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

light near the convergent to arrange itself in the form of an hyperbola, but no definiteness in the position of the axes could be detected other than a tendency for the visible hyperbola to occupy a quadrant opening toward the north or northeast. At many times during the hour the auroral display covered large sections of the southern sky, and the writer can remember thinking of the peculiar lateral shifting of the curtain in certain auroras and wondering how this would look if it took place near the convergent, but saw no such movement. At times a shaft of light more or less meridional in direction lay across the convergent.

At the time the writer hoped that others were making similar observations and that it might be possible to determine the height of the point of convergence and he was somewhat surprised later to realize that his observations indicated the further fact of a change in the position of the convergent with reference to the stars which seemed only partly to be explained by their rotation. He only hopes that similar observations were made by others in different places and that the ones herein recorded are sufficiently accurate to make them of value. They at least have the merit of having been made by one who had no preconceived idea of what they might indicate, and who regrets, if they prove to have value, that he was unable to make use of more exact tools.

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THE DOMESTICATION OF THE LLAMA

TO THE EDITOR OF SCIENCE: A note in SCIENCE for March 15, 1918, by Mr. Philip Ainsworth Means, leads the reader to believe that the llama, alpaca, vicuña, and guanaco are distinct species and that the common belief is that all have been domesticated to some degree.

Prior to about 1890 there was great confusion regarding the specific status of these four animals, though the prevailing theory was that the llama had been derived from the guanaco and the alpaca from the vicuña. It is now known that the vicuña has never been domesticated, and that the alpaca and the llama are both domesticated forms of the wild guanaco.[1] In view of the conspicuous differences between these two tame races of the guanaco it is easy to believe that a very long period of actual domestication has obtained, for the alpaca has been bred for his wool and the llama has been developed as a beast of burden as effectually as any of our races of domestic animals have been produced for special purposes by the most careful selective breeding.

The llama and the alpaca are not known in a wild state, though they of course occur, as do almost all other domesticated species, in a semi-wild or feral condition. They represent one of the rare cases of true domestication of an animal, and one of the still rarer cases where the ancestral species is known and still exists as a wild creature. Contrary to the statement in SCIENCE, they do breed freely in confinement; but since so many wild animals propagate regularly in captivity this can hardly be considered a test of true domestication.

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THE AUDIBILITY OF SOUND

REPLYING to the suggestion of Mr. Willard J. Fisher, in your issue of April 26, that an investigation be made of the area about Halifax with regard to audibility of the sound from the great explosion there, it may interest you to know that such an investigation was undertaken by the National Geographic Society not long after the occurrence of the explosion and that a quantity of data has been accumulated which is to be charted and tabulated as soon as other work will permit.

CHARLES E. MUNROE

SCIENTIFIC BOOKS

The American Indian. An Introduction to the Anthropology of the New World. By CLARK WISSLER, Curator of Anthropology in the American Museum of Natural History, New York City. New York, 1917. Pp. xiii, 435.

[1] Thomas, *Proc. Zool. Soc. London*, 1891, pp. 385–387.