NOTE ON THE ZODIACAL LIGHT.*

By Henry Carwill Lewis.

The results of a series of observations upon the zodiacal light made by the writer, extending over a period of nearly five years, is here recorded. The special precautions taken, both to train the eye to detect faint lights, and to prevent bias on the part of the observer, were given in detail. The zodiacal light may be divided into three portions—the *zodiacal cone;* the *zodiacal band;* and the *gegenschein*. This division is convenient in observation, saves confusion in description, and may be in part a natural one.

The zodiacal cone.—This, the zodiacal light proper, of most authors, is the well-known cone of light rising along the ecliptic, and best seen in the winter months in the West, immediately after the disappearance of twilight. The time of shortest twilight coincides with its greatest brilliancy. Several observations are given when the writer saw it cast a distinct *shadow* at that time. Its comparative brightness with the Via Lactea at different seasons were given, and its relation to the ecliptic discussed. It was stated that the cone in our latitude is not symmetrical; and that while its axis of greatest brightness lies exactly upon the ecliptic, its axis of symmetry is north of that line. An inner short cone of greater brightness was described. The warm color was shown to be due to atmospheric absorption. No pulsations were ever observed which could not be explained either by atmospheric changes or by changes in the eyesight of the observer. No periodic changes in the zodiacal light were observed; the same series of changes occurring each year with an equal amount of brilliancy. It was shown that while the zodiacal cone is frequently seen by moonlight, the moon appears to have no appreciable influence upon it. The account of the zodiacal cone closes with a description of its *spectrum*, which is always continuous and free from bright lines.

The zodiacal band.—This is an extremely faint zone of light, somewhat wider than the Via Lactea, which, like a strip of gauze, is stretched across the sky along the zodiac from horizon to horizon, and which can be seen at all times. It is a belt which forms a very faint prolongation of the zodiacal cone, and which, like it, is best seen when the ecliptic makes a large angle with the horizon. It is so faint that it can only be seen with difficulty. The best method of observing it is described. It is brightest along an inner line, and fades off more suddenly on its southern than on its nothern edge. It has a width of about 12°, and its central line is slightly north of the ecliptic. Observations prove the zodiacal band to be a constant and invariable phenomenon.

The gegenschein.—The gegenschein is a faint patch of light, some 7° in diameter, which nightly appears in that part of the zodiacal band, which is 180° from the sun. Night after night it shifts its place so as to keep opposite to the sun. It is decidedly brighter than the zodiacal band, and occasionally a central nucleus about 2° in diameter, of greater brightness, can be observed. While the brighter portion of the gegenschein is circular, its faint boundaries have sometimes the form of an oval, whose major axis is parallel to the ecliptic. A large number of maps of its position among the stars have been made, which show that while its central point is always 180° in longitude from the sun, it has a latitude of + 2°.

The moon zodiacal light.—An oblique cone of light in the proximity of the moon was described by Rev. G. Jones, but has not been detected by the writer. The light preceding moonrise rises at right angles to the horizon, and seems purely atmospheric. One observer has described comet-like tails on either side of the moon. The writer holds that such appearances are caused by diffraction through floating vapor, since they are never seen on clear nights.

The horizon light.—The phenomenon to which this name is applied, though having no connection with the zodiacal light, is so continually observed with the latter, and at certain seasons is so apt to be confounded with portions of it, that it is necessary to take it into account. The horizon light is a faint band of light with parallel sides, lying all around and parallel to the horizon, and separated from it by an interval of darkness. It is brightest, and terminates most abruptly on its lower edge. This sharp lower edge is 5° above the horizon, while the diffuse upper edge varies in altitude with the state of the atmosphere. The horizon light has a mean width of about 15°. It is purely atmospheric and appears to be caused by reflected starlight. It becomes very bright when the moon is above the horizon. Below the horizon light is a very dark space here called the *absorption band.* This quenches the light of the Via Lactea, the zodiacal cone, and all except the largest stars and planets, which last, while in it, are deeply colored. In the summer, when the ecliptic is low, the horizon light frequently blends with the zodiacal band.

THE ACTION OF SUNLIGHT ON GLASS.*

By Thomas Gaffield.

As great a variety of tints and colors appears after exposure to sunlight as is witnessed in the original specimens. A general classification of the changes of color produced by the sun in colorless glasses is as follows: 1. From white to yellowish. 2. From greenish to yellowish-green. 3. From brownish-yellow and greenish tints to purple. 4. From light-green or greenish-white to bluish. 5. From bluish and other tints to darker tints of the same colors. Every specimen of colorless glass exposed ten years shows some change of color or tint, except some white flint glass, such as is used for fine glassware and optical glass. The optical glasses with the exception of two specimens of crown, which became of a yellowish color, showed only a very slight change of tint, leading some to the opinion that oxide of lead, which enters largely into its composition, may act as a protecting shield against change by sunlight exposure. In experimenting for ten years with colored glasses of the main spectral colors (red, orange, yellow, &c.), no change was observed in any pot-metal specimens (colored throughout the body) save a slight darkening of the purple. A change to a purplish or yellowish color was observed in the colorless body of some of the flashed and stained specimens, when looking through the edges of these glasses, which are originally colored on the surface only. The sunlight coloration is not sufficient to be noticed in an observation through the surface of the glass. An experiment with pot-metals not of the primary colors, but of the intermediate ones which most nearly approach those which are produced in colorless glass by sunlight exposure, showed the following changes: First, from brownish tints to a flesh color; second, from flesh color to tints of violet or purple; third, from amber, olive and purple to darker tints of the same colors.

It is interesting to know that, so far as such colors in pot-metal were used in the old cathedral windows, the results of these experiments prove that they must have changed in color or tint, and that the glass which we see in these old churches to-day, and which has suffered sunlight exposure for centuries, must be of very different hue from that which it exhibited when it left the artist's studios or the glass factories of the mediæval ages. It is a curious fact, noticed by Pelouze and Percy, and confirmed by Mr. Gaffield's experiments, that, with some exceptions among the colored specimens, all of the glasses changed in tint or color by sunlight exposure can be restored to their original color by the heat of a glass-stainer's kiln, and can again be colored after a second exposure to sunlight; and that this coloration by sunlight and de-coloration by heat (of about the temperature of red heat) can be carried on indefinitely. Diffused light will also color glass, but only with a greatly diminished effect, proportioned to its comparison with the power of the direct rays of the sun.

ON A SOLUTION OF FERRIC GALLATE AND FERRIC OXALATE AS A REAGENT FOR THE QUANTITATIVE ANALYSIS OF AMMONIA.*

By Prof. N. B. Webster, of Norfolk, Va.

Preparation.—Ferric sulphate in solution is decomposed by gallic acid, and the resulting black ferric gallate is par-

* Read before the A. A. A. S., Boston.