN IMAGE OF THE OBJECT. *And this Principle, when followed out, is analogous to that of a* MARINER'S COMPASS IN THE CRANIAL EYE, *and* ANOTHER WITHIN THE HEAD; *by means of which, a Spectator perceives External Objects, as a Mariner perceives the Pole; and each, alike, steers toward, or from, or wide of, his object upon One and the Same Principle.*

PROOFS, &c.—At first, and during a considerable part of the investigation of the nature of vision; I had viewed the problem, of the Visual Principle on which the Mind Steers, as presenting one of the greatest difficulties in the whole subject of Optics. I discerned, indeed, that the difficulty

was no greater upon my own view of the subject, than upon the scheme of Drs. Reid and Potterfield. But, still, to view the mind as being able, from its watch-tower in the brain, to steer toward an external object which it never perceives; and, to do this by the mediation of an eye or compass which is continually varying its motion in the most complex manner, inasmuch as not only the *eye or compass*, but *also the body or compass-box*, is continually in motion, and the motions of each very frequently differing from and confounding those of the other; appeared to me to exhibit a mystery of the most complicated nature. Dr. Reid, it is sufficiently known, was enabled to *cut* this gordian knot by a single slash of his *Theory of the Mind:* because, according to that Theory, the Creator, by some unaccountable law of our nature, has willed that we should *perceive external objects* THEMSELVES IMMEDIATELY,—a doctrine which, if it were true, would give to his Visual Principle of External Direction some verisimilitude, *though not any real truth;* but which is a Scheme so revoltingly in face of the reason of all Philosophers, (Reideian's alone excepted,) that even the Scotch Professor Brown, the Successor of Mr. Stewart in the University of Edinburgh, judged it necessary to absolve himself from it.

From the early part of my investigation of Optical Phenomena, I indeed discerned that the Mind must certainly steer on the principle of a Mariner's Compass: And I have asserted the same, in a former proposition of the work. But it was not until I had contemplated the matter

very repeatedly that, what I conceive to be the true and precise principle of the thing occurred to my thought: and, when it did so, the simplicity of the principle filled me with surprise that I could have been so long kept from discerning it. Whether, or not, I am right in supposing that I thus advanced, from the first general conception of the fact, to a strict rationale of its principle, is a matter which must be judged from the suggestion of the following experiments, which I now offer in proof of it.

Previously, however, it may be expedient to describe, particularly, the *real* difficulty in question; which is this: The perceiving mind, and its *compass the eye*, and its *compass-box the body*, being all one System in a natural or physical point of view; we may naturally *suppose some real, though occult, connexion* between all these, insomuch that an *image in the Cerebral Eye* may have a *similar relative site* on the retina of that eye, to that which was before possessed by its *antecedent image on the Cranial* Eye; and thus the Mind, *in its Place posterior to the Whole Visual Mechanism*, would, consequent upon the *ultimate image in the Cerebral Eye*, see any object *in a* SIMILAR RELATIVE SITE to that which was occupied by the *first image in the Cranial Eye*.—But, when the perceiving mind has to deal with an *external* object; neither it, nor its body, nor its eye, has *any natural connexion* with that object, any more than it has any real perception, or sight, of that object: In addition to which, both the eye and the body are continually confounding the process, by their

varying motions: How, then, are we VISUALLY TO CONNECT the Image in the CRANIAL Eye, with the *distant and unconnected External Object*, so as to enable us to steer rightly toward that object?—Now, it has already appeared, Drs. Potterfield and Reid assert that we do this on a principle of EXTERNAL Direction: while *External* Direction, we are to observe, is a principle *beyond* the eye. And, on the contrary, I have here to suggest that, we do so, *not* on a principle of *External* direction; but, on a principle of INTERNAL VISUAL SITE—namely—the SITE OF OUR CO-INCIDENT VISUAL IMAGES, *made up of our* SENSATIONS OF COLORS, which is a principle operating *within* the eye, or brain, or rather and strictly speaking *within the mind itself*. And the following is the test, which I now propose for the subject; observing only that, to an unphilosophical reader, the one principle may perhaps appear to be identical with the other; but, to a philosophic mind, the difference must be discerned to be real and great, and its *consequences* still greater. The difference, indeed, may be briefly expressed even here; and it is no less than this: that *any* principle WITHIN the eye is a *principle of* VISION *properly so called;* but *any* principle BEYOND the eye is *not a principle of* VISION, but is a principle of JUDGMENT, *subsequent* to *experience*. The real difference, therefore, between Drs. Reid's and Potterfield's principle, and that which I propose, is that they think we SEE objects in a certain external direction; whereas, I intend to show that we ONLY JUDGE THEM TO BE in a certain external direction *in consequence of our* SEEING A CERTAIN

CO-INCIDENCE OF IMAGES.—I proceed, to the proofs of this proposition.

EXPERIMENT FIRST.—When a novice in the art of shooting first takes up a gun, with intent to fire at a mark; he will, almost inevitably, hold it in such a position, that the *upper side of the barrel* will present the *visual image of a very short line* to his sight; and the consequence of this will be that, his *shot will pass over* the object, *at a distance above it proportioned to the length of the* IMAGE. But, if a practised hand should take up the gun; he would, *from acquired judgment*, bring the *image of the silver* "SIGHT" at the end of the barrel *as nearly as possible in one* with the *image of the top of the* BREECH; and, would *also bring* BOTH THESE IMAGES *nearly in one with the* MIDDLE OF THE IMAGE *occasioned by the external* "MARK;" by doing which, he would reduce the *image of the line* of the barrel to *almost a mere sensible point:* And the consequence of all this would be, his ball (if the other circumstances were right) would hit the middle of the mark.—Such, and so simple and familiar, is the experiment by which I here introduce to the reader the VISUAL PRINCIPLE OF CO-INCIDENT IMAGES,—a principle which, I have no hesitation in believing, forms the key to the right understanding of the curious fact HOW THE MIND STEERS with regard to EXTERNAL OBJECTS.

Now it must be evident that, *all that* VISION has to do, in this experiment, is to GIVE NOTICE WHEN the three *Images*—namely—that of the MIDDLE *of the external mark or object,*—and that of

the silver "SIGHT,"—and that of the TOP OF THE BREECH *of the barrel,*—are ALL CO-INCIDENT IN ONE SAME VISUAL POINT: For it is JUDGMENT, from experience, that *points the gun;*—and *judgment,* from experience, that *knows the shape of the barrel,* and knows also *both the existence and the direction of the external object:* And all that VISION has to do, in the matter, is to REPORT ITS EVIDENCE TO THE MIND that the THREE IMAGES *have gained* ONE SAME SITE, before our Judgment shall order the discharge of the barrel. And this is so certainly true that, I affirm, if a gun had been placed before the eye of Cheselden's patient, the hour after he first saw; and, if any skilful hand had directed the gun to the middle of a mark; this patient would have declared the *middle of the mark,* and the *silver "sight,"* and the *top of the breech,* to be *all one same small object,* of about the size of a large pin's head; and this object he would confidently believe to be *touching his eye,* and NOT *to be* AT ANY DISTANCE EXTERNAL FROM IT.

It is always to be duly remembered that VISION ITSELF is an act of JUDGMENT. For *mere sensation of color, without perception of variety or form,* could not be called vision: and it is *Judgment* that informs us when the images in the mind are, or are not co-incident. But an act of vision is a PRIMARY Judgment: and the Judgments that this vision *has an external cause;* and, that this external cause is in *this, or that, direction;* are *Two Secondary* Judgments, extraneous to vision.

If I may be allowed here to express my feeling, of a matter which at least impresses me very

strongly; I cannot help thinking the example, now given, involves the whole arcanum of the STEERAGE of the mind and body, towards an object, with equal simplicity and truth. Because, in order to put this principle to the last degree of ordeal, if we take the most extreme and preposterous case of vision imaginable; as, for example, if a man were to thrust his head, inverted, between his legs; and, then, looking backward, were to see an external object at which he desires to shoot;—he has *only to bring the three images* (already mentioned) into an *apparent coincidence;* and, if all other circumstances be right, he must be sure to hit his mark, even though his eye, his head, and his body, were all of them *ever so completely twisted* from *their natural and corresponding order.*

And here we are called to observe that the Principle just described is precisely analagous to that by which the Mariner Steers by his Compass.—The CAPTAIN Mariner, sitting below in the cabin of his ship, and looking on his Compass, knows *precisely as well,* and precisely *on the same principle,* as the helmsman who is on deck steering the vessel, that the ship is steering to "DUE NORTH:" For, in order to be certain of this, he has only to observe that the North Point of the Magnetic Card is "IN ONE" with the "SIGHT" marked on the card-box; which "*sight*" is always IN ONE with the *ship's head;* and, then, (provided the compass have *no variation*) he is assured that his vessel is sailing due North. Precisely, then, it is the demonstrated fact from the

case of the gunner as above described, that the Perceiving Mind, *in its Cabin in the Brain*, has only to observe WHAT RELATIVE SITE *is occupied by any* SENSATION OF COLOR, AS IT IS EMBRACED BY ANY OTHER sensations of colors; and the mind is then assured, by its Judgment from experience, that an external object is at that moment in such a direction from the eye, that a gun so held that the images of its two extremes and the image of the object shall be all co-incident, shall, if discharged of its ball, occasion that ball to hit the object.

From such experiments, then, it is evident that the CRANIAL EYE is analogous to a *Mariner's Compass placed on* DECK; while the CEREBRAL EYE is analogous to *another compass placed* BELOW IN THE CABIN, and while, also, we are carefully to observe that the *last mentioned analogy is not the* FINAL one, since, in strict fact, the ULTIMATE *Visual Compass is made up of our* SENSATIONS OF COLORS, *including their varieties and interlimitations, in the mind itself.* Notwithstanding this last distinction, however, it is beyond all question that, the *Generic Principle*, on which the Mind steers, is certainly that by which the Mariner steers—namely—When the Mariner steers by his COMPASS, (*as contradistinguished from his steering by a land-mark,*) he does NOT SEE the far distant object to which his Compass guides him.—And, precisely on the same principle, the Mind *never sees* any external object: but it always steers by the help of its Co-incident Sensations of Colors; by which, as by a Compass, it is guided to its object.—In a word; It is, by the above ex-

ample which illustrates it, put in proof that the Mind steers by the *mediate instrumentality of a* SERIES OF COMPASSES—namely—by a SERIES OF THREE SEVERAL compasses;—*the last one being made up, as already said, of Sensations of Colors in the Mind itself.*—And, hence, we are led to discern a large additional cause of wonder, and of adoration, of the wisdom and goodness, along with the power of the Creator; in his enabling us, by such an unavoidably duplicated system of Visual Mechanism, to preserve our existence, as well as to attain a knowledge of our own and of his nature.

Such is the complete effectiveness of the Principle of Co-incident Images, now proposed, that, as a striking example of its efficacy, I observe, however extravagant it may appear, if a man, or an animal, had an eye, *not in his head,* but situated, like that of a Snail, at the *extremity of a feeler;* and if this feeler reached from here to the Continent of America; this animal, standing on English ground, might steer truly toward any external object in that distant region; and this, even, if the feeler should be ever so much *distorted, or even turned backward;* by only preserving the visual image of the object co-incident with that of some other co-existent visual image, as will be demonstrated by *the following experiment.* As a test, at this moment, however, of the truth of this position; I need only point to the manner in which a novice begins to employ an *inverting telescope: which he is sure to move from side to side in* DIRECTIONS THAT CONTRADICT HIS PURPOSE; until, at length, taught

by experience of his repeated mistakes, he finds that, *whatever be the nature of the instrument, or of the motions he must employ in using it,* the ONLY PRINCIPLE by which he can attain his purpose is that of CONSULTING THE PLACE OF THE VISUAL IMAGES IN HIS SIGHT.

EXPERIMENT SECOND.—The only difference between *shooting at* an object, and *walking on a path toward* that object, is but a *slight variation of the case; without so much as a specific difference in the* PRINCIPLE. Thus, if we should stand upon the curb-stone of a street-path; and desire to walk on this curb-stone, as a path, toward another person who is at any distance from us on the same line of stones; we should first view the *image* which the *line of stones* makes in our sight; and this image would appear to form a *very short line of object.* We should, next, proceed with our *feet,* as nearly as possible as we did with a *gun* when we have been shooting; that is, although we cannot reduce the *image of the other person,* and that of the *line of curb-stones,* and that of our *feet,* all three to a *strict co-incidence;* yet, we shall approach as nearly to this act as possible; and our judgment, the while, is awake to the variation in the case, insomuch that our eye is, as it were, *actually shooting at the person every step we take,* and it is *also better directed* to its object than a gun usually is in the hands of a novice.

