but the principal difference observable is at the pylorus, because, as Mr. Home conceives, some animal substances, after solution, are less readily changed into chyle than others.

In the most perfectly carnivorous animals, the internal membrane is extremely uniform in its appearance; but even in these a division or capability of it by muscular contraction is observable.

The first instance in which Mr. Home remarked this division in the *human* stomach, was in a woman who was burnt to death, after having been unable to take much nourishment for several days before. But since that time, as he has taken frequent opportunities of examining the human stomach recently after death, he finds that this contraction may generally be met with in a greater or less degree; but when a body is examined as much as twenty-four hours after death, this appearance is rarely to be met with; which accounts for its not having been before particularly noticed.

The series of stomachs arranged according to their structure, which has been given, includes the principal peculiarities that appear to Mr. Home capable of influencing the process of digestion: it is, however, considered only as a first imperfect attempt, which he hopes that other inquirers will render more complete.

Experiments for investigating the Cause of the coloured concentric Rings, discovered by Sir Isaac Newton, *between two Object-glasses laid upon one another. By* William Herschel, *LL.D. F.R.S.* Read February 5, 1807. [*Phil. Trans.* 1807, *p.* 180.]

The account, given by Sir Isaac Newton, of these coloured arcs, appeared to Dr. Herschel highly interesting, but he was not satisfied with the explanation of them. Sir Isaac Newton accounts for the production of the rings, by ascribing to the rays of light certain fits of easy transmission and alternate reflection; but this hypothesis seemed not easily to be reconciled with the minuteness and extreme velocity of the particles of light.

With the view of inquiring further into the cause of these phenomena, Dr. Herschel, so long since as the year 1792, borrowed of this Society the two object-glasses of Huygens, one of 122, and the other of 170 feet focal length. Notwithstanding various interruptions, the series of experiments, made in the course of this time, has been carried to a considerable extent; and Dr. Herschel thinks the conclusions that may be drawn from them, sufficiently well supported to point out several modifications of light that have been totally overlooked, and others that have not been properly discriminated.

The aim of the present paper is to arrange the various modifications of light in a clear and perspicuous order; but Dr. Herschel reserves his sentiments upon the cause of the formation of concentric rings, for a subsequent communication.

The first section describes different methods of making one set of concentric rings visible. The first method consisted in placing a double convex lens, of 26 inches focus, upon a piece of glass, of which

the upper surface was plain and polished, but the under surface either plain, concave, or convex. These were placed before a window, in such a position that the light fell upon the lens at about 30° from the perpendicular, and was received by the eye, at an equal elevation, on the opposite side.

Instead of the surface of glass, a metallic surface was next substituted; and the same lens placed upon it, gave the same appearance of similar concentric rings.

Moreover, it is not necessary that the surface of the under substance should be plain. It may be either concave or convex; so also may the upper surface, in contact, be either convex or concave, provided that when a concave surface is applied to another that is convex, the radius of concavity be greater than that of the convexity to which it is applied.

The second section treats of seeing the same rings by transmission, which, of course, admits the same variety in the forms of the surfaces in contact, but will not allow either of them to be metallic.

The third section distinguishes the several images, of any object, that are reflected from the different surfaces of several plates of glass, laid one upon another, on account of the use that may be made of these images, in assisting to discern the complicated phenomena produced in succeeding sections.

In the fourth section a second series of rings is produced, by placing the lens upon a piece of looking-glass, which occasions the primary set to be seen a second time by reflection. But as this is less bright, the primary set must first be obscured, by bringing the second reflected image of a pen-knife, or other pointed body, over it. In this case there are three images of the pen-knife. The second obscures the primary set of rings; the third shows them to the greatest advantage.

The same varieties of contact which were found to make one set of rings, may, of course, be applied to make a secondary set, if there be a reflection beneath sufficiently bright to render it visible.

