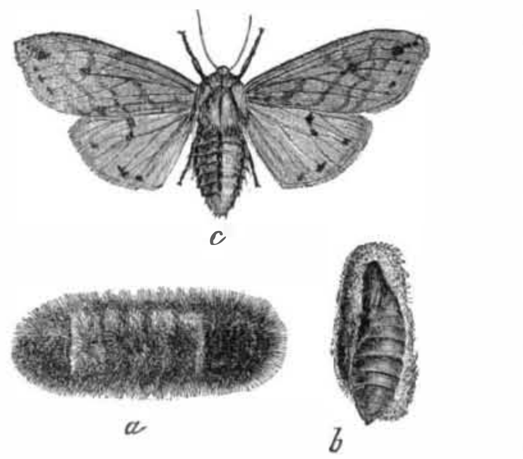
From the Fourth Annual Report of Charles V. Riley, State Entomologist of Missouri.]

THE ISABELLA TIGER MOTH.

The larva of this insect, *a*, is very common with us, and is familiarly known as the hedgehog caterpillar. It is thickly covered with stiff black hairs on each end and with reddish hairs on the middle of the body. These hairs are pretty evenly and closely shorn so as to give the animal a velvety look; and as they have a certain elasticity, and the caterpillar curls up at the slightest touch, it generally manages to slip away when taken into the hand.

It feeds on plantain, clover, dandelion, grasses, and a variety of other plants, and after passing the winter in some sheltered spot, rolled up like a hedgehog, it comes out

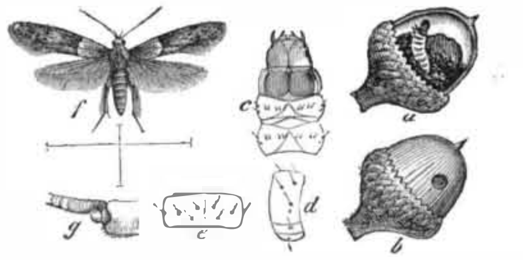


The Isabella Tiger Moth—*Arctia Isabella*, Smith.—(*Lepidoptera*, *Arctiadæ*.)

in the spring to feed upon the first herbaceous vegetation, and finally spins its cocoon (*b* represents one cut open, giving a view of the chrysalis) and goes through its transformations. The cocoon is composed principally of the caterpillar's hairs (which are likewise barbed) interwoven with coarse silk. The chrysalis is brown with tufts of very short golden bristles, indicating the positions of the larval warts, and with a tuft of barbs at the extremity. The moth is of a dull orange color, with the front wings variegated with dusky, and spotted with black, and the hind wings somewhat lighter and also with black spots.

THE ACORN MOTH.

The mast, which is so valuable to the swine breeder in the oak land sections of Missouri, is often very seriously affected and greatly diminished in quantity by the workings of the larva or grub of a species of long snouted nut weevil (*balaninus rectus*, Say.) The female, with her long bill, pierces a hole in the young acorn, and deposits therein an egg which gives birth to a legless arched grub with a brown head. This grub devours during the summer the contents of the acorn, and in the autumn drops, with the rifled fruit, to the ground, where it soon gnaws its way out through a circular hole and buries itself for the winter. It becomes a pupa in the spring, and eventually issues as a beetle.



The Acorn Moth.—*Holcocera glandulella*, Riley.—(*Lepidoptera*, *Tineidæ*.)

After the original depredator has vacated its tenement, a little guest moth comes along and drops an egg into the already ruined acorn. The worm hatching from this egg grows fat upon the crumbs left by the former occupant, rioting amid the refuse and securing itself against intruders by closing, with a strong covering of silk, the hole which its predecessor had made in egress. In the winter time, or in spring or early summer, the farmer, who notices three fourths of the acorns under his trees infested, as they have been for the past two years, by this worm, is very apt to consider it the true culprit, whereas it is rarely if ever found in acorns that have not first been ruined by the weevil above mentioned, or injured by some other insect, or in some other way.

This after comer is of a yellowish or grayish white color, often with dark marks on the back, a light brown head, and a horny piece of the same color on the first and last joints, and small hair-emitting dusky points over the body, *c d e*. It is, withal, easily distinguished from the weevil larva by its full complement of six true and ten false legs. It changes to the chrysalis within its borrowed domicile, and the chrysalis gives forth the moth by first pushing partly through the silken door.

The moth, *f*, is ashgray in color, and characterized chiefly by two distinct spots near the middle of the front wings and a transverse pale stripe, well relieved behind, across their basal third. The male differs from the female by the basal joint of his antennæ being much flattened and articulating with the stalk by means of a nodule, *g*. The moths issue all along from the end of April till September. They vary much in size and conspicuity of design.

JOHN E. LAUER, of New York city, produces the acid phosphates for yeast powders by treating bone black first with sulphuric acid and afterwards with muriatic acid.