In this case, it is plain, if the other person were so far off as to appear no bigger than a *sensible visible point;* he must appear to be the *mere farther*

end of the line of curb-stones. And if, at the same time, we could bring our feet to occupy the presenting place of the breech of a gun; the act of *walking* would become an act of *shooting*. Upon the other hand, it is evident, that if, when we are in an act of *shooting*, the mind could get out of its ocular window;—it might then be conceived to *walk along the gun-barrel, as on a path, to its object.*

As a practical and familiar confirmation of the principle now advanced—namely—that it is VISUAL SITE that is the real principle of steerage of the mind and body; I need only point to an *ordinary foot-path*, which men make across a large field. The general character of such paths is that, they are *not straight*, but are usually *crooked or meandering*. Now the reason of such meandering is evidently this:—There being *no visible straight* path marked out at first for a guide to the sight of the *first traveller;* he is unable to steer himself steadily *from a want of the co-incidence of the several requisite images:*—and although, all the while, his *judgment* informs him *vaguely* that he is steering toward his object; he can gain *no precision* in his steerage, from a *want of the marks* which alone could give such precision. Some foot-paths, indeed, may be straight; because the aberrations of a second traveller may be *contrary* to those of a first: And this, and other accidents, may occasion a path to be not meandering. But it is a notable fact that the *generality* of foot-paths *do* meander: And, I think, I have here *assigned* the true cause of it.

In order to illustrate and confirm the principle

in question, still farther; Let us here observe how the Mariner steers his vessel, in order to approach *straightly* toward any port, or point of land, when a thwarting tide or current is conveying his ship in a direction wide of that of her head. The mariner, (if he can,) KEEPS OR MAINTAINS THE VISUAL IMAGE OF ANY LAND OBJECT, IN ONE with THE VISUAL IMAGE OF ANY OTHER *land object beyond it;* and, *so long as he can maintain this co-incidence of the images of the two objects* in his eye, and mind, he never cares farther about the tide or current; for experience has taught him that the principle of co-incident images carries him surely and safely to his anchoring place.—It is to be kept in view, here, that the Mariner, the Traveller, the Gunner, and perhaps the Snail, are all, by the beneficent imposition of Providence, cheated into a confident belief that it is the EXTERNAL OBJECT of their steerage that they SEE: And it is only the Philosopher, of the School of Locke and of Newton, that recognises the real truth—namely—that they see nothing beyond the Visual Modifications of their own minds.

To enable readers to judge, now, of the difference in philosophicalness, between the Scheme of Drs. Potterfield and Reid and that here insisted upon; they have only to observe that our steerage by *Co-incidence of Images* is here accounted for by a *regular and strict rationale;* though, indeed, it amounts only to a very short and simple one: While, on the contrary, the SUPPOSED VISUAL *Principle of External direction* is held up, by its assertors, *as a mere fact for which they not only do*

not pretend to account; but which, they expressly assert, is hidden from all such attempts; and which, therefore, they call a connate or original law of our nature.

If it should be objected here, or at any stage of this investigation, that *several co-incident* visual images must form *but one confounded, or single image:* I answer; This was provided for, virtually, in describing the first experiment: and it was *never intended* to be asserted, even in the case of shooting at a mark, that we bring the several visual images into a *strict, accurate, or complete,* co-incidence: But, we universally bring them *so very nearly* into a strict co-incidence, that, the dullest understanding must discern that the VISUAL PRINCIPLE *of the* PLACE *or* DIRECTION *of* OBJECTS, WHEN DULY FOLLOWED OUT, RESOLVES ITSELF INTO A STRICT *co-incidence* of images, as *being that of its ultimate and essential nature.*

Upon the other hand; If, with a view of depreciating this Principle, it should be said that, after all that has been advanced, every clown who has handled a gun must have known the principle before it was here suggested: I answer; Not only did every such clown know it, *in a certain way;* but, *also, the very essence of it,* AS A VISUAL PRINCIPLE, *consists in the fact that* ALL MANKIND knew *and practised* it.—*The only matter for our philosophical* consideration of the thing is that, *no Philosopher had ever explained it.* As an example, in proof of this; the exposition given by Drs. Potterfield and Reid has been demonstrated to be contrary to the

truth of our nature, PRECISELY ONLY BECAUSE *it has been demonstrated to be contrary to the knowledge of a fact* PRACTICALLY KNOWN AND RECOGNISED ALIKE, BY ALL GUNNERS AND ALL OTHER MEN, though it was never THEORETICALLY EXPLAINED by any one.

On this occasion, it may be of service to repeat a remark, which I have made in a former work with regard to the perception of *Visible Outline or Figure;*—namely—that, in some of the most important departments of Philosophy, *mankind in general know in* ONE AND A PRACTICAL sense, what neither themselves, nor Philosophers for them, know in a PHILOSOPHICAL OR RATIONAL sense. As an example of this; it is certain that, from the beginning of time, every painter's boy must have known that, *without some two contrasting colors*, there can be *no visible line or figure:* And yet, no Philosopher had ever discerned that a *visible line is purely nothing but a meeting and contrast of two of our different Sensations of Colors.*—In such cases of philosophical oversight, it appears to be the *extreme simplicity* of the fact that forms a subtilty which causes the thing to escape detection. Nothing in the world can be *more simple*, or more *self-evident*, when brought within our apprehension, than the nature of a visible line, as that nature is demonstrated in the laws of our visual sensations laid down in Section First of this inquiry. And *this very simplicity* could be the only reason why all philosophers have *overstept* it, in some such way as a man oversteps the threshold of a door before he is aware that he is beyond it. This appears to be

so manifest that, as I have on a former occasion remarked, even the acute Bishop Berkeley, *throughout his speculations on Vision, never doubted that every visible line is a* "BLUE," *or a* "YELLOW *line*," *or a line of* SOME OTHER COLOR. Impressed with this simple nature of the thing; I have on a former occasion, (in replying to a letter of Professor Stewart in which he says—"You have my free consent to take the credit of the discovery,")—deemed it due, in allusion to the word "*discovery*," to state that I never valued myself upon evincing any particular acumen in the discernment of the laws of Visible Figure, unless on the comparative ground that no person before me had discerned them. But here, in consequence of the entertainment which these laws of Vision have received, I cannot withhold the expression of my belief, (without annexing this belief to any illiberal imputation upon any one,) that if they had belonged to Mr. Stewart; or, been launched from the Chair of a Metaphysical University; Europe, at large, would have heard of them before this time.

As for the *Visual Principle of Co-incident Images*, here insisted upon; Although this Principle is indeed *less simple* than that of a Visual Line, it is *yet so simple* that, this has probably aided much in its escaping the notice of such erudite and considerable inquirers as Drs. Reid and Potterfield. Of the great probability of this; I can offer a fact of my own experience: And I will here furnish this fact, in case it may at any time serve the cause of philosophy, by forming a guide to future inquirers on other subjects. The fact is that, few persons have

been more early inured to the use of the gun, or have for half a life been more daily in the practice of employing it, than myself: consequently, I must be as intimately acquainted with the visual principle of co-incident images, *considered as a practical* principle, as with any daily fact whatever. *And yet,* at this late period of my life, when I was *seeking for the rationale of the steerage of the mind by the eye;* although this desideratum has here been demonstrated to be *founded in the practical principle in question, and in this alone;* it cost me *very repeated reflection, for some weeks,* before the practice of the gun occurred at all to my aid; and I was, all that time, under serious doubt that the rationale of the subject might prove ultimately a thing not within human attainment.

Upon this, I would farther point out, for the sake of future inquirers, that, although it is strictly true, as has been proved by *Experiment Second,* that we *walk toward* any object on the very same principle of co-incident images as we *shoot at* any object; YET, if my attention to the fact *had not been previously drawn by my reflecting on the way we act when we are* SHOOTING, I deem it to be a considerable chance, I might never have arrived at the principle at all. And this appears to be so probable, that, I do not much believe any person would have arrived at the principle in question, who had never handled a gun, or some other such instrument. Whether Drs. Reid and Potterfield were sportsmen; I know not. But, if they were not; it may account for their adopting, and reasoning upon, the Chimerical Scheme of our SEEING *Ex-*

ternal Direction; and for their not having fallen upon the Principle of Co-incident Images.—As a farther evidence of this; I observe that, *since* the principle of co-incident images has occurred to my mind, I perceive, plainly enough, that the use of a *Telescope* involves this principle. And it certainly appears that Dr. Reid was used to *Telescopes*. But, in employing a Telescope, the principle in question is *not near so obvious to notice,* as in the case of using a gun; insomuch that, although I had myself been in the habit of using Telescopes in early life; this did not in the least suggest to me the principle now under consideration, and perhaps it never would have done so.

And here closes what I had to suggest and demonstrate with regard to the Principle of Visual Place, or Direction:—the real nature of which, if it has been truly explained, is certainly, *owing to the Pneumatological consequences which it involves,* one of the most important considerations in the whole compass of Optical Science; And here also ends what was intended to be advanced with regard to that Fourth Mode of Vision, the suggestion of which I was induced to hazard; and from the nature of which, I have delineated so large a portion of the rationale now submitted to the reader.

SECTION FOURTH.

OF ERECT VISION WITH A SINGLE EYE.

INVOLVING THE CROSSING AND REFORMING OF IMAGES BEHIND THAT EYE.

Introductory Matter.

The field of Visual investigation upon which we are now about to enter, is one which I had by no means anticipated when I first resolved to entertain the subject of Cerebral Vision. The phenomena and results which I had in the beginning observed, as contradicting the existing doctrine of single and erect vision, appeared to me to be fully sufficient to establish all that I then desired to suggest. Although, if there had been no farther field of investigation in the subject, it would certainly have rendered the inquiry a matter of comparatively small extent, when contrasted with that which it will occupy from the additional department examined in the present section. In the course, however, of laying out the matter first mentioned, as has been done in the foregoing Sections; and, in resorting to the experiments requisite for its proofs and illustrations; it could not well have happened that my attention should have remained uncalled to such Phenomena as those of Extraordinary Vision with One Eye: a

variety of which, have been treated by Drs. Potterfield and Reid; and quoted particularly by the former, from the experiments of the French Philosopher Mons. de la Hire. And I had no sooner turned in this direction than I was struck by the general fact, the consideration of which will occupy some space in my remarks upon it, previously to going into its proofs.

In this place, it may be proper to advert to what I shall particularly explain in the Preface to the work—namely—that the objects of my habitual research, and the circumstances of health which have attended and have frequently interrupted their progress, had altogether prevented my affording any serious attention to the subject of Optics, notwithstanding all its acknowledged interest, and also notwithstanding its being in part connected collaterally with the objects of my usual pursuit. And this more especially was the case in consequence of my not having, until very lately, at all suspected that any practicable field had been left open in this Department, for any investigation of the nature of the present inquiry: the mention of which fact will explain why I was not sooner called to examine such phenomena as are now about to be considered. This being understood; I subjoin the following observations.

From the results of the experiments which will be described in their proper place, I feel confident, it will not for a moment be denied that the general fact, now in question, opens to our view a new and most interesting field of knowledge of the Mechanism of Sight; since, in addition to the

results of those dioptrical reasonings, which have in the foregoing Sections established the fact of the convergence and ultimate co-incidence of every *two corresponding impressions, one in each eye;* we are now called upon to contemplate a *similar system of mechanism existing in each eye singly,* altogether apart from, and independent of, the mechanism of the two eyes when they act in concert.

Among the other consequences, of the fact now suggested; it must be attended by one, which I may mention here—namely—that whereas it might otherwise have happened that we might be fain to grope, more or less in the dark, in attempting to determine the *precise* place, within the cerebral mass, at, or by the instrumentality of which an ultimate and co-incident impression is formed in consequence of a previous impression upon each of the two eyes: Or, even, if this place were ascertained with only a considerable degree of probability, leaving any portion of doubt, or denial, in the minds of some readers, and incomplete satisfaction with any:—In either of these cases, the fact of Double Functions being displayed by a Single Eye must vastly aid toward the complete solution of the problem; since the *place* of *meeting*, in the case of a SINGLE eye, *must be somewhere* ANTERIOR to that where the analogous operation in the case of BOTH eyes takes place; and the precise place must be more open to detection.

The Phenomena, to which we are here in the first instance called to attend, as they are described by Drs. Potterfield and Reid, I may notice in the following general terms.—Make two, or

three, or any greater number of pin-holes, in a card, within such a distance from each other as will admit rays of light to enter the pupil of the eye through all of them at the same time; and, sticking a common pin up in your view, from any distance *either within or beyond the distance of distinct vision*, look at this pin through the holes: whereupon, you will see as many pins, or pins' heads, as there are holes in the card.

