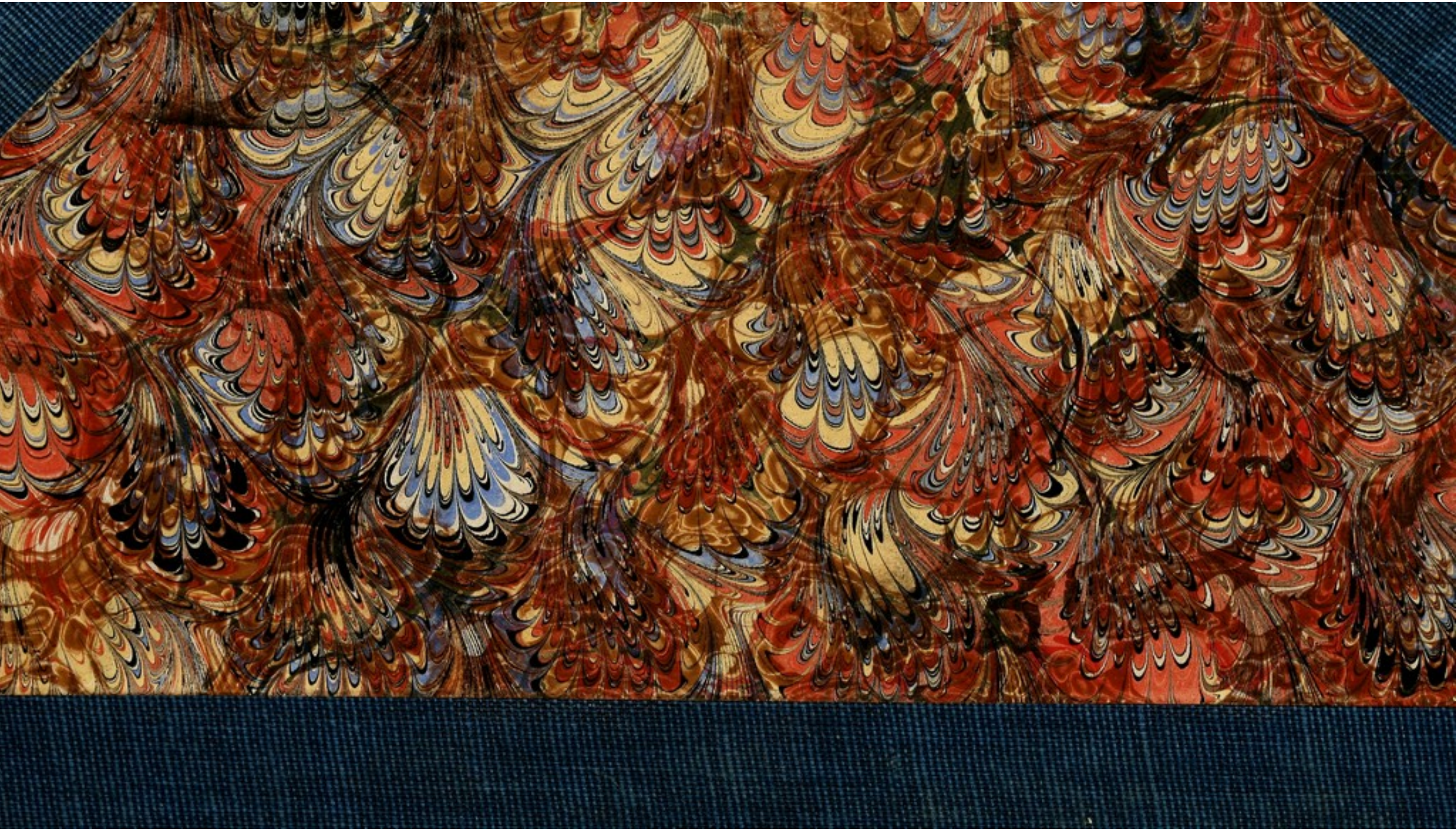
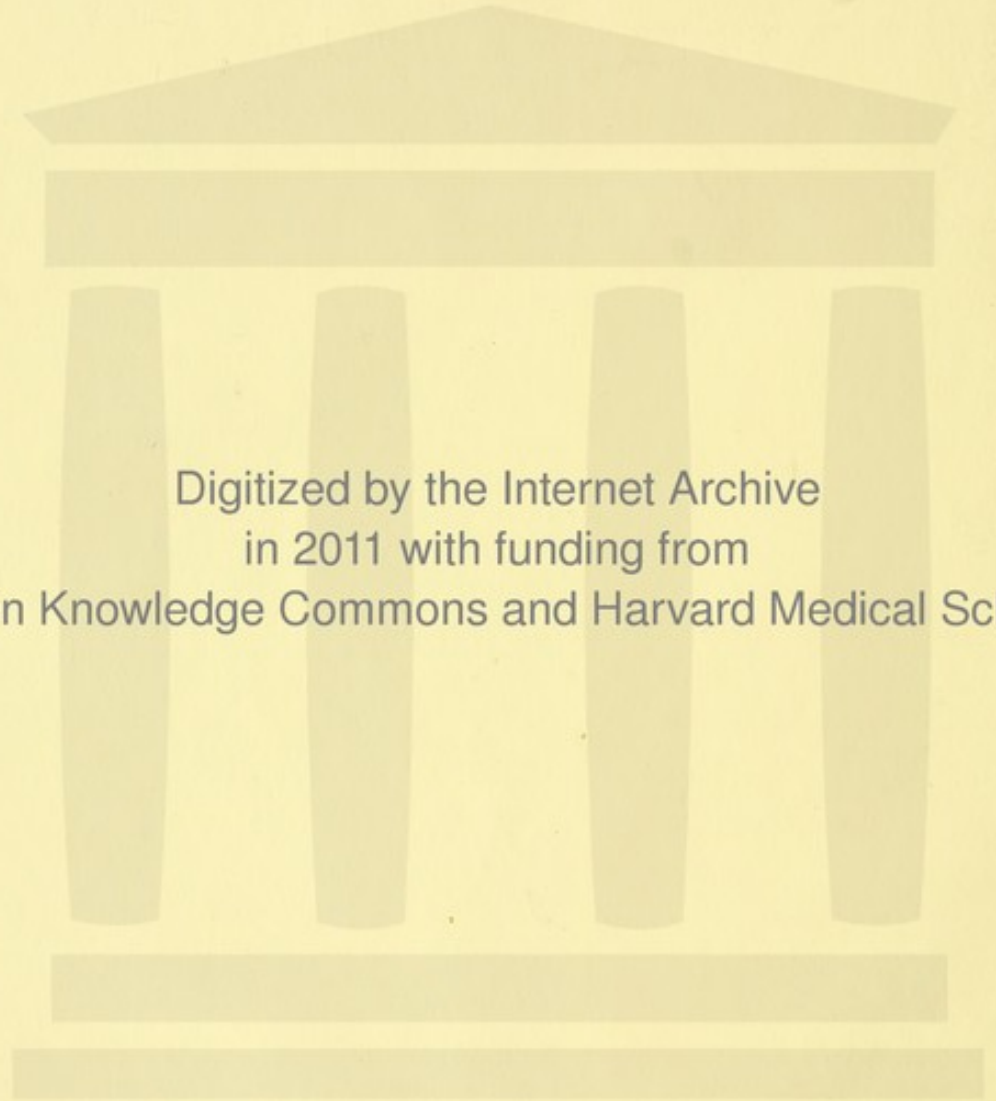
On a new membrane in the eye : being the substance of a lecture delivered at Oxford : before the late meeting of the British Association for the Advancement of Science / by George Hunsley Fielding.





