

minutes after sunset; November 3, a brilliant orange sunset after a very clear day."

These observations were recalled by the receipt within a few days of a pamphlet from Mr. T. F. Claxton on "The Recent Sunset and Sky Glows." This paper was presented to the Mauritius Meteorological Society on August 27, 1901.

The first few paragraphs are as follows:—

"The gorgeous sunsets and sky glows of the past three months recall those vivid displays of 1883 and 1884 which were associated with the disastrous volcanic eruptions at Krakatoa, in the Straits of Sunda, and it is not surprising to learn that toward the end of May of this year similar, though less serious, eruptions occurred in about the same locality, according to the following cablegram which appeared in the *Daily Graphic*:—

"Batavia, May 23, 1901.—The volcano of Keloet is in eruption. It is reported that there has been great loss of life among the natives. District of Kediri enveloped in total darkness."

The sunset glows at Blue Hill followed this eruption, and the sky glows at Mauritius after about the same interval as similar but more brilliant glows in these latitudes followed the eruption of Krakatoa. It would be extremely interesting to know if there are observations at intervening places. We should be glad to receive notes of such at the Blue Hill Observatory, Hyde Park, Mass., U.S.

I wish also to call attention to the recent violent volcanic eruption in the island of Martinique, and suggest that observers be on the watch for the earliest optical phenomena. We should be glad to receive notices of such observations. There were some marked barograph undulations at Blue Hill on the morning of May 7 which are perhaps connected with this volcanic eruption.

HENRY HELM CLAYTON.

Blue Hill Observatory, Hyde Park, Mass., May 10.

#### A Method of Showing the Invisibility of Transparent Objects under Uniform Illumination.

As is well known, a perfectly transparent object is visible only in virtue of a variable illumination. This condition might be approximately realised, as Lord Rayleigh points out in his article on "Optics" in the "Encyclopedia Britannica," on the top of a high monument in a dense fog. It is doubtful, however, if the experiment would be very successful even under these conditions, as the observer's body screens the light in certain directions, making the illumination far from uniform. The following method I have found to give very good results:—

The inside of a hollow sphere of metal, which can be separated into two cups, is thickly coated with Balmain's luminous paint. A small hole, not much larger than the pupil of the eye, enables the observer to view the interior and any objects within the sphere. I used for the sphere one of the metal floats which are used as automatic regulators in water tanks, and which can be obtained from any plumber. The float was made in two parts, which were easily separated by melting the solder. It is rather difficult to get a good uniform layer of the paint. Several coats are required, and even then it is apt to appear streaky in the dark. I am inclined to think that a better plan would be to mix the dry powder with boiled down Canada balsam, which will harden on cooling, and coat the outside of two glass hemispherical evaporating dishes with the hot mixture. The lips of the dishes would make the eye-hole. This mixture I have found produces much more uniform surfaces, and I am employing it at the present time in some experiments in infra-red photography.

If the inner surface is exposed to sunlight, and a transparent object such as a glass or crystal ball, a thick lens or a cut glass decanter stopper is put in the interior, it will be found to be practically invisible when viewed through a small hole, for light of equal intensity is incident in every direction. I have found that a large stopper with many facets does not quite disappear, some of the edge facets appearing darker than the diffused blue glow which fills the interior of the ball. This I believe to be due to the fact that the light reaching the eye from these facets by refraction happens to have undergone several internal reflections and suffered a loss by absorption owing to a long path through the glass. The luminosity of the interior of the sphere is not quite uniform, however, and this may be sufficient to explain the appearance of these facets. The observation is best made in a darkened room, the eye being brought close up to the small aperture.

Since writing the above I have tried the balsam mixture on

NO. 1700, VOL. 66]

the outside of hemispherical glass dishes. It is, however, better to scratch a small hole in the paint than to attempt to use the lips of the dish as an aperture, as in the latter case the line of union, which is always slightly darker than the rest of the surface, cuts directly across the field of view, which is a disadvantageous arrangement.

R. W. WOOD.

Johns Hopkins University, Baltimore.

#### Misuse of Coal.

THE tone of Prof. Perry's letter in reply to Mr. Rosenhain is so acquiescent that it may seem to diminish the force of his original contention as to the national misuse of our stock of coal. There are two considerations which ought to be stated in reply to the plea that men may learn to grow their fuel as they go on, by a proper cultivation of the best vegetation.

The first is this. The soil will not long continue to yield food if it be asked to provide fuel also. About three years ago Sir W. Crookes devoted his address, as president of the British Association, to the consideration of the present position of the world's food-supply question, and arrived at the conclusion that the outlook was not far from a gloomy one.

In that conclusion he was but echoing Malthus, though with much better data and a more complete record as to what were in Malthus' day unexplored countries.

If examination of the food-yielding powers of the soil leads to such a result, it is evident that to add an additional demand for fuel will seriously injure both. Even though Malthus and Sir W. Crookes be only partially right, enough is left to prevent us getting any long-lived satisfaction by growing fuel. There remains the possibility of "intensive" cultivation, and this may be one form of the new engine Prof. Perry asked scientific men to look for. Already Lord Rayleigh has made a bold attempt to make this economically possible by preparing nitric acid from the air. Perhaps with the resources Prof. Perry asked for, Lord Rayleigh might succeed.

The second point is this. Prof. Perry's concern was mainly for British resources. The economic life of a large proportion of our people is bound up with an economic advantage in fuel and other minerals. Every scientific discovery which raises the efficiency of transformation from coal fuel to mechanical power helps to defer the day in which England's mineral endowment will no longer be exceptional. The moment that oil or other natural fuel can compete with coal in the open markets, our prosperity must begin to decline. Similarly, if fuel can be grown to compete with coal, we lose position, simply because we cannot expect to grow so easily and well as many other countries.

