person, it was afterwards tried in one who was subject to calculus, consisting of the triple phosphate of magnesia. Though his stomach did not admit the use of stronger acids, the carbonic acid proved highly grateful; and by examination of his urine, it appeared that the phosphates, which before were voided as a sediment of white sand, were now passed only in a state of complete solution, by means of the redundant acid.

Supplement to the First and Second Part of the Paper of Experiments for Investigating the Cause of Coloured Concentric Rings between Object-glasses, and other Appearances of a similar Nature. By William Herschel, *LL.D. F.R.S.* Read March 15, 1810. [*Phil. Trans.* 1810, *p.* 149.]

The Supplement now offered to the Society, is intended to clear up certain points which have been represented to the author as obscure or doubtful in his former communications, and at the same time to connect more intimately the prismatic experiments of the second paper with those made upon convex glasses, and described in the author's first paper on the subject.

Since Dr. Herschel has heard the originality of his observation of the red bow called in question, upon the ground that a red bow had been observed by Sir Isaac Newton, which is merely the converse of the blue bow (the change of colour being dependent upon the direction in which the light is received upon the prism), Dr. Herschel first endeavours to answer the objection, and reminds us that in his former observations the angular breadth and elevation of the two bows are different; but those of the Newtonian blue and red bows are said to be, and are, necessarily equal. In the Newtonian experiment also, the same beam of light is made to exhibit both phenomena, being received upon two right-angled prisms, applied base to base, so that one portion of the light is reflected upwards, as a blue bow from the under surface of the first prism; and the remainder, by transmission, through the second prism, appears as a red bow to an eye beneath. But in Dr. Herschel's experiment, the same prism is made to exhibit, to an eye in the same situation, the red bow as well as the blue, by means of light transmitted in an opposite direction through the under surface of the prism, without any occasion for a second prism, which (as Dr. Herschel observes) is necessary in the Newtonian method of conducting the experiment.

The next objection replied to by Dr. Herschel, regards the streaks that may be seen adjacent to the bows when a second surface is applied to that side of a prism at which a critical separation of the colours takes place. It has been said that streaks parallel to the bows, though not dependent on critical separation, will in that situation be seen most easily and most distinctly, because the visual ray, under those circumstances, passes with the greatest obliquity between the surfaces.

To this objection Dr. Herschel replies, that these streaks not only

can be seen most easily and most distinctly in the place where the bows are, but they absolutely cannot be seen anywhere else.

The parallelism also of the streaks to the bows, in the author's estimation, proves that the same cause which determines the direction of the bow, must determine that of the streaks, and thus establishes their dependence on critical separation.

Dr. Herschel also contends, that streaks of different colours could not be produced by a plate of air, of uniform thinness, between plain surfaces, and that the prevalence of a blue colour in the streaks belonging to the blue bow, and of the converse in those belonging to the red bow, prove their dependence on critical separation.

Since it has been conceived by other persons, that by means of a plate of air, having the form of an extremely thin wedge, straight bands of colour would be produced between plain surfaces slightly inclined to each other; and as an experiment in support of this opinion had been shown to the author, he gives his own explanation of the fact: and he ascribes the production of the colours to distortion of the surfaces, because a degree of force was in that instance employed for the purpose of producing the requisite contact at one extremity of the glass. And since in other experiments, made with perfectly plain surfaces, where no pressure was employed no streaks could be seen, Dr. Herschel concludes that when streaks are seen, the surfaces employed are either not plain in their general extent, or are terminated by some inconceivably small curvature at the edges in contact.

It has, in the next place, been observed to the author, that in the enlarged figure which he has given in his last paper to illustrate the streaks, the vacancies observable correspond with, and depend upon, the assumed intervals between the rays, which in that figure are represented as originally separated by blank spaces.

Dr. Herschel admits that there is some plausibility in this objection, but informs us, that the supposed force of it is founded on a misconception of the figure, which is not designed to represent the visible arrangement and colours of the streaks, which can only be deduced from their mixture at the place where they enter the eye; but he declines a thorough investigation of this point, because it would really be an endless undertaking.

One section of the present communication is devoted to the consideration of the breadth of the streaks compared to that of the bows, and the cause why they must take up a broader space than the bows from which they are derived; because it has been remarked, that this circumstance precludes the possibility of accounting for them by critical separation. But although this remark may at first view appear to be justified, it must be remembered (says the author) that the modifying power of the surfaces is added to the principle of the critical separation. The modification specifically named by the author, is that of reflection by the plain surface held under the prism, which, in the first instance, magnified the extent to $2\frac{1}{2}$ times the breadth of the bow; and if the reflection be repeated any number of times be-

tween the two adjacent surfaces, it may increase the extent in any greater proportion.