Dr. Reid, in the course of treating this general fact in several of its modifications, dwells upon it as being very wonderful; and points out particularly the consideration of its surprisingly *contradicting* the ordinary laws of vision. And there is a sense, in which this his remark is just: of which fact, he enumerates several instances. But, while I make this admission, I would rather affirm, as being by far the most important feature in the case, that there is another and far more important sense in which the general fact very wonderfully and beautifully *corresponds with and confirms* the ordinary laws of single vision with both eyes. With regard to any suggestion, or suspicion, on the part either of Dr. Reid or Dr. Potterfield, of any such important result as being deducible from these extraordinary phenomena; there is no such matter adverted to by them, more than by any other writer. On the contrary, the only use they make of the phenomena, is to furnish a proof, as they deemed it to be, that we see objects in a certain *External Direction*. And, with regard to that attempt, I rest upon the confidence that its merits have been decided in the 19th and 20th

Propositions of this inquiry. As for the *supposed proofs*, which Dr. Potterfield, (and Dr. Reid after him,) gives from experiments upon two holes in a card; I shall only observe that they could be plausible in no case, except in any case wherein the objects impress the retina *near its axis:* And, even then, the *proofs* are *certainly not sound*, though they may at first sight appear specious:—I ought to add that Dr. Potterfield, singly and condemned by Reid, has employed the same phenomena to establish his position that we SEE *the distance of objects from the eye.* But, I think, neither of the Writers in question has evinced any other conception, as being deducible from these extraordinary phenomena.

From a phenomenon known to Writers on Optics, it is a property of the eye, that, when the pupil is rendered opaque in the middle, it causes double vision of a small object presented to the diseased eye. And, from this fact, I from the first discerned that a single eye, in this case, operates on the principle of two corresponding eyes. In consequence of this, I introduced a Proposition in Section Second; the substance of which will be embodied and absorbed in the Propositions that are now to follow. In the same place, and upon the same ground, I introduced another Proposition, with regard to the known fact adverted to by Dr. Reid, as well as by Dr. Potterfield, that *not only a central ray*, but equally *any collateral and converging* ray, that enters the pupil of the eye from an external object, will make us see that object in the

direction of the *central* ray: From which case I argued that, *as it is solely because the collateral ray, or rays, are* BENT, after they pass the pupil, that they make us perceive the object in a direction that is *mediate between* themselves and rays which should pass at an equal distance on the other side of the pupil, (which is the real fact,) so, by parity of reasoning, it is solely because two separate impressions of light, in our two eyes, are *conveyed, or reproduced posterior* to the eye, that they make us perceive the object single and in a position in a line intermediately between the positions of the two eyes. But the Propositions, now alluded to, were founded on mere reasoning—*à priori*—from the GENERAL assertion of the facts by Writers on the subject: And I had not then had the curiosity to resort to the experiments described by Potterfield and Reid. It remains only to say that, the moment I resorted to the experiments, my attention was called to a class of Phenomena which present themselves to the single eye, without the aid or intervention of holes to divide the pupil into two or more pupils; and the appearances, in this case, are so precisely of the same class as those which arise in certain cases when we see objects with *both eyes together*, that, it was quite manifest, the most interesting results were involved in the fact.

1.—AND FIRST:—It becomes certain that, *Each Single Eye has corresponding, and uncorresponding*, points on its retina, *that is to say on opposite sides of the eye's axis.* For, when we see a pin's head double; *one* of the heads is on *each side of the axis*, and is equally distant from it: because we *cannot*

see the head double, unless we look *directly* at the pin, that is to say with the axis of the eye in one with the pin: In proof of which, if we direct the eye a little on either side of the pin, and carry the hole in the card aside with it; we instantly lose sight of one of the two heads, in consequence of the *septum of the card falling in a direction with it*.

2.—SECONDLY.—It is a fact strictly demonstrable, from the extraordinary phenomena now in question, that, in the case of Vision with a Single Eye, the *visual rays* RE-CROSS EACH OTHER AFTER FALLING UPON THE RETINA; and thus are made to produce a REFORMED *tactual visual image* SOMEWHERE BEHIND THIS EYE, YET BEFORE *they reach the place of junction of the tactual visual impressions produced on* BOTH *eyes:* And thus, each eye, acting by itself singly, produces a *reformed and erect* tactual visual image; which image is conveyed backward, and is at length discharged on the perceiving mind as well, and in the same manner, when we *see with only one eye*, as when we see with both eyes. And it follows therefore that, in each case, and in all cases universally, the *tactual visual images, or impressions*, which discharge themselves upon the mind, ARE ERECT, *and are* NOT INVERTED.

When we duly contemplate the thing, now suggested, we are naturally led to the following consideration. It is evident, the moment our attention is called toward it, that, after proofs had of the existence and operation of a Visual Mechanism for the re-crossing and rectifying of impressions when we see with BOTH EYES; we must *expect* the existence of a similar provision in the case of see-

ing with ONE EYE ONLY; and, from the beginning, it ought to have been anticipated that, in case of proofs of the former, we should have to look for that of the latter.—But, the little expectation which could well have been entertained, of our actually arriving at any such proofs in the operation of the Single Eye, might have been sufficient to deter any one from the whole investigation. In this case, therefore, it was perhaps fortunate that the difficulty did not occur to my thought, until the phenomena themselves suggested to me, at once, both the obstacle in all its magnitude and the unexpected removal of it. Of the truth of this, however, the reader has yet to be satisfied. And I am led to mention the fact, here, only as a step in the *history* of the subject which may possibly have its use for some future inquirer.—To the proofs, therefore, of this department of the subject, I now proceed.

PROPOSITION 21.

EACH EYE, SINGLY, *in adapted circumstances, can perform similar functions, of* SINGLE *and* DOUBLE VISION, *to those that are performed by the two Eyes acting in concert.*

PROOFS AND ILLUSTRATIONS.—In laying out the proofs of this important Proposition, it is proper to notice that, the instrumentality of any such artifice as that of dividing the pupil of the eye into several pupils, by looking through pin-holes in a card, is not essentially requisite; because the most important of the phenomena which will

form our data, may be perceived by the naked eye: Although, in some cases, the device of looking through eye-holes will enable us to perceive the phenomena more vividly, and clearly: And, in others, we shall find the purpose answered better by employing a lens, or even two lenses. I shall, nevertheless, commence the proofs in question by taking into consideration the phenomena we perceive when we employ two pin-holes in a card, for the purpose of seeing a pin's head, or any other small object, double: because there is a certain subtilty in the exhibition of the SEEN objects in question; which neither the expositions of Drs. Reid and Potterfield, nor yet the diagram supplied by the last-mentioned Writer in illustration of his solutions, at all advert to: nor could a reader completely apprehend the subject, unless a full exposition of it were expressed; and this exposition illustrated by Figures explanatory, like those which will be supplied herewith.

Besides the object in view, as above mentioned; I shall embrace this occasion to render the phenomena, discerned by means of pin-holes, the example by which to introduce the suggestion of the *re-crossing and rectifying* of the inverted retinal images of External Objects; or, rather, and to speak strictly, of the *production, or formation, of erect tactual visual images within the head, or the brain,* IN CONSEQUENCE OF *inverted images impressed upon the retina.* At the same time, I request it may be observed that, I propose to do this in the present Proposition as being little other than a description, and not as being the

final test, or proof of the fact. And, hence, I have reserved the formal proposal of the re-crossing and rectifying of images behind the Single Eye, to form the title of the next set Proposition; because therein the crucial and final tests of the fact will be regularly stated.

With regard, then, to the introduction of the fact of the re-crossing and rectifying of tactual visual images behind the Single Eye; it is to be observed here, as a preparatory step, that Dr. Potterfield has described the phenomenon, which I propose to employ in the suggestion of it, in the following terms:—"Axiom 2."—"When an object "appears double, from its being seen with one "eye, through two small holes in a card, if the "distance be greater than that to which the eye "is accommodated, upon covering either of the "holes, that appearance that is on the same side "will be made to vanish; and if the distance "be less than that to which the eye is accommo-"dated, upon covering either of the holes, the "appearance that is on the contrary side will be "made to vanish."

Now, with respect to the axiom of the subject thus stated; I have in the first place to remark that, while it is true without any ambiguity in the case wherein we are beyond the *greater* of the two distances mentioned; it is not true without ambiguity, (although it is true in the sense in which, it appears, Dr. Potterfield intended it,) in the case wherein we are within the *lesser* distance. The real fact of the matter, in both cases alike, is,—the word—"*appearance*"—in the axiom of Dr.

Potterfield, is an ambiguous expression; because, in both cases alike, we *see two objects*, both of which have a fair claim to the name of an *appearance*,—namely—the *pin's head or other such object, and a circle* in which it is seen. Now, when we are *beyond* the limits of distinct vision, if we close either hole in the card, we lose sight of *the pin's head, and of the circle* in which it was seen, *both being on the same side:* but when we are *within* the limits of distinct vision, if we close either hole, we lose sight of the *pin's head* on the contrary side, as Dr. Potterfield has asserted; but, along with this, we lose sight of the CIRCLE *that is on the* SAME *side* with the hole that is closed; and here, then, is a discrepancy of fact, from that observed by Dr. Potterfield; and a very curious and subtle phenomenon, to be accounted for.

The exposition of the matter is this.—Although it is true, according to the description of such experiments and results as that given by Drs. Potterfield and Reid, that the rays of light from the external pin's head, in their approach to the retina, have *not crossed;* yet, the *rays of light let in by the pin-holes,* and which *occasion the retinal images of the two* SEEN *circles,* HAVE CROSSED *in a very large proportion, though not altogether.* And, hence, the LEFT-*hand* SEEN PIN'S HEAD *is within and belongs to the* RIGHT-*hand* SEEN CIRCLE; so that, when we lose sight of the *right*-hand *seen circle,* from stopping the right-hand hole, we must lose sight of the *left*-hand *seen pin's head* along with it. As a test of this exposition; when we have *removed beyond* the distance of distinct vision, the *retinal images of*

the seen circles will have crossed ALTOGETHER; and therefore the retinal images of the *pin's heads* will have crossed along with them, because each image-pin's-head *must be* SEEN *within its own* CIRCLE. The truth of this exposition, moreover, will be illustrated and confirmed by the Diagrams which are supplied for this and other purposes.

But this exposition, as far as it has gone, is, as I have already said, *only preparatory* to the suggestion of the re-crossing and rectifying of the inverted images formed upon the retina of the single eye. And this fact, now to be entertained, is the following.—When we are *within, as well as when we are without,* the limits of distinct vision; the rays of light which form the inverted retinal images of the CIRCLES occasioned by the two eye-holes have *met;* and while, in the *latter* case, they have *also crossed altogether;* in the *former* case they have *crossed only in great part,* leaving a *small portion of intersection,* which portion of intersection is always *seen of a brighter color* than the other part of the circle on either side of it. But, when we are *within* the limits of distinct vision, the rays of light which occasion the two retinal images of the *pin's head* have *not crossed, nor yet met.* And, as the *right-hand retinal image of the pin's head* is certainly *within the right-hand retinal image-circle,* (BOTH being occasioned by the *right-hand hole;*) it follows that, the two images are impressed on the retina according to the *dotted circle and dotted pin's head* in *Fig.* 3. of the Plate in illustration; that is to say, the *greater part of the image-circle* is impressed on the *left* of the eye's axis; and the

image pin's head is *near the edge* of this circle, but falling on the *right* of the eye's axis.

The above-described process, we are to observe, is the fact of the case *in so far as concerns the* EYE—*i. e. the* CRANIAL EYE. But, in order to afford us a VISION, in consequence of this Ocular fact; and, in order that this vision should be ERECT; I have here to suggest that there is, wonderfully provided, a Mechanism *behind the Single Eye*, analogous in its operation to that which has been demonstrated behind BOTH eyes in the case of two-eyed vision; and, from the operation of this Mechanism, the SEEN CIRCLE, *with the* SEEN PIN'S HEAD WITHIN IT, is revealed as if it were situated on the CONTRARY *side of the eye's axis* to that on which, we know from the laws of Dioptrics, it is impressed on the retina. Thus, while the *retinal impressions* are made according to the *dotted parts* of *Fig.* 3;—the VISION—*i. e.*—the SEEN CIRCLE AND SEEN PIN'S HEAD are seen according to the *black-line parts* of that Figure.