ON A

NEW MEMBRANE IN THE EYE;

BEING THE

SUBSTANCE OF A LECTURE

DELIVERED AT OXFORD;

BEFORE THE

LATE MEETING OF THE BRITISH ASSOCIATION

FOR THE

Advancement of Science.

BY

GEORGE HUNSLEY FIELDING,

MEMBER OF THE ROYAL COLLEGE OF SURGEONS IN LONDON; MEMBER OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; HONORARY CURATOR OF COMPARATIVE ANATOMY IN THE HULL LITERARY AND PHILOSOPHICAL SOCIETY, &c. &c.

PLERIQUE ERRARE MALUNT EAMQUE SENTENTIAM QUAM ADAMAVERUNT PUGNACISSIME DEFENDERE QUAM QUID VERISSIME DICATUR EXQUIRERE.—CICERO.

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1832.

TO THE REVEREND

WILLIAM BUCKLAND, D.D. F.R.S.,

PROFESSOR OF GEOLOGY AND MINERALOGY IN THE UNIVERSITY OF OXFORD; PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE;

THIS LECTURE

IS, BY PERMISSION,

DEDICATED, AS A TESTIMONY OF THAT PERSONAL RESPECT AND ESTEEM, WHICH,

(THOUGH IT MUST BE FELT BY ALL THE MEMBERS OF THE ASSOCIATION WHO VISITED OXFORD,—WHO WITNESSED HIS ZEALOUS, HIS UNWEARIED EXERTIONS, AS PRESIDENT, AND WHO EXPERIENCED HIS GREAT KINDNESS AND LIBERALITY)

CAN BE FELT BY NONE MORE DEEPLY THAN BY

HIS MOST OBEDIENT SERVANT,

THE AUTHOR.

TO

GEORGE FIELDING, ESQUIRE,

SENIOR SURGEON TO THE HULL GENERAL INFIRMARY; SURGEON TO THE WORSHIPFUL THE CORPORATION OF THE TRINITY HOUSE, HULL; VICE PRESIDENT OF THE HULL LITERARY AND PHILOSOPHICAL SOCIETY; MEMBER OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, &C. &C.,

THIS LECTURE

IS INSCRIBED,

AS A SMALL TOKEN OF FILIAL ATTACHMENT AND AFFECTION,

BY

THE AUTHOR.

PREFACE.

In presenting this Essay to the Public, the Author must beg to observe, that (with the exception of a few notes) he has deemed it advisable to preserve it as nearly as possible in the state in which it was delivered to the Meeting of the British Association. It may probably, therefore, appear somewhat brief, as the limited time which was allotted to the reading of each Paper (a circumstance arising from the numbers presented) rendered condensation imperative, and must now afford the best and only apology.

The sole object of the Author is to elicit Truth;—he has been led away by no favorite theories—has given way to no imaginative speculations—but has only advanced the results of the most careful and diligent observation and the most rigid experiment; and he therefore hopes for that indulgence and that liberality which a British Public is ever ready to bestow.

Kingston Square, Hull, August 10*th*, 1832.

AN ADDRESS,

&c.

