Fleure, who was appointed professor of zoology at the college ten years ago, will now devote all his energies to the department of geography.

DR. R. H. JESSE, JR., head of the department of chemistry at the Montana State University at Missoula, has been appointed dean of men for the institution.

DISCUSSION AND CORRESPONDENCE

ASTIGMATISM AND COMA

PERHAPS the clearest statement of the prevailing theoretical distinction between the five spherical aberrations is that given in the last edition of the Encyclopedia Britannica by Dr. Eppenstein of the Zeiss factory.

The differentiation there made between astigmatism and coma is not, however, in strict conformity with the facts. The term "astigmatism" as applied to lenses has always referred to the increasing lack of sharpness in the image towards the edge of the field in an uncorrected or poorly corrected lens system and "coma" to the peculiar radial flare sometimes very evident in the outer portions of the field.

The explanation given in the article just referred to is that astigmatism is the aberration due to obliquity and is therefore fully shown by very narrow bundles of rays, while coma can not be shown at all except with a wide bundle.

This explanation is the result of reasoning from the theory of astigmatism devised by Sturm, who assumed a behavior of oblique rays completely at variance with the facts. By the use of a method developed by the writer it is possible to calculate with strict accuracy the path and focal point of any ray through a lens surface from any point of the field by the use of which it became at once evident that the two foci calculated by Sturm's method locating the position of the two astigmatic surfaces are pure fictions, though this calculation is nevertheless a rough numerical approximation of this aberration. The detail of the new method of calculation will be presented elsewhere.

As a matter of fact only distortion and curvature are independent of the bundle width, and both coma and astigmatism are increased with increase in the width of the ray bundles, and it is not true, as stated in this article, that coma alone is the result of the width of the ray bundle. This can be very easily proven without recourse to mathematical calculations by the use of a poorly corrected photographic lens, examining the images on the ground glass or making photographs of a grating, using a wide and a narrow stop.

The best known test for astigmatism is the fact that where this aberration is uncorrected one of two crossing lines may be very vague, while the other is sharp and distinct. This is best seen with the wide stop. The effect is usually explained according to the Sturm theory by saying that only one of these lines can be in focus at a time and that either may be brought into focus. If one will shift the ground glass he can easily prove that only radial lines can be sharply focused by an uncorrected lens, and that towards the edge of the field lines at right angles to these radial lines can not be brought into focus at all and are in fact most nearly in focus on the same plane as the radial lines.

When the grating is rotated 90° the lines that were vague may become sharp but only when a line is approximately radial is the effect of astigmatism nullified.

Both astigmatism and coma consist in a longitudinal spreading out of the image produced by the zones of the lens. The radial lines remain sharp because the shifting is radial and the shifted images of a radial line are superimposed, the line remaining sharp because its width is not increased to an appreciable extent.

Instead therefore of making the distinction expressed by Dr. Eppenstein that the features of lateral aberration due to obliquity constitute astigmatism, and that those dependent on difference of zones produce coma, the writer would suggest that the former be defined as the difference of focus produced by the median region of the lens and that of the most distant marginal point while the latter represents the focal difference of the nearest marginal point of the lens.

The reasons for these new suggestions are: (1) That the sharpest focus is normally produced by the central portion of the lens and lateral aberrations depend on differences of focus that may result from the passage of light rays through a marginal region of the lens; (2) that the best measure of lateral aberrations are the extreme deviations, and these are those of a point at the edge of the object field through the nearest and through the most distant marginal point of the lens; (3) that the greatest difference of focus of a lateral object between the central image and that produced through an edge point is the one produced by the most distant point on the lens surface and therefore this may most appropriately be designated astigmatism; (4) that the focus through the nearest marginal point of the lens may lie on either side of the median focus and if on the same side as that of the distant marginal point there is produced the characteristic optical effect called coma, and finally (5) that these two measurements are strictly comparable with the measurement always made to determine the longitudinal aberration of the axial rays and are therefore the only consistent methods of determining the two lateral aberrations.

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Observations on the Auroral Convergent, April 5, 1918

An auroral display of more than usual interest occurred on Friday evening, April 5, 1918, and was observed by the writer from a point about one and a half miles southeast of the Dominion Observatory, Ottawa.

At about 10.30 P.M. the rays seemed to be converging at a more or less well-defined point approximately half way between Saturn and the "Big Dipper." For all that the writer knew the position or path of the point of auroral convergence and its height above the earth's surface had been subject to such frequent observation that any measurements he might make on this particular evening would be superfluous, but they seemed to him more worthy of record for a scientific magazine than the random descriptions of color, play of light and duration which have recently appeared and he decided to see whether or not the position of the point of convergence could be determined with any degree of accuracy.

Exact Western Union time was obtained from "central," but the rough nature of the observations makes the times recorded below approximate only, say within one minute, the fact that they are recorded as 11.20 and 11.40 being due not to rough estimation but to choice. The writer used a clothes reel with taut wires, revolving it so that one of the wires intersected both Saturn and the point of convergence. Three small markers (½ inch wide) were hung on the wire and moved about until they covered Saturn, the point of convergence (convergent), and another known point or star, all in line.

The following observations were made:

10.55 P.M. Saturn, convergent, and Mizar in line.

Saturn to convergent: convergent to Mizar
:: $11\frac{3}{4}$: $10\frac{1}{4}$.

11.20 P.M. Saturn, convergent, and star at end of handle of "Big Dipper" in line.

Saturn to convergent: convergent to star
:: $11\frac{7}{8}$: $8\frac{5}{8}$

11.40 P.M. Saturn, convergent, and point in sky on line from Mizar through end of "Big Dipper" handle and the barest fraction (say one sixth) farther from the end of the handle than that is from Mizar, all in line.

Saturn to convergent: convergent to point
:: $13\frac{1}{2}$: 7

11.55 P.M. Saturn, convergent, and Gamma of Bootes in line.

Saturn to convergent: convergent to Gamma
:: $15\frac{1}{2}$: $7\frac{1}{2}$

For the last observation (11.55 P.M.) the rays of light had become faint enough to make the exact position of the convergent somewhat doubtful and measurements were discontinued. In fact the latter observation was taken at 11.55 instead of at midnight, which would have preserved the 20-minute interval, because of a fear that the position of the convergent would become too indistinct for observation.

There was a perceptible tendency for the