It is easy to discern that, the above being the nature of the fact perceived when we either employ, or stop, the hole on the *right* hand; a corresponding process will follow if, instead of this, we either employ, or stop, the hole on the *left*,—we being all the while WITHIN the distance of distinct vision; and the appearance will be that represented in *Figure* 4.

And, when *both* holes are employed; and we, consequently, see two pins' heads; they will appear as in *Fig.* 5: in which figure, we are to observe, the *retinal image-circles and pins' heads are*

not represented; but they are always to be *understood as existing unseen on the retina, on opposite sides of its axis* to that on which the SEEN OBJECTS *appear to be situated.*

It will always be recollected that, we no more ever see any tactual visual image in the Optic Trunk, or in the Cerebral Eye, than we see that which is impressed on the retina: Though it is as strictly demonstrable, or rather is already as strictly demonstrated, that such tactual visual images are formed behind the eyes, as it is that the sun's light is distributed on a wall through the medium of a prism. When, therefore, for the mere sake of convenience in reasoning, I all along speak of the *re-crossing, reforming, or rectifying,* of images; it must never be mistaken to mean that a SEEN IMAGE OR VISION IS A REALLY-RE-CROSSED, or REFORMED image. And, hence, the seen circle and pin's head, in the case now under consideration, although they appear to be situated on opposite sides of direction to those which dioptrics inform us are occupied by the retinal images, are in no other way connected with, or *correspondents* of, the retinal images, than by their being *mechanically subsequent, and consequent, on* the retinal impressions.

From the exposition now given we perceive that, when we are *within* the distance required, the SEEN PIN'S HEAD appears to us on the *same hand* as it does upon the exposition given by the disproved Principle of our SEEING *External Direction,* namely upon the left hand; And, when we are *beyond* that distance; both the *seen circle* and

the *pin's head* are seen on the same hand as that shown by the disproved Principle in question, namely on the *right* hand when the *right-hand hole is stopped.* The real truth is, that the Mind, *in the mere act of vision, having nothing to do with, (because not perceiving)* any thing but the images made up of its own sensations of colors, finds, nevertheless, that the *relative site of each of these sensation-images,* with respect to the co-existent sensation-images among which it is situated, *corresponds* with the direction of the external object which occasions it; so that, if a retinal image of that object be on the *left of the eye's axis,* the consequent produced *sensation-image* will appear *on the right in the percipient mind.*

Thus it happens that, while Drs. Reid and Potterfield, from an experiment on a *single* pin-hole, which, being moved over the pupil of the eye, causes an external pin's head to appear to move always in a *direction opposite, although* the rays of light from the pin "*do not cross* as in ordinary vision," thought that this fact establishes their Principle of Perpendicularity; it appears from the present exposition, on whose truth I shall insist in stating the future demonstrations of the subject, that the *retinal image,* though it is formed by rays that have not crossed, *is utterly excluded from the ultimate or proper Visual process* by the *production of ultimate and erected sensation-images in the mind:* And, what those Writers held to be a SEEING *of the real pin in a certain* EXTERNAL DIRECTION, is purely a seeing of a *sensation-image* of the pin in a certain SITE *in a sensation-circle in our own mind.* Upon

which, it is only farther requisite to observe that, EACH ASSUMPTION, ALIKE, makes the external pin to appear in one *same direction;* and all that we are concerned in, in this place, is the momentous fact of what, for the sake of convenience, is here called the *re-crossing and rectifying of images behind the Single Eye.*

In order, however, to prevent the caution, now given with regard to the phraseology in question, from carrying a reader into an error on the opposite side; I observe that, we *must assume a real re-crossing of rays, or lines, of something;* whether they be supposed to be those of *Light*, under any modification of its substance; or, the "*Materia Subtilis*" of Newton; or, the *Galvanic Principle;* or whatever other Agent; UNLESS Light, or the supposed Agent, be supposed to operate by UNDULATIONS, propagated along the nerves: in the last of which cases, the *crossing will not be actual or real;* although a *change of result from one side to the other* will equally be the consequence. Therefore, we are not warranted to assume an *actual* re-crossing: And, even, if this were assumed; we are, above all, to distinguish that this could not be a re-crossing IN THE EYE; and, therefore, we are to note that, the *black-line objects represented in the Diagrams are fallacious representations* in so far as regards their *apparent site*, since the *seen* images of things are in the perceiving mind alone.

In case it might otherwise be thought that the DIAGRAM, *Fig.* 3. affords not a true, or conclusive proof of the *crossing of the two retinal circles;* I observe that *Fig.* 3. is made from the

actual fact that, when a pin's head is about two inches from the eye, the *external circles*, seen through the two pin-holes, are each of the *exact size of a Sixpence*, as is depicted in the *two dotted circles*, one on each side of the pin's head. Now it is self-evident that, if these two dotted circles, instead of being *in contact*, or a *little intersected as they are drawn*, were drawn *asunder*; the *more they are asunder, the more the retinal circles they occasion on the eye must cross, and actually separate*: which fact proves that they *have crossed*, as in the Figure; though *not wholly so*.

Proposition 22.

In any *case of Vision with a* Single Eye, *the* Ocular *Image of the Object is re-crossed after its* inverted formation on the retina, and is reformed and made erect posterior to that eye; *and this rectified image is a* tactual visual *image formed in the* Third or Cerebral Eye; *from the discharging of which last, upon the perceiving mind, we consequently have* Erect Vision *consisting in the* Sensations of Colors *which it occasions.*

Proofs.—In the proofs of this Proposition we shall, as I have already intimated, have no essential demand for the employment of any means other than the naked eye; Although the use of glasses, and sometimes of pin-holes in a card, will be found very conducive to our case, and to clearness in the experiments: And, indeed, for the

reasons last mentioned, I shall begin the account of these experiments with such means; and shall only in the end call the attention of readers to the fact that the requisite general results may be had from the use of the eye alone. The experiments, to be here described, may be divided into various classes: because, we may try a variety of them by the same means, and in the same general circumstances; one only of which, for most part, I propose to describe in each class.

Experiments of the First Class.

As a preparatory experiment, to others that are to follow; If we look at a window in a room, with a Single Eye; and, at the same time, if we hold a concave lens (such as that of a common opera-glass) with its *middle* before the eye; this refracting medium will throw a *diminished image* of the window, seen through the lens, upon the *large image* of the same window seen through the naked eye. Now, this phenomenon is precisely of the same kind with that of One visual image thrown upon Another, when we look with two eyes through two eye-tubes, at the end of each of which tubes there is outlined an object, upon a cap fitted for that purpose. And, from the laws of dioptrics, we know that the cause, in the present case, is that the rays of light, which pass through the concave lens, are reflected so as to fall upon the retina on the field of the large image occasioned by the window in the naked eye, on which large image the diminished image is seen, as being co-incident.

With regard, now, to the fact of the re-crossing and rectifying of the inverted retinal images; if the window have any particular mark on any part of it, to serve as a guide and test of the fact; and, *if the images were not re-crossed and rectified* after their inverted existence on the retina; we must see the two images (one upon the other) in a *reversed position* to the position of the real external window: but this we shall not see; and, therefore, the images ARE re-crossed and rectified.

Experiments of the Second Class.

If, in the case already supposed, we hold the concave lens, not with its middle, but with its *edge* upon the eye,—namely—with *its right edge* upon the *left side of the eye;* and if we look at the window so as to see it through the lens, and also through the other parts of the pupil of the naked eye, moving the lens as may be found requisite; we shall, then, see the window extending on each side of the axis of naked vision, because its image in the naked eye falls on each side of the axis; and we shall also see a *diminished window on the left* side of the former, because the lens has converged the rays of light, and has caused a small image of the external window to fall on *the right* side of the image on the naked eye.

Now the reason why the SEEN *diminished image is on the* LEFT side of the *large image*, while the RETINAL *diminished* image is impressed upon the RIGHT *side*, is that it *has been re-crossed over*, or which is to the same amount and is the strict truth, it is a *newly-produced image in the mind, mediately*

consequent upon the primary inverted image on the retina.

And, as for the proof of the fact of the images being *thus rectified,* as well as re-crossed ; it is certain that, if they had not been so, the lesser image must be seen with its *back* to the large image, that is with that side next it which, (it may be proved from any external mark,) is *farthest from* that edge of the real window with which it *now appears to be in contact.* Thus, the two *seen* images, instead of appearing according to the external window represented by *Fig.* 9. would appear with the lesser image on the *contrary side* of the larger to that on which it is actually exhibited ; and, with its marked edge in contact with the edge of the larger, which is contrary to what we witness.

Experiments of the Third Class.

The Two Classes of Experiments, already described, exhibit ; THE ONE of them, an object thrown upon the face of another, but this without the fact of their *interlacing* each other : —The OTHER, an object thrown on one side of another, in apparent contact with it, and connected in such an order as could not have happened if the retinal images had not been re-crossed. But there remains, yet to be adduced, the last desideratum on the subject,—namely—the exhibition of *One Object seen interlacing Another,* in a manner similar to that which was exhibited in the case of our employing two eye-tubes, in an experiment of two-eyed vision : And the Class of Phenomena, now to be introduced, affords us this proof.

The Phenomena and their results, now under investigation, are perceivable with the naked eye; and they escape ordinary observation only because we seldom look at objects within the distance that suits our eye, in which case alone they are discoverable; and because we are seldom given to philosophize upon them when, by any accident, we are thus situated. The employment of glasses, or of eye-holes, in experimenting upon these phenomena, will be found convenient: but they are by no means essential.

Experiment First.—If we look through two pinholes at a *shilling*, situated about three inches (*the nearer the better*) from the eye; we shall see, *not a circular* object, but an object *acutely oval*, it being pointed at the top and bottom: And this difference of shape, from that of the real external shilling, is occasioned by *a stripe of the middle of the seen shilling's being annihilated*, in consequence of the *retinal image of one half of this stripe being thrown upon the other half* in the eye, by reason that the two halves of the retinal image of the shilling have crossed *only incompletely*, because the humours of the eye have not had power, at so small a distance, to make the two halves cross completely, as they naturally tend to do under the laws of dioptrics.

Accordingly, when we look at the shilling, as above described, and cast our eye upon the numeral figures of its *date;* we shall see, instead of 1815, the figures 815;—or, else, 181;—the 1, or the 5, being lost to our view: And the exposition of this phenomenon is the same as that already given—namely—the rays of light which have oc-

casioned the two halves of the retinal image of the shilling have crossed according to the laws of Dioptrics; but they have not had room to cross altogether, and the small remainders of the two sets of rays that have not crossed have formed a *coincident retinal image upon the centre or axis of the eye:* One half of which image is, of course, *lost to the breadth of the seen shilling;* while the other half tells in the account.

Now, this case is manifestly and exactly similar to that in which, when looking with both eyes through two eye-tubes, we throw the two seen circles, occasioned by the farther ends of the tubes, upon each other; and, by these means, reduce the breadth of the two seen circles to that of one of them. And, by reason of this sort of coincidence, we find in the present case that, while we have lost sight of some of the numerals of the date, the *seen head and neck* of the object is *very considerably narrower* than when we see it from the distance of distinct vision.

But the important fact of the RE-CROSSING of the images, in this case, remains yet to be considered. And the evidence of this fact consists in our observing, in any phenomenon of interlaced vision, that, the INTERLACED FEATURES *do not present themselves in that* REVERSED ORDER, *in which they must have appeared if their images had* NOT *been rectified,*—they always appearing in the same order as that of the features of the *external* object which occasions them: AND, AS THEIR WHOLE APPEARANCE IS AN INTERLACED APPEARANCE; this phenomenon exhibits the most rigorous

may be employed. As, for example, the *Black-line Figure* 6, *as it stands in the* PLATE, (without reducing a reader to the trouble of forming objects for the purpose in any other way,) will afford us a very sufficient case of interlaced vision. And, accordingly, if we look at *Fig.* 6, within the distance of five inches; and still better if we are within two inches from it; we shall see, instead of its real external form, which is that of a *leaf, with its stem and ribs distinctly marked for the purpose, the* INTERLACED *form of Fig.* 7; the *seen ribs being duplicated, near the stem, into a lattice.*—If we look at the Figure through a hole in a card; we shall see the interlacing more clearly: but, we can see it, well enough, without any such medium.