CULTIVATED and flowery as seems the Garden of Science, and smooth and tempting as its winding paths may appear, there are none now before me who will not be ready to confess, not merely that many of its plots are still sterile and unyielding, but that every individual bed, rich and luxuriant as it may be, is still capable of higher cultivation and improvement. The institution of so noble an Association as the one I have now the honour to address, while it powerfully proves the truth of what I have just advanced, proves also the necessity of an union of efforts, by shewing that the higher we advance in the scale of perfection, the more toilsome and laborious is our way. It is the duty, therefore, of every one to use his best endeavours to forward the progress of Science; and though the light he may be enabled to throw on the path be but a single, a solitary ray, it may serve as a guide to

further improvement, and can never be unacceptable to the real lover of truth.

The discovery I have made, and the observations I am now going to offer to you, if they be correct, must necessarily alter the received laws of vision ; and if these remarks shall finally conduct us but one step further in the elucidation of truth, my object will be answered. Acquainted, and well acquainted, as all before me of course are, with the Anatomy of the Eye, it would be superfluous as well as tedious to enter into any anatomical description of its various parts, and I shall therefore proceed at once to my subject.

If we look through the Cornea into the bottom of a recent Eye, (say of the sheep or ox, as these are the most readily obtained) we shall perceive a bright shining surface, which is more or less brilliant according to the time the Eye has been kept, and the consequent transparency of the coats and humours. It is still better, however, to remove the Cornea, and take out carefully the humours and the Retina; we shall then have a perfect view of the part in question.

By this last process we shall find that this beautiful part is immediately behind and in con-

tact with the Retina, or to speak more anatomically, with the exterior coat of the Retina, now called the Tunica Jacobi, in honour of its discoverer, Dr. JACOB, of Dublin.

I would ask then, what is this brilliant surface which we find placed immediately behind the Retina, and which we can any day see in the dusk, glittering like gold in the Eye of the domestic cat?

If we refer for an answer to any standard anatomical work, we shall find that what is termed the Pigmentum of the Eye, is immediately behind and in contact with the Retina; therefore this bright surface is the Pigment of the Eye.

In proof I need but quote Bell's Anatomy, than which we have not a better treatise in our language—

"The pigmentum nigrum is the black or brown mucous substance, which lies between the choroid coat and the retina." "This matter is in *immediate contact with the medullary pulp of the optic nerve.*" "The *dark colour of the secreted pigment* is in some measure peculiar to those animals which see in the brightest light of day; but is *wanting, or of a bright reflecting green or a silvery whiteness, in such as prowl by night.*"

Another remarkable sentence in the same work tends very much to confirm my opinions.

In describing the Choroid, Sir C. BELL observes —"And it has upon its inner surface a PIGMENT, *which being sometimes firm, might be taken for a* MEMBRANE."*

It may, however, be said, that this bright part is the Tapetum. If so, I should be glad to have it defined what is the Tapetum ?† And this question, simple as it may sound, is not so easy of

* Bell, III. 33.

† "The *internal surface*, (says Sir C. Bell) of the Choroid coat, has long been called the Tapetum, from its villous or fleecy appearance, when seen through the microscope. This surface, in the adult, is of a brown colour; in very young subjects, it is red and bloody; and when minutely injected, it is like scarlet cloth. It is by this vascular surface or Tapetum, that the black Pigment, which is laid under the expanded Retina, in the human Eye, is secreted."

In a note, the same Author observes, he "cannot conceive how the Pigment should be confounded with the Tapetum." "The name of Tapetum or Tapis was first given by the French Academicians, in their account of the dissection of a lioness." "The membrane which is put into the bottom of the Eye, and laid on the Choroides, which we call the Tapetum, was of an isabella colour, intermixed with a greenish blue. It was easily separable from the Choroides, which remained entire, with its ordinary thickness, after that we had taken away the membrane which forms the Tapetum."‡

Finally, he says—"In regard to the Choroid coat, we have to understand that it consists of two laminæ; the outer and that which is next to the Sclerotic, being the proper Choroid; the internal lamina the Tunica Ruyschiana: that on the surface of the Ruyschiana there is a pile or fleece which is called the Tapetum; and lastly, that the *secretion of this inner surface is a Pigment*, which, in the human Eye, has the appropriate name of *Pigmentum nigrum*; but, in many animals, *it is of a silver, golden, or*

‡ Bell's Anatomy, III. 33.

solution. Some regard Tapetum and Pigmentum as synonimous terms; others think the Tapetum

isabella colour; though, in my apprehension, *the colour, in all these varieties, depends still upon a peculiar secreted matter.*"

With all due deference to the high authority of this account, (and more especially as from my respected tutor, some years since,) my opinion is, that so far from rendering the matter clearer, it makes it still more obscure. In page 34, Sir C. Bell observes—"The *internal part*" (of the Choroides,) again, is organized into a *secreting surface*, and is the Tunica Ruyschiana." Therefore, according to this plan, the Choroides has *two internal surfaces, both of which are to secrete the Pigment.* These two different parts (as Sir C. Bell states them to be,) occupy the same place, and perform the same functions. The late Mr. Shaw, (Sir C. Bell's assistant at the Anatomical Theatre,) we shall find advocating the identity of these two with each other, and regarding them as synonimous.

Indeed Sir Charles himself, in what may be called the summing up of his account of the Choroides, (and which is quoted at length above,) seems rather sensible of this difficulty. He makes the Choroides consist of Two Laminæ; the *external*, the proper Choroid; the *internal*, the Ruyschiana; upon the Ruyschiana he places the Tapetum, which he defines as a *pile* or *fleece*, (the strict anatomical meaning of which term I confess I cannot comprehend, for it is evident it is not intended to be regarded as a distinct membrane, nor as a lamina of the Choroid; for then the Choroid would have been stated to consist of *three laminæ,)* and *upon the Tapetum, and secreted by it,* (that is by this pile or fleece, the Tapetum, and not by the Ruyschiana) he places the Pigmentum, which is of various colour in different animals. It is of no importance however, to me, what is meant by the term Tapetum, unless it be synonimous with Pigmentum. I am only sorry that it is not in my power to obtain a perusal of the original account of the dissection of the lioness by the French Academicians, from which Sir Charles Bell has translated a portion (and no doubt it will be the most important part) in his work.

