Optical Note.

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If one observes a Newton's ring apparatus through a thin film of mica, several sets of rings are seen in those parts of the field, where if white light is used, ordinary Newton's rings are not found. Each group consists of a middle dark ring with two concentric white rings next the dark one, and several colored rings outside and inside. Besides these prominent groups, a group of faint rings is observed inside the first group. All sets are concentric with each other and the space between any two sets is devoid of rings. The diameters of these rings depend on several conditions. The thinner the mica film, the smaller the diameters. The greater the air film of the Newton's ring apparatus, the smaller the diameters. The effect of inclining the film so as to receive the light from the Newton's ring apparatus more obliquely is equivalent to using a thinner film. All these phenomena can be very easily explained by the ordinary elementary theory of interferrence.

As to the existence of these rings, it is well known that the rings are invisible in those parts of the field, which correspond to a great thickness of the air film, because the lights of maximum and minimum intensities are very nearly equal in their wave-lengths for a given direction. If we examine a small portion of an ordinary Newton's ring (which is invisible in white light) by a prism, a large number of dark bands are seen in its spectrum. If we bring the dark middle ring of the first prominent, group as seen by a mica film (let us call it the group A) into the centre of the field by increasing the thickness of the air film, so as to form a central dark spot, and examine the spectrum of a small portion of it by a prism, we observe a series of dark bands between which there is a series of curved dark bands. The straight bands are those formed by the mica film, and the curved ones are those formed by the Newton's ring air film. The dark central ring of A is formed, because the lights of maximum intensity through the air film are the very ones which are of minimum intensity through the mica film. The reason why the bands are curved, is obvious. If we form a white central spot by an approach of A toward the centre, the straight bands coincide with curved bands, so that lights which are as a minimum after interferrence through the air film, are still minimum after the interferrence through the mica. Hence no change is produced by the mica film. After a few colored rings, whose formations can be readily understood after the above explanations of the formations of dark and bright rings, there is a space of uniform illumination. And then a second group that may be called the group B, very similar to A is seen. Here again in the middle dark ring, the lights of maximum intensities through the air film are minimum by the interferrence through the mica. If a central dark spot be formed of the dark ring and its spectrum examined, we again see a series of straight and curved bands, but this time the number of curved bands are twice as many as straight ones. And one of the straight ones coincides with one of the curved ones in the middle part of the latter. If a central white spot formed by white rings of B group be examined, the two curved ones fall neither on the curved dark bands nor on the part just mid-way between two bands, corresponding to the light of maximum intensity, but between the two, so that the light of maximum intensity passes through the mica. Whatever be the order of the group, in the middle dark ring the light of maximum intensity is made minimum by mica and in the white rings, the straight bands are not in the middle part between any two dark curved bands. Five groups were well observed, and groups of a higher order might be observed by means of thinner mica. It is needless to say that air films corresponding to the central dark bands A, B, C, &c. are in the ratio of 1, 2, 3, &c., as is proved by the fact that the squares of the diameters of the dark rings are in the same ratio.

The difference of march between once and twice reflected rays by the air film corresponding to the middle dark band of A together with the loss of $\frac{1}{2}\lambda$ is precisely equal to that introduced by the mica film, as is shown by the fact that the dark band produced by the air film lies mid-way between the two bands produced by the mica. Hence the thinner the film, the nearer is the group A to the centre of the system.

In the faint rings, the difference of march introduced by the air film corresponding to the dark middle ring is greater than that by the mica film by $\frac{1}{2}\lambda$. Hence if we could observe its spectrum, there would be twice as many straight bands as curved ones, but I was not able to observe it on account of faintness.

The effect of inclining the mica film so as to receive the rays more obliquely is equivalent to thinning the film as regards the difference of march introduced. Hence if the group A is not seen within the field on account of too great a thickness of the mica film, it can be seen if the film is held obliquely.

The groups are also well observed by reflected light from the front surface of the mica film. It is needless to say that the appearances are complementary.

In conclusion, it may be stated that the phenomena described are in no way peculiar to the mica film. Any thin film can be used. The same phenomena were observed by means of a thin air film between two achromatic prisms. The observation of course, much more difficult than with a mica film.