Correspondence.

[For the Scientific American.]

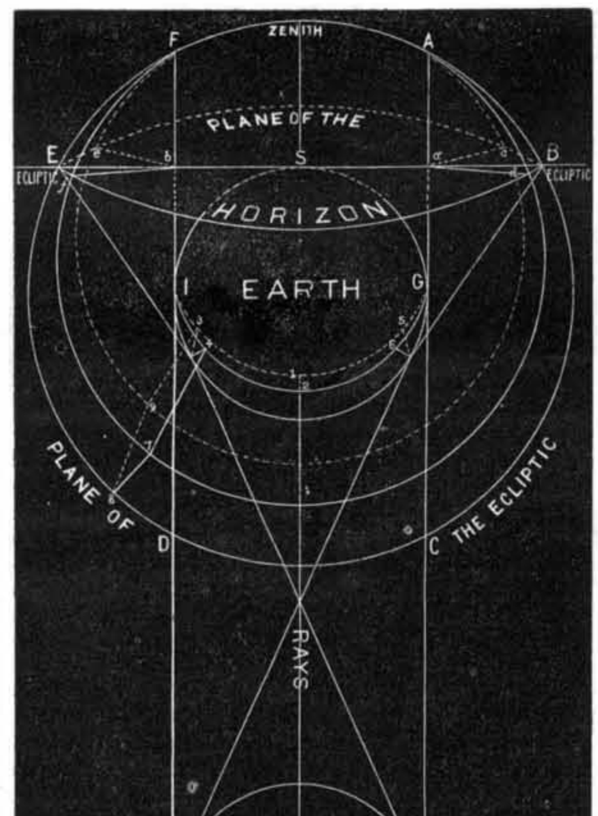
Explanation of the Cause of the Zodiacal Light.

What is known as the zodiacal light is an optical phenomenon caused by the reflection of the rays of the sun from the earth, upon the atmosphere and thence to the spectator.

For the purpose of illustration I have taken the case of the "double light" (a pyramid in the east and one in the west at the same time), as a knowledge of the principle involved in the formation of the double light includes that of the single pyramid.

The most favorable condition under which the zodiacal light can be seen is when the spectator's position is in the plane of the ecliptic, and this is probably the only position from which the double light can be seen at all, the plane of the ecliptic being then perpendicular to the spectator's horizon.

The figure annexed is a representation in perspective of the plane of the horizon (the spectator's station being at S, the earth), showing the lune, G 1 I 2, from which the rays are reflected, as regards the spectator; the atmosphere, A B C D E F, showing the portion illuminated by reflection from the lune, 4, 7, 8, 9, 3, being a section in the plane of the spectator and the sun. The portion of the illuminated atmosphere which alone will be visible to the spectator, at S, will be those parts illuminated by the reflection from the portions of the lune included in the spherical triangles, 5 G 6 and 3 I 4, all the rest being below the plane of his horizon; the reflected rays, 5 *c*, 6 *d*, 3 *e* and 4 *f*, are omitted to avoid confusion in the lines. The visible parts will, therefore, appear to him in the form of the two pyramids, A *a d* B *c*, and F *b f* E *e*, their bases, *a d* B *c* and *b f* E *e*, resting on the horizon, and their apices being limited by the thickness of the atmosphere, *a* A and *b* F. It is evident, therefore: (1) That any deviation of the position of the spectator from the plane of the ecliptic would be attended by a simultaneous change in



the form and position of the pyramids, in consequence of the change in the form of the lune. (2) The double light could only be seen at, or about, midnight, as at that time the spectator is directly on the opposite side of the earth from the sun, and the lune, therefore, is perfect. (3) The intensity of the light would vary according to the nature of the portion of the surface of the earth from which the rays were reflected at the time, as land, water, etc. (4) The brightest part of the pyramids would be the center of the base, on account of the greater thickness, as regards the spectator at S, of the illuminated portion of the atmosphere through that part, that is, along the lines *a* B and *b* E. (5) On the same principle, the moon should also give a zodiacal light. The most favorable time would be when the spectator's position was in the plane of the moon's orbit, a short time before her rising or after her setting, and about the time of the full moon. The moon, however, could not give the double light, because, she being much smaller than the earth, the cusps of the lune would not embrace the whole of the semi-circumference of the earth, and therefore the reflection could not reach that part of the atmosphere above the plane of the spectator's horizon.

The pulsations noticed by some observers are, without doubt, the effect of refraction, either in the body of the atmosphere, or perhaps caused by the irregular motion of its surface (atmospheric waves).