Here it is sufficiently manifest, from what has gone before, that the PHENOMENON OF THE INTERLACING is occasioned by the *duplication of the retinal image* caused by the external leaf or figure. And this *interlacing* is only one of the various modifications of that *blurred appearance* which is called *indistinct vision;* which sort of duplication, *as being the cause and nature of indistinct vision,* is known to Optical Writers. But this knowledge has never led any Writer to suspect that, not only are the retinal images duplicated, by the one's crossing the other; but also that, *after this they are re-crossed and reformed behind the eye.* And this is the fact now to be insisted upon; always observing, throughout this work, because it is of vital importance that it should never be misapprehended, that, by the term *re-crossing, reforming,* or *rectifying,* of an image, a *real crossing over of*

any image is never meant; but it is meant only that, in any case of Single-eyed Vision, an ERECT *cerebral tactual visual image is* PRODUCED, CONSEQUENTLY UPON the previous existence of an *inverted image on the retina;* and that, an ERECT PROPER VISUAL IMAGE *is produced consequently upon this Cerebral Image;* and, lastly that, both the cerebral image and the visual image in the Mind *are formed and appear upon a* CONTRARY SIDE, IN ANY PRESENT *field of vision,* to that side on which the INVERTED RETINAL IMAGE *which occasions it* IS FORMED.

Now, to prove this fact in the present example, we are to observe that there are TWO DIFFERENT AND OPPOSITE ORDERS, in which the crossing and duplication of the image seen according to *Fig.* 7. MIGHT happen: One of which agrees with that of external nature, in the objects without us: And the other contradicts, and violates that order. And we are now called upon to mark the fact that, the duplication which we SEE when looking at *Fig.* 7, is in the SAME ORDER as that of the *external object Fig.* 7. Whereas, if the retinal inverted images had not given way to rectified images, thus seen; it is certain, from the laws of Dioptrics, that the seen object must have been, *not as Fig.* 7; *but, on the contrary, as Fig.* 8 *would appear if its middle stripe were interlaced similarly* to the interlacing of the middle stripe of Fig. 7. And here the reader will critically observe that, the *ribs* of the external leaf, Fig. 6, *point downwards:*—whereas, the ribs of the image which

this external leaf occasions on the retina, represented by Fig. 8, *point upwards*. And the certain consequence of this would be, if the images were not rectified behind the eye, that the *order of the two sets* of SEEN ribs, *in their state of interlacing each other*, must be REVERSED from the order of the ribs in the external leaf. But this violation of the order of external nature is not now, nor in any case, ever witnessed; and, therefore, the images are re-crossed behind the eye.

Experiment Fourth. — Of all the experiments which I have been led to try, in order to exhibit the Phenomenon of Interlaced Vision; there are none that have so beautifully shown the desired result, as those in which are employed two external objects of different and contrasting colors. And among these, perhaps, the reader may find none that will more neatly answer the purpose than two pieces of coin—namely—a *white* and a *yellow* — placed in contact, and moderately inclined from the eye: which may be done by placing the two pieces upon an ink-stand, side by side each other.

If we place a *guinea* and a *shilling* as now described, the *former upon the left* of the *latter*, *Fig.* 10;—and if we look at them from within the distance of distinct vision, especially the more so if we bring the eye within two inches of them; we shall then see a very notable portion of the *edge of one of these coins interlacing the edge of the other;* and the two contrasted colors—the *white* and the *yellow*—will display, in the most distinct and beau-

tiful manner, the FACT ON WHICH SIDE EACH OF THE SEEN OR SENSATION IMAGES IN REALITY STANDS *in relation to the other, agreeing with Figure* 11.

Such is the vivid impression of decisiveness and conviction of the fact, which this phenomenon calls up in our judgment while we are contemplating the two interlaced sensations of colors, as they appear contrasted in their very tissue;—sometimes *each color appearing distinctly interwoven with the other;* and sometimes, *both being nearly merged in one;* although, *still,* we can discern some *very fine curve lines of each coin* interlacing similar lines of the other; that every other species of the phenomenon of Interlaced Vision seems cast behind, in its claims to equality as a test of the fact: Although, in strict fact, all the phenomena in question are equally conclusive.

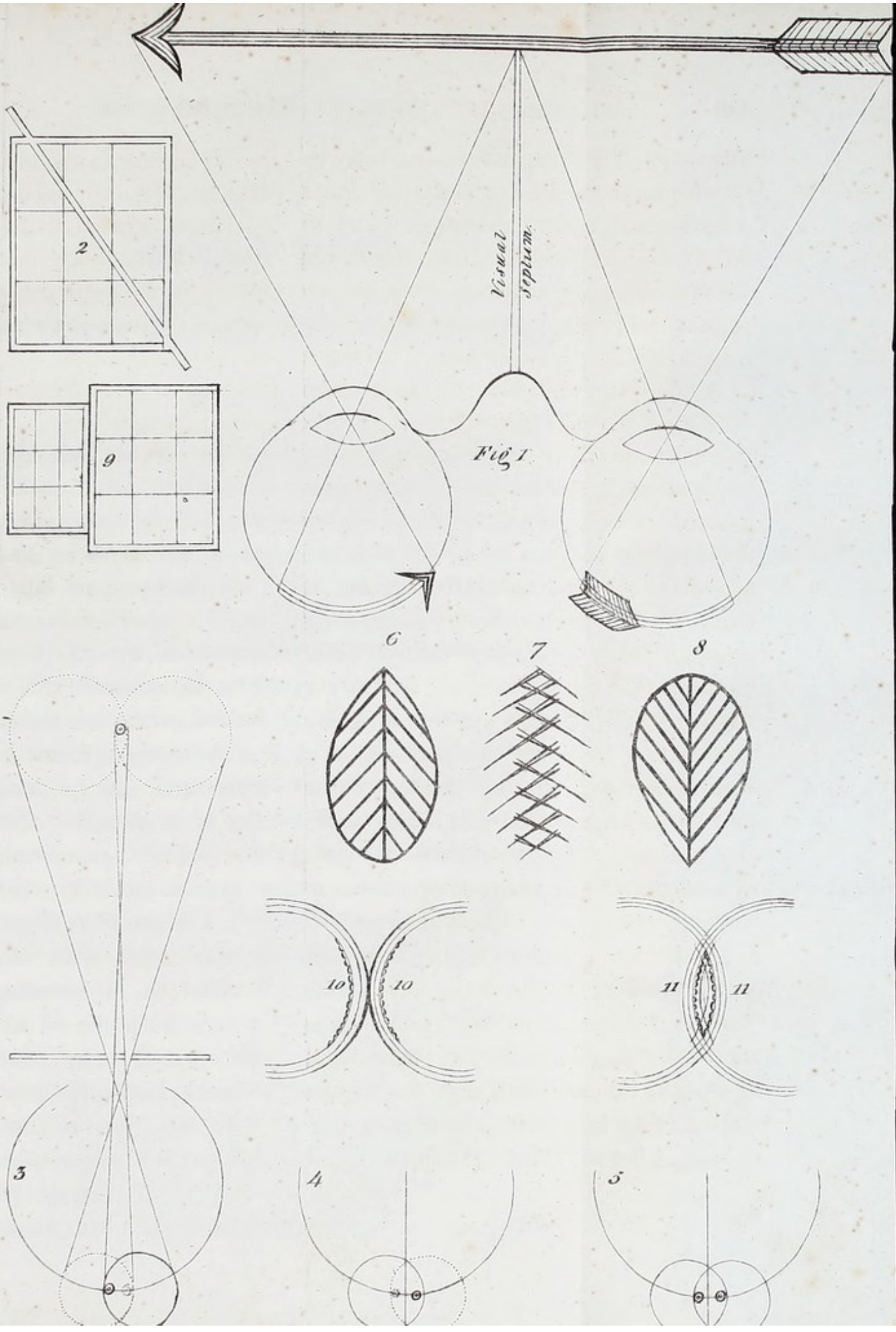
If we look at the two coins through two pin-holes in a card; they will show the phenomenon more clearly; and, even, in *a greater extent of interlacing:* at least, I find this to be the case of my own vision; although, to a younger eye, perhaps, the result may be equally extensive and vivid in either case.

After all that has been said before, with regard to the *preposterous order of position* in which the seen images of things must be thrown if they were not re-crossed and rectified behind the eye; I need hardly here point out the dioptrical certainty that, if the seen image of the shilling, and that of the guinea, had not been thus re-crossed and rectified, the SEEN SHILLING MUST HAVE APPEARED ON THE LEFT, *and the* SEEN GUINEA ON

THE RIGHT; both which are contrary to the order of position of the two real external coins; while it is also contrary to the order in which we actually see them. At the same time, the *fact of the interlacing* forbids any attempt, even the most extravagant, to pretend that the eye deceives either itself or us, in the exhibition of such a test.

It appears almost superfluous to remark farther, unless for the sake of readers who are not in the subject, that when we are looking at the two coins the *retinal image* of the real external guinea (which guinea is on the *left* in external space) *falls* upon the RIGHT *side of the eye's axis*,—it being crossed over, as well as inverted upon the retina; and, in like manner, the retinal image of the real shilling (which shilling is on the *right* in external space) falls upon the LEFT side of the eye's axis. If, then, the SEEN INTERLACED IMAGES of these two coins *were not reformed and rectified* images; they *must have appeared* interlaced the CONTRARY WAY to that which they actually exhibit; that is to say, the *phenomenon of the interlacing*—WHICH PHENOMENON CANNOT BELIE ITSELF,—*must have belied* EXTERNAL NATURE, *which it does not*.

In closing, as I now do, the proofs of the Subject drawn from the Phenomena of Interlaced Vision; I hope I may be allowed to affirm that, there is no fact in Dioptrics, or in any department of Optical Science, that is more rigorously demonstrated, than that of the re-crossing and rectifying of images behind the single eye.


2
9
Visual Septum.
Fig 1
6
7
8
10
10
11
11
3
4
5

SECTION FIFTH.

OF VISION WITHOUT EXTERNAL OBJECTS.

Introduction.

In the course of treating the Fourth Mode of Vision, I had occasion to show, in a Proposition appropriated to that purpose, that we have a distinct proof of the re-crossing and rectifying of Visual Images from the Phenomena called ACCIDENTAL COLORS. These phenomena, it is sufficiently known, are occasioned by the presence, *in the first instance*, of external objects; but which objects are removed from our field of vision before the correspondent colors arise in the mind, consequent on the impression in the eye previously made. But there is yet another class of Visual Phenomena; which, owing to the *manner and nature of their exciting cause*, claim to be considered as being of a *Different Species* from any of those that have been treated in the foregoing Sections; or, at least, the production of which must be regarded as constituting a *Different General Case of Vision*. The Appearances, to which I now allude, are those which arise in the Mind when, at any time, the Eye is subjected to any considerable blow, or pressure: an accident which may happen in various ways. And I here announce that I propose to investigate, to a certain

extent, the laws of these appearances: While I at the same time intimate that, the Phenomena in question involve very unexpected and considerable consequences, in the light which they throw upon the fact of the re-crossing of visual images; over and above the important consideration that their existence and manner of excitement bear very seriously upon the SCIENCE OF MIND.

In the earliest of my publications on the Phenomena of Mind,* I entered largely into a consideration of the process of thought in the case of the *Five External Senses*, treated respectively.—And, while the work in question had its origin at a period of nearly thirty years back, in a country and circumstances wherein, with hardly an exception, I had no access either to the writings of philosophers or to the converse of men acquainted with such matters; it happened, by an accidental co-incidence, that my research was, in its general character, of the *same nature* as that which had been instituted by Dr. Reid, in his "INQUIRY INTO THE MIND;" that is to say, it was an *inductive inquiry, in order to ascertain the fact, whether or not our* SENSATIONS, *and consequently our* IDEAS OF SENSATION, *are* EXTENDED RESEMBLANCES *of the external objects which excite them.* It is sufficiently known that all Dr. Reid's experiments, and conclusions, have turned on the side of DENYING any such resemblance:—While the whole of mine have led me, all these years, to insist on *affirming* a

* An Essay on Consciousness.

resemblance. Which, of these two courses of research, will stand the test of time; is a matter which rests with the public to decide. But, the most remarkable circumstance, which I would here point out to readers, is a fact which must speak for itself—namely—that Dr. Reid's "INQUIRY" has been held up, by his Successors, as a "MODEL OF PHILOSOPHISING:" While, *all attempts to speculate either way* as to whether, or not, the Mind or its Sensations are "*extended or inextended*," have, by the same authority, been *expressly excluded from all legitimate inquiry*, as being to the last degree UNPHILOSOPHICAL IN THEIR VERY NAME. Assuredly, men of reflection, who are in this department of knowledge, must be roused to attention by a manifestation of inconsistency so glaring,—so confidently advanced,—and so arbitrarily inflicted upon whatever understanding it may find in a state to receive it. But, as concerning the subject of the present inquiry; I proceed, now, to advert to the manner in which I had considered the phenomena of Vision excited by pressure, in the work to which I have alluded: And I do this for the purpose of pointing out, in the sequel of the Section, the remarkable harmony which subsists between the facts in question and the views of Sir Isaac Newton with regard to Vision, and to the NATURE OF MIND. At the same time, it is proper to add that, I supply the following extracts only because the volume, of which they make a part, is out of print; and because, although I suppose it contains a mass of facts on the

subject, it would in many respects require to be re-cast; which I have yet had, and shall have, no leisure to put in execution.