The last objection to which the author replies, relates to those positions in which rings of colours, and other similar phenomena, are seen, but in which the colours produced by critical separation could not reach the eye. For instance, rings and bands of colour, which arise from contact at the under surface of a plate of glass terminated by parallel planes, are seen through the upper surface, although colours separated by critical reflection or intermission, evidently could not come to the eye under these circumstances. But Dr. Herschel reminds us, that he does not affirm critical separation to be the sole cause of the rings produced by contact of a plane and sphere, but that it only furnishes the colours, which are afterwards modified by the subjacent spherical surface; and next proceeds to several sets of experiments, which he considers decisive in support of the validity of his theory, in reply to this objection.

In the first set of experiments a series of prisms, of different forms, are successively placed within their bases, resting upon a spherical metallic surface.

When a right-angled prism was placed in this situation, and the eye was gradually raised from a level with its base, no colours were seen till it arrived at the elevation necessary for critical separation. At this point the blue bow became visible, and rings began to be perceived at the same time. When the eye was lifted gradually higher and higher, till it arrived opposite to the vertex of the prism, the rings continued visible, without interruption, notwithstanding successive changes which occurred in their colours and size: and even when the eye was carried beyond the vertical position, the same rings continued visible, so as to be seen, upon the whole, through a range of at least 77°.

Instead of the right-angled prism, having a refracting angle of 45° on each side, Dr. Herschel afterwards substituted prisms with their vertical angles successively more obtuse, and with equal refracting angles on each side, first of 30°, then of 25°, then of 20°, and lastly of 9° on each side.

In all these instances the phenomena were similar; but the range of visibility increased in proportion as the refracting angle was smaller, so that in the last instance the range within which the rings were visible from each surface, exceeded 138°. And hence might be inferred the still greater extent, in case of plain glass, which may be looked upon as a prism with a vanishing refracting angle.

These experiments, in Dr. Herschel's estimation, establish the modifying power of spherical surfaces, whereby they render colours that have been entirely separated, visible in every direction.

In the next set of experiments, the author substitutes a cylindrical surface for that which in the former set was spherical; and by a similar series of prisms, successively more and more obtuse at their vertical angles, the coloured streaks, which in this case appeared instead of rings, were rendered visible to greater and greater extent, till with a plain glass they were seen as far as 170°.

In a third set of experiments, conducted in the same manner, the under surface brought into contact with the prisms, consisted of mica, rendered nearly cylindrical by being bent over a cylindrical surface.

From the irregularity in the form of the mica, that of the colours was also irregular; but they served to show the increase of extent to which such appearances may be rendered visible by corresponding change of the angle of the prism.

Dr. Herschel is consequently of opinion, that any one who could object to the admission of critical separation as the cause of the phenomena under consideration, cannot have paid sufficient attention to the modifying power of the subjacent reflecting surface, which is so essential to their formation.

If any one is disposed to assume that the rings must arise from some other cause than critical separation, unless it can be shown how rays critically separated can reach the eye, the author thinks it is not to be expected that *he* should trace them through a most intricate complication of reflections from curve to curve, when it has been shown, in the second part of this paper, that even with streaks produced by contact of two plain surfaces, it would be an endless attempt to follow them. He accordingly thinks it sufficient to have proved, to his own satisfaction, two essential points; first, that colours separated critically may be formed into rings, when modification will increase the field of visibility to any extent beyond the limits of critical separation.

Enough (says the author) has been said to prove that the phenomena of coloured rings, and other phenomena that have been ascribed to certain fits of easy reflection and easy transmission, admit of the most satisfactory explanation, by substituting the solid principle of the critical separation of the different colours, in the room of these fits.

On the Parts of Trees primarily impaired by Age. In a Letter from Thomas Andrew Knight, *Esq. F.R.S. to the Right Hon. Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read March 22, 1810. [*Phil. Trans.* 1810, *p.* 178.]

In the first communication which Mr. Knight made to the Society in the year 1795, he showed that the period to which the existence of any one variety of fruit could be prolonged by grafting, was limited; and that any portion detached from an old tree, and transplanted upon a young stock, was not thereby restored to what can, with propriety, be called a young tree.

Mr. Knight's endeavours have, since that time, been directed toward ascertaining which of the several organs it is that first fails in the performance of its proper office in consequence of age, and the result of his experiments forms the subject of the present letter.

In the prosecution of these inquiries Mr. Knight bears constantly in mind the analogy that subsists, in many respects, between the organs of animals and those of vegetables; for though it may not be in his power to avail himself of any assistance to be derived from