The fifth section treats of three sets of rings, produced by increasing the number of reflecting surfaces, as when a slip of glass is interposed between the lens and the looking-glass of a former experiment, or when the lens, laid upon two slips of glass, is placed on a plain metallic reflector.

The sixth section pursues the same complicated appearance, as far as four sets of rings, and shows how they may be discerned, by means of the reflected images of the pen-knife.

In the seventh section the size of rings is considered, so far as it depends on the curvature of the surfaces; but Sir Isaac Newton having already treated this part of the subject at large, Dr. Herschel does not think it necessary to enter further into it.

In the eighth section, the species of contact requisite for exhibiting the rings is mentioned, the size of them being considerably affected by pressure. They grow larger when the two surfaces that form them are pressed closer together, and diminish in proportion as the

pressure is removed. The smallest ring of a set may thus be increased to double or triple its former diameter. But to produce that which may properly be called contact, mere pressure is not sufficient; and it will be necessary to give a little motion laterally backwards and forwards, accompanied with moderate pressure.

The number of the rings, which may be seen at once, varies from eight or ten to as many as twenty, accordingly as the light is less or more favourable. As the size of the rings is altered, so the colours of them are much affected by pressure. When a convex surface, of fifteen feet radius, is laid upon a plain surface, if the colour which first appears be red, a moderate pressure will convert it into a ring of red, with a green centre; and in the same manner, by increase of pressure, the green will give place to red; and so alternately for six or seven times, till at last, in absolute contact, the centre becomes black, surrounded by white.

The twelfth section describes the successive development of all the prismatic colours, by using lenses of greater radii. For though a small lens, of two inches, shows nothing but black and white in the series of rings that surround the centre of absolute contact, with a lens of four inches a faint red colour begins to appear in the outward rings; and this redness will be more manifest with radii of five, six, and seven inches; but the rings will not assume a green colour till a lens is used of sixteen, eighteen, or twenty inches: but it must be observed, that this and other colours appear soonest when the lens is not kept in such contact as to give a black centre.

With a lens of twenty-six inches, violet, indigo, or blue, may first be discerned at the centre. With one of thirty-four, the white surrounding the black inclines to yellow; with forty-two or forty-eight, yellow *rings* become visible; with fifty-nine, blue rings are plainly visible; with ten feet, orange may be distinguished from yellow, and indigo from blue; with fourteen feet, violet becomes visible.

When the Huygenian lens, of 122 feet, is well settled, the central spot, which in small lenses appeared black, is diluted, and drawn out into violet, indigo, and blue, surrounded with an admixture of green; while the white ring that surrounded the black spot is also subdivided, and blending with the green edge, surrounds it with yellow, orange, and red.

The order of the colours, whether the rings are seen by reflection or transmission, is such, that the most refrangible of each ring are toward the centre; but the black of one set corresponds in position to the white of the other, and the red to the green, so that the dimensions of rings, of the same colour, in each are not alike.

Hence a sudden change of colours may be produced, in each set, by intercepting that light by which they were before seen, and occasioning them to be seen by the opposite; and this alteration of colour is accompanied with an immediate change of size.

In several of the succeeding sections Dr. Herschel explains, by reference to figures, the courses of the rays by which each appearance is seen, and refers them each to the surface from which they are reflected.

He next examines which are the reflecting surfaces, by means of certain scratches, and other defects.

In the 25th and 26th section he finds, by means of similar defects, that the surfaces in contact are alone concerned in the formation of rings; and in the 24th and 28th section he discovers, by various irregular surfaces which he employs, as 1st and 4th surfaces of two glasses in contact, that these are not concerned in the production of rings. And in the 27th section he observes, that the colour of the under glass does not affect the primary set of rings.

The results of the foregoing experiments are,—

I. That only two of the surfaces are essential to the formation of concentric rings.

II. That these two must be of a certain regular construction, so as to form a central contact.

III. That rays, from one side or the other, must pass through one of the surfaces at or near the point of contact to the other surface, and be reflected from it.