In, and near, *page* 232 of the work, I have expressed what follows: —— "If the eyes be covered lightly, we have a total absence of vision: But, if we begin to *press* with the hand, *gently*, we shall then have a *beginning sensation of faint light*, not in a uniform surface, but a surface consisting of UNDULATIONS; and, as we gradually increase the pressure, these *Undulations* will gradually increase, both in *size* and in *brightness*, until, by the time the pressure amounts to pain, the luminous undulations will equal the lustre of the sun itself."

"Colour is physically occasioned by small nervous motions, with consequent Undulations in the Surface of the Mind, taking naturally proportionate times."

"The fiery undulations produced by pressure on the eye, (at any given degree of pressure,) are not either circles, or squares, or triangles, or of any other definite shape; but they are *nevertheless undulations*, possessing peculiar shapes, and constituting a *surface of mottled light:* and I believe it is impossible, by pressure, to produce *undulations small enough* to appear as a surface of uniform light."

"It is of importance here to consider the fact that, when we have pressed the eye to a considerable degree of pain, and have produced *large* Undulations of the *brightest possible* light; we

may contemplate these Undulations as belonging to the sense of VISION; and, otherwise, as belonging to the sense of TOUCH."

"If we contemplate the fact, of *one motion's* producing *two such different sensations* as *Colour* and *Touch;* it manifests such a connexion between *Feelings of the Different Senses;* and, opens such a view of the *conscious* and *physical* operations of the Mind; as, I am obliged to think, strongly evinces a physical connexion between it and our body."

"If we observe a surface of water, with large undulations raised by the wind; and if, at the same time, there be *very fine rain;* we shall perceive *little delicate undulations,* raised by the rain, playing in undisturbed repetition upon the *bosoms of the large waves.*—In a similar way; it may be possible for *Visual undulations* to occupy the very same position on the mind's surface, that is occupied, synchronously, by *gross undulations of the Sense of Touch.*"

The extracts, now given, are taken nearly in the consecutive order of the original. But, on account of the bearing of the work upon the present subject; and, in order to show its agreement with the Newtonian views concerning Vision within the Mind; I add the following extracts, from different parts of it.—"If we observe a surface of standing water, during small rain; we shall perceive a surface of little circles that *rise distinctly, then blend and die:* which process may somewhat resemble the tendency to blend amongst *synchronous sounds;* thereby producing, less or more, *confusion in hearing:* Or, if the rain be heavier; its

impulses may rather indicate the greater tendency which *synchronous Tastes* have to blend, and to confound each other—Again; if we observe water during rain of the *finest possible degree;* we shall perceive a surface covered with *delicately beautiful minute circles,* which *rise, and die, without blending,*—their *sizes not enabling them* to invade their next neighbours. These last I suppose to resemble, rudely, the *manner of visual undulations:* and their minuteness is the reason why they die without reaching farther than a *mere contact* with those around them."—"This repetition being rapidly kept up; each succeeding surface of waves shall be strictly similar to the preceding set, so long as the sensible object affects the eye; and we shall have a *continuous sensation of one color* therefrom."

The last consideration which I shall advert to here, as suggested in the work in question, is the supposition that, the *reason why we can entertain sensations of Sight in a much greater rapidity of succession,* than we can entertain sensations of Hearing, (the difference being about double in the number of succeeding sensations,) is the *difference in the sizes,* respectively, of the *undulations* of each sense; by reason of which, those of HEARING take about *double the time to rise and fall, so as to give place to their successors,* that is required by sensations of SIGHT.

How far these views are in harmony with those advanced by Sir Isaac Newton, I hardly need point out to any philosophical reader: While, at the same time, I may appeal to the general tenor of my own speculations, as a test whether I appear

to have been biassed, in the course of them, by an undue admiration of the genius of Newton, any more than by that of any lesser Philosopher. But, although here altogether disowning any such bias; I cannot do other than feel, and I cannot refrain from expressing this feeling, that I reflect with very peculiar satisfaction upon finding that the tenor of my own course has led me, even to the ultimate stage of speculation in the present essay, to results which in fact amount to ONE SAME VIEW OF THE NATURE OF MIND with that entertained by Newton. Most certainly, I never, at any time, had the smallest inclination, either to wrong the intentions, or to undervalue the endowments, of those Writers who have held up the Pneumatological creed of Newton as a beacon of error, in estimating it as no better than the visionary conceit of a philosophical age in reality barbarous when compared with that era which themselves have introduced. But, the longer I prosecute any speculation on the subject, the more I am filled with astonishment that it has been possible, that any sound understanding, which has been in earnest with regard to it, could so misinterpret whole series of proofs; and so refuse the impression of a host of others, which admit of no misinterpretation; as has been done in the writings of the opponents of Newton on the ground in question. But, I proceed to another consideration.

When we consider the view entertained by Newton of the nature of our Sensations; it may, at

first sight, appear surprising that we find no account taken by him of that Species of Vision which is produced without an External Object.—The only notice concerning any such Vision expressed by him, is in regard to the phenomenon which, he says, resembles a *peacock's feather:* Which phenomenon he mentions so very briefly, and so voidly of any supposition of its involving *any consequence* in philosophy; that I shall be under the necessity to remark upon this, his omission, farther on. But our surprise may cease with regard to this when we recollect that, neither Locke nor Newton could ever have anticipated, that a time would come when the extension of our sensations would be denied; and a new Scheme of Pneumatology be erected upon this denial. The reader will remember, with regard to the *History* of the subject, that, (it has been expressly acknowledged by Professor Stewart,) the *first suspicion suggested* against the extension of our sensations was that which consisted (to use the words of Mr. Stewart) in the "*criticism which Dr. Hutcheson had stumbled upon:*"—the merits of which criticism I have sufficiently considered in other places, and need not dwell upon here. After so decided an exposition of the *time*, as well as of the *manner*, of the origin of the Reideian School; we cannot be surprised that neither Locke nor Newton ever concerned himself about bringing *proofs* of the reality of the extended modifications of our mind; which, no philosopher, from the beginning of recorded speculation, had ever thought of calling in question. For this reason, I have on a former occasion supposed it

was that, the Laws of the Interlimitation of our Sensations of Colors, (which are the Constituent Elements of Visible Outline or Figure,) never occurred to the mind of Locke; although, they might readily have occurred to that of a Sign Painter, if he had been *speculatively* interested in the fact.

As a *recognition of fact in the History of our Sensations*, therefore, it is a very valuable recognition that has been left by Professor Stewart, that Dr. Hutcheson's indefinite conception of the matter was the *firs* note of dissent raised against the fact of the extension of our mental modifications;—valuable, I say, if those who are interested in the subject will only duly profit by it, and by its attendant circumstances in the fabrication of the Reideian Theory; both which, I have sufficiently pointed out in my other writings.

It remains, that I proceed to the Propositions to be discussed in this Section.

PROPOSITION 23.

THE FACT OF THE RE-CROSSING AND RECTIFYING *of Visual Images behind the* SINGLE EYE, *in the case of Vision with that Eye, is farther and collaterally demonstrated, (beyond the Proofs adduced in the foregoing Sections,) by the Phenomena of Visual Objects perceived by us in consequence of employing Pressure upon the Eye* WHEN THERE ARE NO EXTERNAL FIGURED OBJECTS *either existing, or* SUPPOSED BY US *as existing, to which the Objects perceived can be referred as their cause.*

PROOFS AND ILLUSTRATIONS.—The last query left by Sir Isaac Newton, at the end of his OPTICS, is of the following tenor:—"When a man "in the dark presses either corner of his eye "with his finger, and turns his eye away from his "finger, he will see a circle of colours like those "in the feather of a peacock's tail. Do not these "colours arise from such motions excited in the "bottom of the eye by the pressure of the finger, "as at other times are excited there by light for "causing vision? And, when a man from a stroke "on his eye sees a flash of light: Are not the like "motions excited in the *retina* by the stroke?"

Now, notwithstanding what I have said in the introductory remarks to this Section, it appears very surprising that the mind of Newton should not have been called, by the Phenomenon in question, to any greater extent of research, than that which is manifested by the query he has thus left with regard to it. And this is the more so when we consider that it appears, from certain manuscript papers of this great man, obtained by Mr. Harris and published among the Notes to Optics of the latter, that Newton had occupied himself considerably in an *Anatomical* inquiry with regard to the probable *manner, and ultimate seat* of Vision; insomuch that, the query which he has left with regard to the manner of Cerebral Vision is by no means a solitary conjecture formed without previous speculation. But, however curious it may be, that the phenomenon of the peacock's feather should have remained a sterile fact in the eyes of so great a Philosopher; and, that it has shared the

same fate in the estimation of Dr. Potterfield, who came after Newton and who adverts to this phenomenon in words that are the mere echo of what Newton has uttered with regard to it;* while, also, I find no notice at all concerning it in other Writers on Optics; I confidently apprehend it is a fact pregnant with very extraordinary results, in throwing light upon the manner of Cerebral Vision; and this, in an extent beyond what can be affected by any of the phenomena of the Vision of External Objects.

In the *First* place, therefore, I have to observe, generally, that, in the experiments employed in the Subject, it is so far from being requisite either to *turn away the eye from the finger;* or, yet, to experiment in the *dark;* that, in general, the position of the eye, or pupil, is *never altered;* and, what is still more remarkable, the peacock's feather always appears the *most rich, vivid, and prominent, when the eye is open toward a strong light*,—facts which prove to what a degree this class of phenomena has been neglected, or rather overlooked, by inquirers on Vision.

---

* Dr. Potterfield, *Book 5, chap.* 4, says:—"It is from this "principle that, when a man in the dark rubs the under part, "or either corner of the eye, with his finger, and turns his eye "away from his finger, he will see toward the opposite side of "the eye a circle of fiery colours, like those in the feather of a "peacock's tail."

This Phenomenon, moreover, he accounts for, almost word for word, as Newton has done. And the *only utility* which he suggests, concerning it, is that it may serve, in the case of a person afflicted with a cataract, to show whether, or not, the optic nerve is paralytic.

Secondly.—I may at once proceed to describe the experiments, which furnish us with the proofs of the re-crossing and rectifying of the retinal image formed in the eye, upon pressure of that eye.

The most convenient instrument that I have found, for the purpose of pressure, is the head of a pin. And, if such an instrument be steadily pressed; and, still better, if it be pressed by *throbbing or continued impulsions;* upon any side of the eye, whether the eye be closed or open, and whether it be in the dark or in the light, but better if in the light and the eye be open; we shall always see a colored spot, *apparently on the* OPPOSITE *side of the eye to that of the pressure;* the *size* of which spot will be *correspondent to the degree of pressure, or, to the size of the pressing instrument;* and the *character* of which will be that of *several concentric circles, having usually a black ground, with a greenish fiery margin;* and, when the pressure is *much, a spot of white,* with a *small black spot in its centre,* will appear in the middle of the field.

Now it is too obvious from what has gone before, to require any proof here, that the cause of the Phenomenon's being SEEN ON THE OPPOSITE side of the eye, to that on which the pressure is made, is a re-crossing of the retinal image behind the eye. And while it may be proved, by performing the experiment before a mirror with the eye open, that *in general the pupil does not move,* and that, therefore, the seen object is *not occasioned by the pupil;* we have a conclusive proof, in the *fact of the correspondence of the size of* the seen

object with the *degree* of pressure, that this object is *occasioned by the pressing instrument.* The fact plainly is that, while the *gross* object is occasioned by *depression or flexure, to a certain small extent,* of the *sclerotic coat and nervous lining of the eye;* the white circular spot in the centre, with the black spot in the middle of it, is caused by the *immediate and narrower* pressure of the *pin's head:* And thus, the whole phenomenon is simply explained when we have affirmed that, the SEEN *image appears on the opposite* side of the eye in consequence of a change, or re-production posterior to its retinal existence; *which retinal existence is certainly on no other part or side of the eye than the* PART OR SIDE IMPRESSED.