The Tapetum has never, within my recollection, been shewn in the British Anatomical Schools, as a separate membrane of the Eye, nor as a lamina of the Choroides. Had either of these been done, it would long ere this, have been generally known. Of course the Pigmentum nigrum has never been shewn as a membrane, and it is with this last only that I have to do, in its situation behind the Retina.

a new name for the Tunica Ruyschiana; and Sir CHARLES BELL defines it as a "pile or fleece laid upon the Ruyschiana," and upon it, he says, the pigment is laid, to be in contact with the Retina. The celebrated CUVIER, whose loss the scientific world will long and deeply deplore, when speaking of the Tapetum, says—"The bottom of the Ruyschiana is frequently covered with a very slight coat of this *Pigment*, through which we can perceive its colour, which varies remarkably in different species."

Our illustrious countryman, JOHN HUNTER, published an essay "on the colour of the Pigmentum Nigrum of the Eye," in which he treats of all the beautifully varied colours we find in the eyes of different animals, as the true Pigment of the Eye. The remarks of Dr. BOSTOCK, in his beautiful work on Physiology, are also to the same purpose. RICHERAND embraces the same opinion. FYFE, who seems inclined to deny the division of the choroides into Choroid and Ruyschiana, as did HALLER, ZINN, BICHAT,*

* Pour voir la structure de la Choroide, il faut la soumettre pendant quelque temps à la macération. Privée alors de son enduit, et en partie de sa couleur ordinaire, qu'elle doit un peu à cet enduit, mais qui lui est aussi inhérente, comme je l'ai dit, elle devient transparente presque comme une membrane séreuse. *Sa ténuité et son peu d'épaisseur, lorsqu' elle est ainsi réduite à elle même, ne permettent point de lui distinguer* LES DEUX LAMES *dont plusieurs ont parlé, et dont l'existence isolée a déjà été*

and others, observes, "Upon the inner side of the Choroides, there is a mucus termed Pigmentum nigrum." "In graminivorous animals, and in those which go in quest of prey in the night, the *Pigmentum is of a light and shining colour at the bottom of the Eye, and is called Tapetum.*"

Nothing can be more clear and decided than this. The late Mr. SHAW is the only writer, that I know of, who advocated the identity of the Tapetum and Ruyschiana. He says—"The external part is called the *true Choroid*, from its resemblance to the chorion of the fœtus,—the inner part has, in honour of the discoverer, been called *Tunica Ruyschiana.* The variegated colour of the internal surface in some animals

rejetée PAR TOUS LES VRAIS ANATOMISTES. *On n'y trouve qu'un seul feuillet qui se rompt par le moindre effort.*

La nature de cette membrane est entièrement inconnue.

Speaking of the Pigment, Bichat observes—"On peut la soumettre aux divers agens chimiques soit sur le Choroide elle même, soit sur le papier auquel elle donne une teinte solide que l'air n'altère point, comme si m'en suis souvent assuré. J'ai du papier teint ainsi depuis six mois, et qui est comme le premier jour. Fixée sur le papier et soumise aux Acides Sulphurique, Nitrique, Muriatique, &c., à l'Ammoniaque, á l'Alcool, a la dissolution de Potasse Caustique, elle est de même absolument inaltèrable. C'est à cette couleur particuliere que l'on rapporte les usages de la Choroide, destinée probablement à absorber les rayons lumineux qui ne doivent point servir á la vision."—*Bichat Traitè d'Anatomie, tom.* 2, 436.

having some resemblance to the colour of fine tapestry, induced the Parisian dissectors to give it the name of *Tapetum*." It is therefore evident that the term Tapetum is at best ambiguous in its signification; but if we are inclined to abide by the opinion of the majority, this will be decidedly in favour of the Tapetum and Pigmentum being synonimous terms. Now as all Anatomists agree that the Pigmentum is placed immediately in conjunction with the Retina, and as the part to which I wish to draw your attention is situated immediately in conjunction with the Retina, I apprehend that the following will be the only proposition I shall have to prove; *viz.*— That the part situated immediately behind and in connection with the Retina is Membrane, and not Pigment. The first object, therefore, will be to define the nature of the true Pigment of the Eye.

In Bell's Anatomy, we find the following description :—" The Pigmentum Nigrum is the black or deep brown substance which lies between the Choroid coat and Retina. It is of a nature *to be washed away with a little water and a soft pencil.* This brown tint pervades the whole texture of the Choroid. *This matter is in immediate connection with the medullary pulp of*

*the optic nerve.** As I have already quoted, Sir C. BELL states, that the colour varies in different animals. According to the analysis of Dr. YOUNG,

* From the uses ascribed to the Choroid Pigment, it is plain that its situation must be immediately behind the Retina.

"Its use is *apparently* to stifle the rays of light after they have impinged on the sensible surface of the Retina; for we know that blackness is owing to the absorption of the light, as whiteness and colour is the reflection of it from the surface of bodies." And again—"The natural conclusion, therefore is, that the Pigmentum Nigrum subdues the intensity of the impression; while the reflecting colours of the surface, in animals which see in the night, strengthens the effect of the light on the surface of the Retina by repelling it."—*Bell's Anatomy*, III. 36.