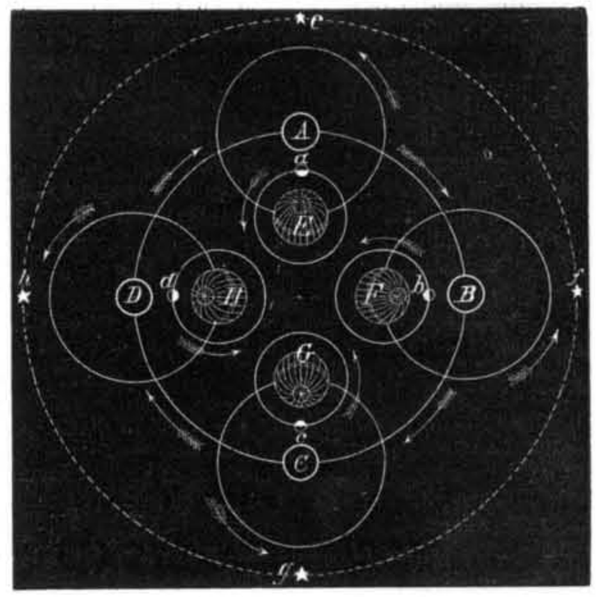
Query: May not the tails of comets be accounted for upon similar principles? In the case of some comets, the enormous length and rapid changes of these supposed appendages appear to indicate the earth's atmosphere as the medium of the second reflection. The question can only be decided by observation. T. R. L.

Mount Airy, Philadelphia, Pa.

Retrogressive Motion of the Sun.

To the Editor of the Scientific American:

In the hopes that my friend and opponent, C. H. B., would



have favored me with his full name, or at least would have replied to me privately, I withheld sending you my diagram showing how precession of the stars is produced by the retrograde motion of the sun. But as he has not complied with my wish, neither opposed me, so far as I know, publicly, and as other astronomers have expressed much surprise at my views and doubts as to their truthfulness (one actually predicts my defeat in case C. H. B. replies): I now present my diagram; and if it fails in one single iota to come up to all the demands of Nature, so far as precession of the stars and recession of the equinoxes is concerned, I will be more than obliged to C. H. B., friend Swift, or any one else to point me to that defect. Instead of a defeat on my part, I am sure of success, and that, no doubt, C. H. B. is beginning to see, or else I am far mistaken; and so will all competent judges, when they study the subject as it deserves.

A B C D in the figure represent the sun in four points of his retrogressive orbit, 90° apart from each other; E F G H represent the earth invariably at her summer solstice, as she is carried backward, as it were, in her orbit, by virtue of solar motion; and *a b c d* represent the moon at four different points of her orbit, also 90° apart from each other, where she will eclipse the sun; *e f g h* represent stars in the ecliptic, or in a circle surrounding the pole of the ecliptic, also 90° apart from each other. The dotted circle represents the ecliptic, the larger ring the orbit of the sun, the lesser rings the orbit of the earth, and the smallest ones the orbit of the moon, and the arrows the direction of movement, respectively, of sun, earth, and moon.

From this it will be seen at once that as A (the sun) retrogrades toward B, the star, *e*, together with all the others, will, as it were, advance eastward; and their rate of apparent motion will be in proportion to that of the sun's real motion. For instance, when the sun reaches B, he will have completed one quarter of his orbit, or 90° of it, and so the stars will have advanced 90°. To move from A to B will take the sun about 6,467 years, and the same time to move from B to C; and so on all around, completing his orbit in 25,868 years. For every ninety degrees the sun retrogrades, ninety degrees is cut off the earth's orbit, as it were. In other words, for every quarter of an orbit the sun completes, the earth comes to her equinoxes one quarter of a year sooner than she would do if the sun were standing still, or if he were pursuing a straight forward course. And so, for every full orbit he makes, the year of the earth is completed 365¼ days sooner than it would have been had the sun been fixed in space. Thus we have 25,868 solar years in 25,867 sidereal years. The truth stands then that, as solar time is prolonged to the amount of one day (less 20 minutes and near 23 seconds) by the motion of the earth direct around the sun every year, so solar time is shortened to the amount of one day in 25,868 days and to one year in the same number of years, by the sun's retrogressive movement in space.

It will now be seen that the so called retrograde "wabble" of the earth is not a gyration, as Newton supposed and as his followers still imagine, but that it is simply a change in her parallelity of polar position, gradually and surely brought about by the retrograde motion of the sun. Precession of the stars and recession of the equinoxes is not therefore peculiar to the earth; but is alike common to and performed in the same length of time by all the planets of our system.

Will C. H. B. or any other interested astronomer be kind enough to examine this theory fairly and minutely, and then answer "yea," or "nay" to it, through the SCIENTIFC AMERICAN, and they will very much oblige its humble author? JOHN HEPBURN.

Gloucester, N. J.

Location of the Million Dollar Telescope.

To the Editor of the Scientific American:

Mr. Alvan Clark, in a letter to *Appleton's Journal*, calls attention to the main difficulty attending the use of great