In farther proof of the fact now under consideration; I observe that, if we move the pressing instrument with a circular progress all round the pupil of the eye, on the region about midway between the pupil and the bottom of the eye; the seen image, which will appear on the opposite side of the pupil, will move round in correspondence with the motion of the instrument,—always preserving an opposite position to that of the points of pressure.

The correspondence of *motion,* and that of *opposite position,* of the seen image, as just described; and the two afore-mentioned correspondences—namely—that of the *size,* and that of the *vividness,* of the seen image, in proportion to the size and degree of pressure of the instrument employed; constitute, together, a complete demonstration of the two important facts—that the seen image is

caused by the pressure in question, and that it is in the sense of the phrase all along employed in this essay a RE-CROSSED image, that is a SEEN image on the *opposite site of our field of Vision* to that on which the pressure is made on the *retina*. Now, therefore, we have only to seek for the *manner in which this crossing, or this* NEW PRODUCTION RATHER, *is effected posterior to the eye,* in its various stages,—namely—first in the Optic Trunk; and, afterwards, in the Cerebral Eye, previously to its ultimate discharge on the perceiving mind.

But, before we proceed to this, it appears proper to entertain that fact which will be the subject of the next set proposition.

PROPOSITION 24.

THE FIGURES *of Objects, perceived by* SIGHT, *are of* ONE SAME GENUS *with the Figures of Objects perceived by* TOUCH.

The attempt of Bishop Berkeley, to show that Visual Figure is not of one same genus with Tangible Figure, was equally fallacious and mischievous in its consequence of tending to mislead the understanding. It was justly condemned by Dr. Reid. And its fallacy is rigorously proved by the Phenomena of Visual Figures perceived in consequence of pressure on the eye. The correspondence of *size*, of the seen object, to the size of the pressing instrument, or to the *degree* of its pressure, is a decisive evidence of the fact: While, also, we at the same time *feel* the sensations of

the two different senses—namely—of *Sight* and of *Touch*—at ONE SAME TIME; and can contemplate, *distinctly*, each of their specific characters.

Here it is requisite to be observed that, the *proportion, as to size* of the visual object, can only be perceived up to a certain degree of pressure. Thus, if we begin to press, or throb gently, with any pointed instrument; the correspondent seen object will be very small, and faint in its colors: and its size, and vividness, will increase up to a certain degree of pressure. But, as perhaps the eye will bear no greater depth of *flexure*, than that now supposed; we shall not find the seen object augment beyond a certain magnitude. But the results, which we obtain, are nevertheless altogether satisfactory with respect to the cause of the general phenomenon.

In a word; The Phenomena perceived from pressure on the eyes demonstrate, conclusively, the fact that VISION *is only a finer Species of* TOUCH, as was believed by the Philosophers of the earliest times. And no visionary speculation can ever, hereafter, carry us away from this proof of the nature of mind.

It was on this general fact that I insisted, at large, in the work already alluded to. But, at that early stage of my speculation on the subject, the arguments and evidences adduced were of a far less definite character than those that are now advanced, including the laws of our Sensations of Colors as stated in the Eighth Proposition.

The ways to the arcana of nature appear often

very narrow; and, at first sight, seem to lead to nothing. But, when once we have gained the clue, by having been brought into a right train of thinking on the phenomena, we are led, by care, from one step to another, until at length an unexpected result breaks in upon us. The Phenomenon which Newton has described, under the name of the peacock's feather, is one of that class which requires, with the strictest propriety, to be designated as being VISION WITHOUT EXTERNAL OBJECTS, since the SEEN IMAGES which we undergo, in any such case, have NO PROTOTYPE *in the figured things of the external world;* although, they certainly have a physical cause external to the mind. And here, the distinction of the two causes is a very material consideration: because, in the case of Vision excited by an external object, and of this vision's being continued after the removal of such object, it might be feigned, however groundlessly, that the seen image is *some relict of the excited nervous action; or, some imagination from memory* excited by the object that is removed: but, in the case of Vision without any excitement from such an object at all, there can be no pretence left, even for the most prejudiced person, to reason in this manner.

The undeniable fact, in the case of Vision from pressure, is that the EXTERNAL WORLD IS SHUT OUT, *from all supposition of its interference with the* MODIFICATIONS WHICH THE PERCEIVING MIND UNDERGOES: And we now find ourselves a Spectator in the *World of our own Sensations, ex-*

clusively; concerning the nature and relations of which sensations, among themselves, we can reason without any thought of their exciting causes.

And here I would call particular attention to the remarkable CHANGE which takes place in the mind, (that is in the *understanding and cast of reflection,*) which we fall into on finding ourselves in this situation. With regard to the state of my own mind, at least, when I am contemplating the various phenomena of Vision without External Objects; (which phenomena I shall presently show to be perceivable with *both eyes acting in concert;*) I, for the moment, lose all recollection of *externality, and of cause whatever;* and I contemplate *only several of my own Mental Modifications, in their various colors, shapes, relative magnitudes, and apparent motions:* while I am aware that the *motions are not real, but only apparent,* since a sensation can *no more move from place to place* on the surface of the mind, than a *wave* of a proportionate size can move, *beyond its law,* on a surface of water.

In the case which I am now describing, VISION IS NOT A LANGUAGE: for it is a Modification of our Mind, consisting in an actual finer *Touch;* and, therefore, it admits of *no interpretation,* or of being considered as a *Sign* of any thing beyond what it is in itself. And, indeed, the same momentous truth holds in the case of ALL PRIMARY VISION WITHOUT EXCEPTION: While, nothing could be more injurious to Pneumatological Science, than a continuation of the assumption of Philosophers that VISION ITSELF *is a* LANGUAGE. At the same time, it is all along to be admitted that

Secondary Vision, as far as it can claim the *Name of Vision,* is a Language; though this is the *sole ground* on which it can ever be affirmed that Vision is a Language at all. I have repeatedly pointed out this important consideration, in other places: and I trust its truth must appear conclusively on the present occasion.

Proposition 25.

The Phenomena of Visual Objects, produced by pressure upon BOTH EYES ACTING IN CONCERT, *demonstrate, by the exhibition of Extraordinary Correspondences, the re-crossing of Images behind both eyes.*

The Phenomena of Visual Objects, perceived from pressure on every side of a Single Eye, demonstrate, as we have seen, the fact of the re-crossing of Visual Images behind that eye. But, in respect to their importance in the subject, these phenomena are far exceeded by the very extraordinary correspondences exhibited between the results of pressure upon both eyes acting in concert; to which, the former serve only as an introduction, or preparatory step.

The limits which I am under necessity to prescribe to the present publication, however, will only admit of my describing the more prominent phases, and correspondences, of the phenomena now suggested,—leaving their farther investigation, or its publication, for a future opportunity. The matter to be here introduced will nevertheless, I trust, be admitted to be of sufficient importance when I intimate that, its Principal Point

consists in the fact of a manifest correspondence between Visual Images, produced by pressure of both eyes, IN AN INTERCHANGE OF THE POSITIONS *of the co-existent seen images;* and, by *certain regulated relations of the varying of the* SEEN DISTANCES *between them;*—both facts, together, demonstrating, conclusively, that these correspondences take place POSTERIOR TO THE EYES; *and, that they do so in result of a System of Cerebral Mechanism purposely contrived for this end:* Which result, I think, may fairly be viewed as forming a DATUM, from which we may be enabled to reason, with more or less precision, upon the *manner*, and the *seat*, of the ultimate visual process.*

Having intimated what is now adverted to; I proceed to describe the phenomena, in such of their varieties and relations as appear to claim our earliest attention.

1.—If we press, or throb continuously, with the head of a pin, on the INNER side of each *closed* eye at the same time; we shall see two of the usual sort of Circular Objects, ONE of them apparently in

---

* As the final, or farther, prosecution of the subject, beyond what I intend here to state, must of necessity bring the inquirer, in great part, upon ANATOMICAL Ground: And, as it is impossible for me, at this time, to continue the mental exertion requisite to do justice either to the investigation, or to myself: I can only say that, in the case of my supplying, at any time, an additional Section, I shall order such a number of copies of it, *singly*, to be set apart, as may prevent the possessors of this from being sufferers; provided only that timely application be made after it is announced.

the OUTER corner of each eye: And the *apparent distance between* the two objects will be about *three inches, or more, taken at a medium.*

2.—If we proceed to operate upon the OUTER side of each closed eye at the same time; we shall see the two usual Objects, *each* of them *apparently in the inner* corner of its respective eye: And the apparent distance between them will be about *half of the former* distance—namely—*about an inch and a half;* though this distance, as will be hereafter noticed, will vary with a variation of the parts of the eyes impressed.

3.—If we impress the *upper* part of *one* closed eye, and the *lower* part of the *other* at the same time; the correspondent image in the *lower* part of the *first*-mentioned eye, and that in the *upper* part of the *last*-mentioned, will appear to be *about as far from each other* as in the case of pressure upon the outer side of each closed eye—namely—*about an inch and a half in point of height;* though the one will *not be perpendicular* to the other.

Upon this last-mentioned general fact, I remark that, my attention has been repeatedly drawn to observe that the VERTICAL LINE OF OUR FIELD OF VISION *is of a much more limited extent,* than the HORIZONTAL LINE OF THAT FIELD. At the same time; this is what ought to be, from all that has been advanced concerning the *correspondence* of Visual Images; and, also, from the *number and arrangement of the eyes,* both which, together, must take in a greater extent of horizontal view, than either eye, singly,

can embrace of a vertical view. This remark, therefore, confirms the fact that our two eyes were made for two distinct co-existent fields of vision.

4.—But the most remarkable fact, in the phenomena now described, is that, in the case wherein we operate upon the *outer* side of each closed eye at the same time; and when, in consequence of this, we see each object as it were in the *opposite and inner corner of the* EYE THAT IS IMPRESSED; if we move the pressing instruments in *contrary directions*, we shall now see that the object occasioned by the *pressure on the* RIGHT *eye is* ON THE LEFT SIDE of the object occasioned by the *pressure on the* LEFT *eye;* that is to say, the SEEN OBJECTS ARE INTERCHANGED *as to their correlative positions*, or, in other words, THEY OCCUPY DIFFERENT VISUAL SITES in the perceiving mind, from what would seem to correspond with the eye whose pressure has occasioned them.

Here then, I say, is exhibited, in the most extraordinary manner, a crucial test of the existence of that Cerebral Visual Mechanism for the recrossing of Images, which has before been demonstrated in so many ways in the foregoing Propositions.

What can be added, here, to the suggestion now advanced, can only regard some details, and illustrations, of the phenomena in question. But the Principal Fact itself is one which, I trust, cannot be contemplated without the greatest cause of satisfaction that our Visual Constitution is in reality such, as has been all along herein asserted. And, hence, there cannot remain a doubt, but the Visual Organ,

which I have asserted as performing the office of a Third Eye, is really existent; and is the actual seat of the re-crossing (by which is strictly meant the new production) of the latest Tactual Visual Images, preparatory to their ultimate discharge on the mind.

Such appears to be the nature and extent of the matter now suggested, in its probable bearings upon the farther steps, (whether followed out by me, or by others,) of the investigation of Cerebral Vision; that, in order to its due illustration, I have supplied a PLATE, with Figures representing the various principal phases of the phenomena.

And, in the *First* place;—By *Fig.* 1, we see represented the several appearances displayed in the case here immediately to be described.—When pressure is made on the OUTER side of either *single eye*, and when this eye is open; we shall see the *usual circular object apparently on the opposite side* of the eye; and this object will *appear at* A P, as if it were on the *outside of the eye and touching the nose.* By carrying the pressure farther back on the eye; we can force the object to appear as if it were *thrust forward* in the situation of F, *or all round beyond the eye:*—but this last is a case not within our present investigation.

But, when the pressure is made on the *outer side of each* CLOSED *eye and at the same time;* (as was described farther back in article second;) we shall, in this case, lose sight of the fallacious appearance AS TO SITE OR POSITION of the seen object of each eye: and, if we now vary the pressure, by contrary motions of the two pressing instruments;

we shall find, to our great surprise and admiration, that the object seen by the LEFT eye is on the RIGHT-HAND SIDE of the object seen by the RIGHT eye,—the two objects, in their respective sites, being now situated as represented by R P.—R P.— indicative of their *Real Places*. Upon which wonderful display I shall comment, after describing the other phenomena in question.