—"Destinée *probablement* à absorber les rayons lumineux qui ne doivent point servir á la vision."—*Bichat*, II. 436.

"The use of the Choroid is not so much to afford a covering to the other parts, as to present a dark surface, destined to absorb the luminous rays, when they have produced on the Retina a sufficient impression. If it were not for the Choroid, the light would be reflected; after having impinged on the nervous membrane, its rays would cross, and produce only indistinct sensations."—*Richerand*, 261.

"The Choroid of some animals, more easily separated into two distinct laminæ than that of man, presents at the bottom of the Eye, instead of a darkish, uniformly-diffused coating, a pretty extensive spot of various colours, and in some most beautiful and brilliant. *It is not easy to say what is the use of this coloured spot, known by the name of Tapetum.*"—*Richerand*, 268.

"Between the Choroid and the Retina there is a thin stratum of a black viscid substance, termed Pigmentum Nigrum, probably a secretion of the vessels of the Choroid. Its use has been *supposed* to be to absorb the superfluous rays of light, that might otherwise oppress the sight or render objects indistinct. This is illustrated by those animals which are devoid of Pigmentum Nigrum, as the Albino. In these cases the organ is unable to bear the strong light of day without uneasiness, while at the same time

the Pigment consists of mucus, combined with carbonaceous matter, on which its colour depends. BICHAT has subjected the Choroid Pig-

it can discern objects distinctly by a very small quantity of light. *Hence we find that those animals which seize their prey by night, or whose habits lead them to spend their time principally in darkness, are either without this substance or have it of a lighter colour.*"—*Bostock's Physiology.*

"The Choroid Coat, with its dark paint, serves to *suffocate the rays of light* which pass through the Retina, thereby allowing a distinct image to be formed upon the bottom of the Eye, and preventing the rays from being *reflected* so as to form a *second image*. In those animals in which this coat, or its paint, is of a bright colour, it acts as *a mirror to reflect light* and make the impression stronger."—*Fyfe*, II. 62.

Here we have the Choroid Pigment, serving two entirely opposite purposes, viz. *absorption* and *reflection* of light. Now, if by *reflecting* light it must necessarily form a *second image*, and if this be urged as an objection to reflection in the first instance, why does it not equally apply in the second instance?

It has often been remarked by dissectors, that the Retina is never found stained by the Pigment after death. Yet they are placed in apposition, according to anatomists; and under these circumstances, we should be led to conclude a stain would be unavoidable. The intervention of the membrane I am describing, will, of course, at once account for this fact. I am aware it may be said that Jacob's membrane will prevent this;—and indeed Jacob's membrane is the most convenient membrane imaginable, and has been liberally used by certain Philosophers at Hull, as a Jacob's ladder out of every difficulty. In fact, if there be such a part as I am describing, and which we find in every Eye, (though some boldly deny the evidence of their own senses) it *must* be Jacob's membrane. A transparent colourless substance, and a semiopaque brilliantly-coloured one, present exactly the same appearance, and must be the same thing! —and therefore black and white are identical. If it be not Jacob's membrane, Jacob's membrane is just as good as it, and therefore there can be no occasion for such a membrane. The world has been said to be supported on the back of a tortoise; but what supports the tortoise?

ment to various chemical processes, and states the following curious facts respecting it, which are of importance to my theory :—

"It may be exposed to the action of various chemical agents, either on the membrane itself or upon paper, to which it gives a permanent tint, on which the air has no effect. I have paper touched with it six months since, which is the same as it was the first day. Fixed on paper, and subjected to the action of Acids, Sulphuric, Nitric, Muriatic, &c., to Ammonia, to the solution of Caustic Potash, it remains absolutely unchangeable."

With regard to the use of the Pigmentum, all Anatomists *seem to agree* (for many express themselves far from confidently) that it is intended to stifle the illuminating rays, after they have impinged on the Retina, and consequently to prevent the reflection of light, which they affirm would cause imperfect vision. The reason of their hesitation is evident; because they find a great number of different animals in which, from the colour of the Pigment, there must evidently

The Tunica Jacobi prevents the Tunica Nervosa from being stained; but what prevents the Tunica Jacobi from being stained?

The celebrated Zinn denied the possibility of separating the Retina into two layers: "Alteramque," says he, "ab altera integram detrahi, ultra hominum artem positum esse videtur." Yet now this thin and extremely delicate membrane, is acknowledged to consist of *three* layers. The exquisitely delicate expansion of the nerve is included between two as exquisitely delicate layers of membrane, and the three together are not the ten thousandth part of an inch in thickness.

be reflection instead of absorption of the rays. They observe, however, that these animals generally see better in an obscure light than a bright one, and therefore tell us that reflection of the rays assists their vision in this obscure light. The cause of this contradiction is left unexplained. —According to Dr. Bostock, M. Desmoulins affirms that he has found animals possessing this bright-coloured Pigment seeing perfectly well in the full light of day. The names of the animals, however, are not mentioned.*

I shall now in the second place, proceed to shew a few experiments to prove my proposition.

Take an ox or sheep's Eye, (for with these only have I conducted all my experiments) and making a section of it, parallel to the Cornea but a little below it, carefully remove the Retina and Vitreous Humour; you may then for convenience again divide the remainder into two parts, so as best to present the coloured portion for examina-

* As instances open to all observers, I would name the ox, the sheep, the deer, and the horse: but all these animals, though probably seeing well, certainly see worse than man in bright glare, and it is well known see better than him in obscure light. Any one accustomed to riding by night and day, as medical men are, will know this with regard to the horse. In the horse, the Membrana Versicolor is a fine blue.

tion. Suppose the Eye of an ox thus prepared, we shall find a pretty extensive spot of a bright blue colour, frequently intermixed with yellow and green.