And IV. That in all these cases a set of rings will be formed, having their common centre in the point of contact.

The cause of these phenomena, Dr. Herschel says, must be either in the nature of the rays themselves, or in the surfaces; and if it can be shown that the disposition to fits of easy transmission and reflection does not exist, a proposition of accounting for them by modifications occasioned by the surfaces, he thinks, will find a ready admittance.

In section 30, he shows that the word transmission will not apply to the case where rings are produced by placing a lens upon a metallic surface, and wishes to substitute the word absorption.

In section 31, Dr. Herschel contends that a plate of air, of the thinness which is supposed sufficient, will not give coloured rings, because in a case of circumferential contact, where a concave surface was applied to one that was convex, of very little larger radius, he could not perceive any appearance of colour.

In section 32, he places a piece of plain glass, four tenths of an inch square, on a concave glass mirror of 10 feet focus, but could observe no rings or colours.

In section 33, he does not find that a secondary set of colours, produced in the usual way, is altered by being seen through a wedge of air, occasioned by the interposition of card between the edges of two slips of glass.

And finally, in section 34, Dr. Herschel could discern no colours when two slips of plain glass, two inches long, were in contact at one extremity, and distant only $\frac{1}{2000}$th of an inch at their other extremities; although in the first half-inch from their contact, the several distances which Sir Isaac Newton considers as capable of producing ten successions of colours, must have occurred.

Dr. Herschel therefore infers, that the rays of light have no disposition to be alternately reflected and transmitted at certain intervals of space; but the examination of the various modifications that light

receives by its approach to, entrance into, or passage by differently disposed surfaces, he reserves for a second part of this paper, to be hereafter communicated.

On the Economy of Bees. In a Letter from Thomas Andrew Knight, *Esq. F.R.S. to the Right Honourable Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read May 14, 1807. [*Phil. Trans.* 1807, *p.* 234.]

During the progress of the various experiments on vegetation, of which Mr. Knight has communicated accounts to the Society, he has had opportunities of paying considerable attention to the economy of bees, and has observed many interesting circumstances, that appear to have been overlooked by former writers.

A general opinion prevails that every hive remains at all times unconnected with other colonies in the neighbourhood, and that strangers are always considered as enemies. Mr. Knight, on the contrary, has in several instances witnessed a friendly intercourse to take place between different colonies, and he imagines it to be productive of important consequences in their political economy.

Having observed several bees flying one evening at a later hour than they usually work, he endeavoured to discover how they were employed, and he found them to be passing in a direct line from one of his own hives to that of a cottager, about 100 yards distant. There was a considerable degree of bustle and agitation in each of these hives; every bee as it arrived seemed to be stopped and questioned at the mouth of each hive, but there was no appearance of hostility or resistance. This kind of intercourse continued, in a greater or less degree, during the eight following days, and appeared to be amicable for the whole of that time. But on the 10th their friendship terminated in a quarrel, and they fought desperately.

Mr. Knight has had other opportunities of observing a similar intercourse with the same result; but he has reason to think that it not unfrequently terminates in a junction of the two swarms; and he remembers to have observed, many years ago, circumstances perfectly similar in one hive followed by desertion of the labouring bees, who left the drones alone in possession of the hive, but without anything to live upon. He further thinks, that when a junction is determined upon, they remove immediately, and return only during the day for the purpose of carrying off the honey.

Mr. Knight has also remarked the manner in which colonies of bees, proposing to emigrate, fix upon their future habitation. He has frequently noticed an examination of certain hollow trees to take place for many days together by detachments of bees, from twenty to fifty in number. This examination was not confined to the mere cavity, but extended to the external parts of the tree above; as if they were apprehensive of injury from moisture by any perforation.

Their scouts must apparently have some means of communicating information of their success, without which it cannot be supposed that others would accidentally meet at a mile distance from their