When the pressure is made on the *inner side of each eye at the same time;* the usual objects will appear on the corresponding opposite sites represented by E and E, indicative of the *extremes* of *distance*, and of the relative situations, of this sort of object produceable by pressure on the eyes. And here I have to observe that, *Fig.* 1. represents the *actual tangible distance between the pupils of the eyes themselves, nearly to the truth of nature*, (in my own case at least,) it being rather more than *two inches and a half:* While, also, the *magnitudes of*, and the *apparent distances between*, the seen objects; (which I have placed behind the eyes, as being TOWARDS their *real* places, though *they appear as if* IN the eyes;) are nearly equal to those that are actually marked in the figure: and there seems to be little doubt, but these visual magnitudes, and distances, are nearly the same as the tactual.

Secondly.—By *Fig.* 2. are represented the two usual objects which appear when we press the *upper* part of one eye, and the *lower* part of the other at the same time. The apparent distance, *in point of mere height*, between the two objects, being about *an inch and a half.* But it is to be remarked, here: and the remark is equally applicable as an explanation of our deception with

regard to the site of the usual object when we see it *apparently on the side of the nose,* as in the case formerly described ; that *the eye can be no judge of the* ACTUAL SITE of any SINGLE object, because it is *no judge of the distance of that object from itself.* But, contrary to this, the eye is, comparatively speaking, an *accurate judge of the actual sites of* ANY TWO SEEN OBJECTS which occupy *certain positions in correlation to each other,* as is the case of the two objects represented by R P. and R P. *Fig.* 1 ; and, is also, the case of the objects represented by E and E.

In order to illustrate what I have last said ; I observe that, when we press on the outer side of the *left* eye, and the eye is kept open ; the *part of the retina* that is impressed from without, is the *same part* that is impressed from within the eye by rays of light from the top of our nose. And the consequence of this is that, the outer pressure being the more effectual, we see the re-crossed image of the *peacock's feather* obscuring that part of our nose upon which it appears to ride ; and see only that part of our nose which *appears round the feather:* both which appearances, we know, are in the mind itself. But, in this case, we are misled by our *previous knowledge of the real place of our nose;* that is to say, as the peacock's feather appears upon the nose, we are deceived into a belief that its real place is *not farther to the right than the middle of our possible field of vision.* And it is only when we see a *second and correspondent* peacock's feather, whose place we can compare with it, that we become undeceived as to its real site.

Thirdly.—By Fig. 3, are represented the other principal phases of that extraordinary phenomenon—the re-crossed objects seen in consequence of varying the modifications of the pressure upon both eyes acting in concert. And here we have to contemplate the appearances immediately to be described.

First.—When we press upon the *upper* part of each eye, ANY WHERE ON THE INNER SIDE OF EACH PUPIL; (always observing that a pressure by *continuous lively impulsions,* or, as steady pressure if at the same time we *wink the closed eyes,* is the most effectual,) we shall observe that the correspondent objects produced are occasioned, *each one of them by its own eye:* Which fact, *not being a fact of re-crossing,* does not require a Figure for illustration.

Secondly.—When we press upon the *upper* part of each eye, upon correspondent parts of the eyes *about half way between the pupil and the extreme outside of each eye;* we may observe, from moving the pressing instruments up and down in contrary directions, that the object seen with the RIGHT eye has *crossed over or changed its place horizontally,* so that it now stands on the LEFT hand of the object seen with the *left* eye, the two objects appearing *at some distance from each other* as represented by the letters L E 1—R E 1—in the present figure.

From this result it is self-evident that, *according to the increase of the distance* between the pressures on the upper parts of the eyes, the seen crossed images *must increase their distance between each other,* until, by the time the pressure is on the

extreme outer part of each eye, the two seen images will be at the *farthest possible distance asunder* that any two CROSSED images can be, as has been represented by the letters R P—R P,— in Figure 1.

Thirdly.—In order to carry on this illustration, by now transferring our attention to the analogous results which take place when we press upon the *lower* part of each eye, *upon corresponding points that are less distant from the middle of the eye than in the last case,* but yet, far enough on the side of each eye to produce *some degree of crossing;* we shall then see the two objects as represented by R E 2—L E 2—in which diagram the two circular objects appear to have *wholly crossed, but no more,*— they presenting themselves in *contact with each other.*

To return, now, to the *upper* parts of the eyes;— When the pressure is made on the *upper* part of each eye, upon corresponding parts that are *only a very little on the outside of a supposed line passing perpendicularly to the horizon through the pupil of each* eye; which limit I may be allowed, for distinction's sake, to call the VERTICAL LINE OF THE CROSSING OF VISUAL IMAGES; we shall see the two circular objects *intersecting each other;* while, also, they have *partly crossed,* as represented by R E—3—L E—3.

It is plain, from all that is here demonstrated, that, when we press upon points that are VERY NEAR the *Vertical Line of the Crossing of Images;* the result ought to be a *confounding, by co-incidence,* of the two circular objects INTO ONE SAME OBJECT, upon the very same principle as that on which,

when we make use of two eye-tubes, the seen two circles occasioned by the two ends of those tubes are *reduced to one same circle.* And, accordingly, this very result takes place in the present case.

In a word; When we are contemplating the re-crossing of the Visual Objects, in the various phases of the phenomena illustrated by Figure 3,—we are in a visual predicament perfectly similar to that in which we have, on other occasions, contemplated two different visual objects thrown upon each other by two eye-tubes: with this only difference, that, in the present case, the objects, in all the different modifications of them except one, are thrown *not merely upon,* BUT ACTUALLY BEYOND each other.—At the same time it is to be observed, that although, in treating the Subject under the Fourth Mode of Vision, I have adverted to the use and capacity of eye-tubes no farther than to mention their bringing their two fields into a *co-incidence;* it is here to be added that, by a crossing of two eye-tubes, in the manner of the *legs of a pair of scissors,* we can throw their two respective fields of vision *across and beyond* each other, precisely in the same manner as that in which the two peacock's feathers are thrown across and beyond each other in the case now under our consideration.

And here, in order to prove the *perfect identicalness* of the two cases of vision—namely—that with two eye-tubes—and that of two peacock's feathers;—I add the following observations, which could not have been brought in so suitably before. —*First.* When we look with both eyes open; we

can see BOTH the peacock's feathers, indeed, and ONE *will be very vivid; but we cannot see both so instantaneously*, or so *vividly*, as is the case when the eyes are closed: for which reason it was that, I mentioned the eyes should *usually be closed* in such experiments. Now the *difficulty*, when the eyes are open, of gaining, or of keeping steadily, a sight of both the peacock's feathers at the same time, is precisely of the same nature as that difficulty which we experience in gaining, or of keeping steadily, a sight of BOTH *objects marked on a pair of caps, at the farther ends of two eye-tubes*, as was explained in the Section which treats of that matter. The fact, in each case alike, proves that very few persons, in the *ordinary* business of vision, see the same object with both eyes at the same time; although men in general are deceived into a belief that they do see in this manner.

Secondly.—The circumstance that, on *commencing* the pressure, and when we look with the eyes closed, we *instantaneously gain sight of both* the peacock's feathers, and preserve them *steadily in our visual contemplation* without the smallest disappointment, or straining of the eyes, farther proves the *perfect identicalness* of the present case with that of our seeing according to the Fourth Mode of Vision—namely,—one Object or Image with one eye, and another with the other.

From all that has been demonstrated, therefore, there cannot exist a doubt but, in the case of the two different fields of vision which we see when we have crossed two eye-tubes like the two legs of a

pair of scissors, that the *field, or image, which we see on the* RIGHT *hand,* and which is occasioned by a *retinal image in the left eye;* and that field, or image, which we see on the LEFT hand, which is occasioned by a *retinal image in the right eye;* are *re-crossed,* or at least *newly produced,* visual images in the mind, in consequence of the previous retinal impressions.

To sum up this very extraordinary history; I have now to add that, when we press upon the *open* eyes; we can not only see both the peacock's feathers, but, with difficulty, we can gain sight also of our nose, with EACH eye. And herein we contemplate the most preposterous phenomenon that can well be imagined: For, while we now see the *right side of our nose* with our *right eye,* as we should expect it to appear; we see it *stand on the* LEFT *side* of the LEFT SIDE OF OUR NOSE as seen with the *left* eye:—In other words; in our present field of vision, with both eyes, we see *two images of a side of our nose, the one image preposterously toward the other;* and the image that stands on the *left,* is that seen by the *right eye;* while that which stands on the *right* is that seen by the *left* eye; insomuch that, we *behold at the same time two noses obliquely point to point.*

Among the other consequences of this strange exhibition; it is certain that, as each of the seen images is seen in consequence of a retinal image which falls with the *utmost possible obliquity on the retina,* we have herein a final confirmation of the fact that Dr. Potterfield's *Principle of Perpendicularity* is utterly void of foundation in nature. It remains therefore to repeat here, that the two

fields or images of vision, which we see apart from each other when we employ two crossed eye-tubes, are *not seen on a Principle of External Direction;* but they are *Proper Visual Images consisting of Sensations of Colors in the mind itself.* Thus, when we see our nose as *two noses standing point to point;* and, know that we see each of them with the *eye that is situated on the contrary side* to that of the seen nose; we are certified, beyond all question, that the noses we see are not seen on a principle of *external* direction: because, when we look at that part of each nose to which a peacock's feather adheres; we know, that the *feather* and the *seen nose to which it adheres* MUST BE BOTH OF ONE SAME MATERIAL, AND IN ONE SAME PLACE; while, also, we are certain that the peacock's feather is mere sensation and HAS NO EXTERNAL EXISTENCE.

Nor is this display of Nature yet ended: For, after trial and a little practice, if we look toward the point of our nose, with our two eyes: (*without pressure,* and, consequently, without seeing the peacock's feathers,) we shall gain a sight of two noses, as we did in the case wherein we employed pressure. And here, by shutting each eye, alternately, we may prove to ourselves that the *nose on the* LEFT HAND is seen with the *right eye;* and, the *nose on the* RIGHT HAND is seen with the *left eye:* And the only difference between the present and the former case is that, instead of standing *obliquely point toward point,* the two noses will stand *side by side* each other in the *collateral* positions of two horses in a carriage.

Here, then, are wonders that make the elegant

and important phenomena of the double pin's heads sink into trifles in comparison. And here, the grand fact of the re-crossing of images within the head is, in the most unexpected manner, demonstrated: because, it must be manifest to all persons that our REAL EXTERNAL nose MUST be seen,—its *right side* with the *right eye*, and its *left side* with the *left eye:* and therefore it is confirmed, most certainly, that the TWO NOSES WHICH WE SEE *are* NOT THE TWO SIDES OF OUR REAL EXTERNAL nose.

If farther proof could make the fact in question appear stronger; we are to observe that, the two seen noses *do not join*, as the two halves of our real external nose join; but they appear *about an inch and a half asunder*. Now the reason, they do so, is plain; it being because each seen nose is seen in consequence of an impression in the eye; and the different retinal impressions fall upon parts that are not calculated to produce a junction of visual objects behind the eyes; but they make the seen noses stand apart, on the same principle as two arrows, marked out an inch and a half asunder, and one of them seen by each eye, would appear an inch and a half asunder.

To what has now been said, is to be added the momentous consideration, that, in the case of *Vision without External Objects*, we have THROWN AWAY OUR EYE-TUBES; and, with them, have THROWN AWAY, OR EXCLUDED, *also* the EXTERNAL WORLD: And we NOW contemplate ONLY *those* VISUAL OBJECTS *and their* CROSSINGS, *which form the* FIGURED WORLD OF OUR OWN MENTAL MODIFICATIONS.

And here I leave this matter, for the contemplation of the Philosopher, and of every reflecting mind. And, if there be any enlightened person, who, upon being first introduced to this display of the power and wisdom of the Creator, as manifested in the contrivance of such a Mechanism, does not feel a sentiment of a very peculiar sort; I must own myself a child, by confessing that it impressed me with such a feeling, in a very strong degree. I speak not with a moment's regard to my having had the accident of falling first upon the thing. But I speak the feeling which the FACT OF THE CROSSING forced upon me, in the opening of its aspect. Nor must I here omit to notice, also, the impression which the *extreme beauty* of the phenomena cannot fail to make, upon any mind that is ductile to a display of Nature: Their richness, and lustre, and symmetry, and varying change of correlative place, in an instantaneous obedience to every contrary pressure, exhibit, to an admirer of Nature, a display,—AND A SYSTEM,—as splendid, as it is wonderful.

If Bishop Berkeley had fallen upon these Phenomena; and had beheld them, at his bidding, revolve round the eye, and round each other, like the bodies of our Planetary System; he would never have denied that a Being, endowed with *Sight alone*, might have learned not only the Science of GEOMETRY, but that of ARITHMETIC ALSO, without any knowledge whatever of the existence of an external *figured* world.

THE END.