1st—We shall find the Retina is not stained by any of these colours.

2ndly—Take a piece of white paper and apply it to the green, or yellow, or blue surface, you will find it *affords no stain.*

3rdly—Wash it with a camel's hair pencil and water, you will *not remove the colour.*

4thly—Its appearance is bright and polished, like a varnished surface.

5thly—By careful dissection you may (under water) separate it in layers from the Ruyschiana. In the sheep I have several times succeeded in shewing three laminæ. It is spread over the whole internal surface of the Ruyschiana, but varies much in thickness, and consequently in the number of its laminæ. It is thickest where the brilliant colours are found, and thinnest in the circumference where the dark colour of the Ruyschiana is visible through it. A very re-

markable circumstance, as regards it, is, that the extent of the coloured spot varies very much in different animals of the same species;—I have sometimes found it occupying nearly three-fourths of the concavity of the globe, and at others scarcely one-fourth. Sometimes the nature of the colour will vary; thus, for instance, I have twice seen this membrane of a bright yellow in the Eye of the sheep, whereas it is generally of a blueish green. But whatever its colour may be, it still presents a bright and polished appearance, and is essentially performing the same office, though varying in its degree of perfection as a reflector, and causing some difference as to the gradation of light best suited for the perfect vision of the animal.

6thly—The true Pigment, possessing its usual appearance and attributes, will invariably be found in the same Eye wherein we see these bright colours, but it is *behind this membrane*, and most plentiful on the posterior or external surface of the Choroid, in connection with the Sclerotica. Thus in the ox, where this membrane is of a fine blue, (not unfrequently mixed with yellow and green) we find the true Pigment very plentiful, and of an uniform deep brown; in the cat, the membrane is a bright yellow, the

Pigment a rich black ; in the fox, it is much the same ; in the deer, it is a very pale blue, the Pigment a pale brown ; in the dog it is greenish blue, the Pigment brown. The statement, therefore, I before quoted, viz.—" *That the dark coloured choroid paint is wanting, or that it is of a bright reflecting green, or silvery whiteness, in such animals as prowl by night,*" is proved to be incorrect by the instances of the cat and the fox. I have never yet found an Eye in which the true Pigment was wanting, excepting in the Albino animal, under which term I include all white animals with red eyes.

7thly—I will now carefully detach a small portion of this substance, and place it between two pieces of glass. It will be found to present a hard and well defined outline; and on putting the glasses in closer approximation to each other, and then suddenly relaxing them, you will perceive that the substance *expands and contracts. This proves that it possesses the property of elasticity.* Again, view this portion by reflected light, you will observe its usual colour ; but look at it by transmitted light, and it will present a totally different one. Neither of these properties belong to any known Pigment ;—as regards the last peculiarity, this membrane evidently follows Sir Isaac New-

TON's laws respecting the colours of thin plates. For instance, a small portion of this membrane, of a pale blue colour by reflected light, presents a yellowish red by transmitted light.

8thly—Having succeeded in obtaining a small piece of the substance, I placed it between two pieces of thin glass, and subjected it to examination with a fine achroamatic Amician microscope, by CHEVALIER.* When viewed as an opaque object, the portion was pale blue; and when as a transparent, yellowish red. With a power of 800 to the diameter, *not only were blood-vessels plainly discernible, but even the globules in those vessels!* By still further increasing the magnifying power to the highest degree of which the instrument was capable, the globules were increased to the size of a very small pin's head. I fancied also that I could trace nervous filaments, but could not quite satisfy myself on that head. This was proof undeniable of its being a membrane.

9thly.—When the Choroid has been so finely injected as to resemble a piece of red cloth, this

* For the use of this splendid instrument, and for his kind assistance in the experiment, I am obliged to M. Gregoire de Lanquetot.

membrane will be found unaltered in appearance, and where the colours exist they will be as beautiful as ever.

Immerse the Eye in spirit for a few days, the colour will disappear, and a whitish filmy semi-opaque membrane will be found covering the Choroid. Re-immerse the preparation in water for a few hours, and the colour will be restored, and the membrane will finally become nearly transparent, for the red injection will be distinctly seen through it. I found this most beautifully exemplified in a preparation I had had for some months by me, and which was minutely injected with size and vermillion.

10thly—Another curious circumstance, as regards this membrane is, that, like the feathers of the humming-bird, it presents different colours according to the angle in which you view it. Take a section of a beast's Eye, in which the colours are vivid, place it in a strong light, and, fixing your eye steadily on one point, walk round the table, you will easily verify this statement.

11thly—We have seen that, according to the experiments of BICHAT, no known chemical agent

has any effect in altering the colour or appearance of the true Choroid Pigment. I shall now proceed to shew a curious experiment, by which the brilliant colours of this membrane may be made to appear and to disappear at pleasure. Take a portion of a beast's Eye, where the colours are bright, and dip it into any dilute acid, (Nitric, Muriatic, or Sulphuric) you will perceive the colours begin to fade and get brown (like the tint of a faded leaf); plunge it into cold water, and on removing it you will find the colours have entirely disappeared, and a black surface is presented to the view; immerse it again in the acid, and on withdrawing it you will find the brilliant colours restored; dip it again in the water, they will vanish, and in the acid they will be restored, as if by the aid of magic! This you may repeat, with the same effect, as often as you please. A solution of Ammonia will produce the same effect.

To explain this phenomenon: I have already stated my belief that the colours of this membrane depend upon the thickness and disposition of the numerous and exquisitely delicate plates of which it is composed; and therefore I conclude that the disappearance and re-production of the colours, by the action of the chemical

agents, is effected by their causing alternate heat and cold, and consequently exciting alternate expansion and contraction in these delicate laminæ.

Lastly—I must offer a few remarks respecting this part of the Human Eye ;—and here I must confess that my opportunities for investigation have been necessarily very limited. I cannot say that I have ever seen a *coloured surface* presented, yet I think it highly probable this may exist in some instances, though not generally. That a membrane of this kind *must* exist, will, I think, be shewn when I come, in the next division of the subject, to treat of its utility in the formation of the image. In the specimens of the Human Eye that I have seen, (after carefully extracting the Retina and Vitreous Humour) I found this membrane bright, polished, and semi-transparent,—the brown colour of the Pigment of the Ruyschiana being visible distinctly through it. In fact it appeared like a fine coat of varnish upon a brown ground. By immersion in Sulphuric Æther it became rather more opaque and somewhat milky in its appearance, and was sufficiently firm to be raised and separated from the Ruyschiana.

Having thus shewn that the surface placed

behind and in connection with the Retina does not possess the usual attributes of a Pigment; that its colours are not the result of any secreted matter; that it consists of an indefinite number of layers, separable from the Ruyschiana; that it possesses *elasticity*, and above all *circulation*, we are, I think, warranted in coming to the conclusion that it is MEMBRANE *and not* PIGMENT.

To this membrane I have given the name of MEMBRANA VERSICOLOR, as in some degree descriptive of its appearance and properties.

It now only remains, in conclusion, to offer some brief observations on its use, and on the necessity that such a membrane should exist.

It is generally assumed and believed, that the image of any object presented to the Eye is pictured upon the Retina,—and by it the sensation producing vision is transmitted along the Optic Nerve to the brain. With this theory I differ most decidedly, and trust to lay before you satisfactory reasons for so doing.

The Retina, during life, is almost universally acknowledged to be *transparent;* and those who do not accord with this opinion call it *semi-transparent.* I believe it to be *perfectly transparent.*

I have seen great numbers of Retinæ, at various periods after death, and always found a degree of opacity in them which, I have no doubt, depends upon the absence of vitality. I once, however, had an opportunity of examining the Eye of a horse (which had dropped down dead suddenly) while all the humours, &c. were quite warm. Here the *Retina was quite transparent*, and possessed internally a very light pinkish-coloured hue, produced, no doubt, by the presence of fluid blood in the Tunica Vasculosa.

If we look at the Eye of the cat, in the dusk, it appears quite luminous,—and this effect can only be produced by the reflection of the rays of light from the Membrana Versicolor, which in this animal is of a bright golden colour. Now if the Retina (which intervenes between the beholder and this bright membrane) were semi-transparent, it would be impossible to have this effect, because the Retina would act like ground glass before a lamp, or gauze before a looking-glass.

Of course, in all philosophical investigation, we are not justified in ascribing to matter properties which are not known and cannot be proved to exist. It is acknowledged that neither

light nor heat produce any sensible effect until they are obstructed in their course,—and, consequently, none will be produced by their passing through a transparent medium. Therefore if the Retina be transparent, no image can be imprinted on it, because the rays of light must pass through it.*

It is acknowledged that there is no susceptibility of vision at the point of insertion of the Optic Nerve, and hence the theory of MARRIOTTE that the Choroides is the true seat of vision.

I have myself seen, in a recent Eye, the light pass through a full quarter of an inch of the Optic Nerve ; and so great was the transparency even of this thickness of nerve, that the light was

* The division of the Optic Nerve causes blindness. The same effect is produced by dividing the Trigeminus. Both, therefore, are essential to the performance of vision. The latter is a Ganglionic Nerve, the former is not. Reasoning, therefore, *a priori*, we should expect to find the Optic the Motor Nerve, the Trigeminus the Nerve of Sensation. As far as we know at present, neither of these conclusions would bear the test of experiment. We find, on the contrary, that the Iris, which is so largely supplied with Nerves from the Lenticular Ganglion, is *insensible to mechanical stimuli*. It appears to be only sensible to light. Yet the other branches of the same Nerve, confer the most exquisite sensibility upon other parts of the face,—nay, even of the eye itself.

The Retina, as we should expect to find, is insensible to stimuli. Still we cannot, at present, avoid believing it to be the true Nerve of Sensation for the production of vision.

not red but straw-coloured when seen after its transmission. How much easier then must it be for light to pass through an expansion of the same nerve, of such extreme tenuity as the Retina?

If any one were to tell us to project an image upon fine transparent glass with a double convex lens, or to heat water with a powerful lens alone, we should think it sufficiently ridiculous; but allow us to place some charcoal at the bottom of the water, in the focus of the lens, and we can make the water boil; or to put a foil behind the glass, and we shall have an image.

So, therefore, it is impossible that the transparent Retina can receive and retain the image of any object. Indeed the experiment may be tried on the Retina itself, after death. I have repeatedly seen that when this membrane has become only partially opaque (as it does soon after death) that if you project an image upon it, that image will be exceedingly faint and nebulous; and allowing the same to take place, *cæteris paribus*, in the living Eye, that image would be totally unfit for the purposes of distinct vision.

But the Retina is transparent, and conse-

quently cannot receive an image; and immediately behind the Retina and in contact with it, we are told, we have the Pigment of the Choroid, the use of which is to stifle and absorb the rays of light after they have passed through the Retina;—therefore, according to our present system, the image projected by the Crystalline Lens upon the Retina will pass through that membrane and be finally stifled and absorbed by the Pigment of the Choroid, which is absurd.

But even allowing that the Retina is not transparent but semi-transparent, it has been already shewn, that it can but receive an exceedingly faint and nebulous image, which would be totally unfit for distinct vision.

It is evident, therefore, that some other part of the Eye must be appropriated for the reception of the Image.*

I shall now proceed to shew that the membrane I have been describing, is the one intended

* It has been said that the formation of an image is not essential to vision. With this, however, I cannot agree, were there no other reason than the fact *that an accurate image is always depicted in the Eye*, and the consequent presumption implied in supposing that any structure or function of the body is designed in vain.

On Membrane in the Eye, being the substance of a Lecture delivered at Oxford before the Meeting of the British Association for the Advancement of Science. By George Hemsley Fielding Member of the Royal College of Surgeons &c &c

The author details numerous experiments in proof the existence of a membrane in the eye which has hitherto escaped observation and his remarks are so intimately connected with each other that we cannot find room for them. The only extract we can make is the following

[Having thus shewn pp. 19
to further purpose p 25]

an error into which you have accidentally fallen in yo
Journal of the 25th inst by awarding to me the Gold Medal
in Comparative Anatomy given at the London University.
It is to Mr Henry Slack of Epsom that this Honor is
due and not to myself who only obtained the Gold Medal
for Botany

Sir

your ob. Sr

Thos. H. Cooper.

Lewes. Sussex
May. 29th 1833.

for this purpose. It presents a bright polished surface of various reflecting power in different animals; having the least reflecting power in animals intended to see well and clearly in a bright light, and the most reflecting power in such as are intended to see well in very obscure light. I term it therefore a Reflecting Membrane, but in so doing it must not be supposed that I intend to compare it to silvered glass, or to a well polished speculum. Different bodies possess very various reflecting powers, and I conceive the membrane in question (especially in the Human Eye,) to have only a low reflecting power. The best substances to which I can compare it, in this point, are polished woods, pearl, and certain sea shells. All these will receive a well defined image from a double convex lens, with but little dispersion of the rays from the surface. I shall now project an image of this candle upon the blue membrane in the sheep's Eye, and you will observe that it receives a perfect image, with little or no dispersion. If on the contrary, I throw the image on the same part (which is of a bright yellow) in a cat's Eye, there will be, *with the same degree of light*, a nebulous image formed from the excessive dispersion of the rays from the surface,—but with a less powerful light we shall have a perfect image.

Hence the inability of these animals to see well in a bright light is from the high power of the reflecting membrane.* How then is vision performed? On this point I rather incline to the theory of De la Hire. I believe that the image of the object is projected through the transparent Retina upon the Reflecting Membrane, which is placed behind and in contact with the Retina. Upon this sensible surface† the stimulus of the rays produces certain undulations, (in the part where the image is depicted); these undulations are communicated to the adjacent (I might almost say *connected)* membrane, the Retina, in which similar undulations are excited, which are propa-

* This intolerance of bright light will be evident to any one who will take the trouble to observe the eye of the cat in full day-light, and especially in glare from the sun. He will find the pupil closed to a mere line, to exclude the admission of too much light,—and the Iris (itself a reflector) actually throwing off the rays from its surface, and yet the animal seeing very imperfectly. See the same animal in the dusk, and we shall find the Iris dilated to the utmost extent, the Reflector glittering in the bottom of the eye like burnished gold, and vision perfectly performed.

† All the Ciliary Nerves which, as we have already seen, are derived from the fifth pair, (the true nerves of sensation of the face) pass upon the outer surface of the Choroid coat, or, piercing it, run along its inner surface to the Iris. In this transit, as Lizars observes, it is more than probable they give off branches. If branches be given to the Choroid, they will doubtless also be distributed to the Membrana Versicolor, and hence its sensibility to the stimulus of light. My experiments have also proved that it is sensible to chemical stimuli.

gated in a series of vibrations along the Optic Nerve to the Sensorium.

As the time allotted me, on this occasion, is necessarily very brief, I shall conclude with a few observations respecting the effects of the various colours of the Membrana Versicolor.

The greater the density and the lighter the colour of the Reflector, the greater will be its reflecting power ; and the less the density and the darker the colour of the Reflector, the less will be its reflecting power.

The more or less intense the rays of light are which fall upon the Reflector, the greater or less will be the possibility of the dispersion of rays from its surface ; and the more perfect the Reflector the less light will be required to produce a perfect image from a double convex lens, and vice versa. Consequently the more perfect the reflecting power of the Membrana Versicolor is, the better it is adapted for vision in obscure light, and the worse for bright light ; and the less perfect its reflecting power, the better it is adapted for vision in full light and the worse for obscure light.

Thus, for instance, in the cat, very little light suffices for the purposes of vision,—and here we have a bright yellow Reflector of considerable power.

In man, on the contrary, who sees best in a strong light, the Reflector is dark coloured, and of the lowest reflecting power. The image is perfectly formed in the day time ; but in obscure light, when the cat sees in perfection, objects are scarcely visible to the Human Eye.

Having now, I trust, satisfactorily shewn that the part behind and in connection with the Retina is Membrane, and not Pigment, and, moreover, demonstrated the necessity that such a membrane should exist, I shall terminate this paper by requesting you will accept my thanks for your kind attention to it.

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