The motive impelling towards a constant search for improved efficiency in the use of coal is therefore doubly strong on our people and Government. Any improvement would be helpful to the whole world; for us it would defer a calamity, possibly for a very long time.

W. HIBBERT.

101 Goldhurst Terrace, N.W., May 20.

#### The Conservation of Weight and the Laws of Thermodynamics.

IN NATURE of May 15, Lord Rayleigh uses the laws of thermodynamics to prove the conservation of weight.

In regard to the doctrine of the conservation of energy (the first law of thermodynamics) the following statement is made in Maxwell's "Theory of Heat," p. 145, tenth edition: "The evidence which we have of the doctrine is nearly if not quite as complete as that of the conservation of matter."

Taking this passage to imply that the two doctrines, conservation of weight and of energy, are to be held true as far as experiment has proved them true, and no farther, the question arises—To what extent have the laws of conservation been proved?

The experiments of Landolt (1893) and of Heydweiller (1901) show that the conservation of weight holds, in the cases investigated by them, to one part in one hundred thousand. The accuracy of the law to one part in a million is left under suspicion.

Energy being more difficult to measure than weight, it is unlikely that the conservation of energy has been proved to one part in one hundred thousand. At the present time, would not Maxwell say, "The evidence which we have of the conservation of energy is not as complete as that of the conservation of weight"?

From the laws of thermodynamics it can be shown, doubtless, that the conservation of weight is absolutely true, but this only on the assumption that the conservation of energy is absolutely true. Again, granted it can be shown that the conservation of weight is true in the same degree as the conservation of energy, yet these proofs will remain of strictly mathematical interest so long as our knowledge of the conservation of energy remains of a lower order of accuracy than that of the conservation of weight.

It seems natural for the human mind to state scientific laws in absolute terms. Nevertheless, in most cases it is proved that the accuracy of the laws is limited. If a scientific law is believed in outside the limits of proof, the law is no longer a matter of knowledge—it has become an article of faith. These are platitudes; they have point only because scientific men state the laws of conservation in absolute terms, and hold these laws as articles of faith.

A. N. M.

University College, Liverpool.

### A Solar Halo.

In a letter to NATURE of May 1 (p. 5) a description is given of a remarkable lunar halo seen at Yerkes Observatory. A solar halo of almost identical character is reported in the meteorological returns for April from Sule Skerry Lighthouse off the north coast of Scotland. The following note and sketch are appended by Mr. N. A. Macintosh, the lightkeeper, to his report:—

"A curious phenomenon was observed in the sky on the 28th. At 12.30 p.m. there was a perfect ring or halo right round

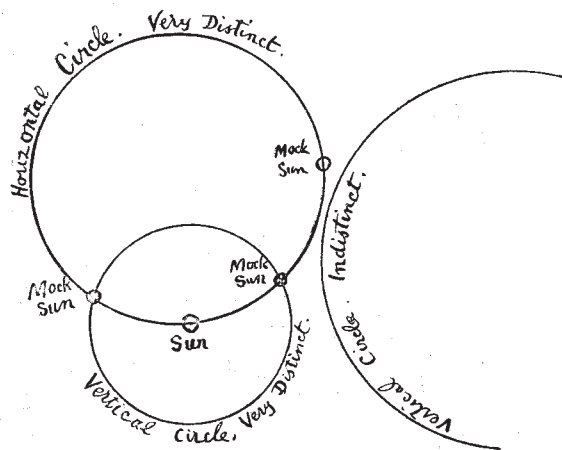


FIG. 1.—Solar Halo, April 28.

the top of the sky with the sun in its southern edge. At right angles to it, and round the sun, was another ring with two 'mock suns' where it bisected the larger ring. These 'mock suns' showed prismatic colours, but about due east on the edge of the larger ring there was a 'mock sun' pure white. In the south-eastern sky there was an indistinct half-circle from the horizon up to the horizontal circle which showed prismatic colours, whilst the others were colourless. At the time there was haze all over the sky, but the sun shone very clearly. It lasted till 1.30 p.m."

The position of Sule Skerry is lat. 59° 6' N., long. 4° 20' W., and as the sun is about 14° north of the equator on April 28, its elevation at local noon, about which time the halo was first seen, would be practically 45°. Hence the "horizontal circle" the centre of which is at the zenith would have a radius of 45°. Evidently, therefore, from Mr. Mackintosh's sketch the "vertical circle" is the ordinary halo of 22° radius. The "horizontal circle" is also well known, though not so often seen as the halo; it is due to the reflection of the sun's light from the vertical faces of the ice-crystals. The coloured mock suns where the two halos intersect are also well known, but with the sun as high as 45° they would be expected to lie a little outside the 22° halo on the white circle. The other mock sun on the eastern side of the horizontal white circle is more rare; it may coincide with the point where a larger halo cuts the horizontal circle, but the laws determining the formation of this halo and

its exact position are not known, and portions of it have been seen on only three or four occasions of which we have any record.

The last item in the sketch, the coloured semicircle rising from the south-eastern horizon to almost touch the horizontal circle, I am unable to suggest any explanation for. The sketch is evidently reversed, as in it this and the white mock sun are shown on the western side. In recording observations of coloured halos, mock suns, &c., it would greatly add to their values if notes were made of the arrangement of the colours, such as "red inside, blue outside halo," "red next sun, blue away from it," and *vice versa*.

R. T. OMOND.

Scottish Meteorological Society, Edinburgh, May 17.

### Mathematical Training.

IN view of the great influence which Schopenhauer has exerted on German thought, I referred to his chapter on mathematics, and find that half a century ago he was even more sweeping in his condemnation of the methods of Euclid than are some of your present correspondents. He mentions that the exact sciences are confined to those dealing with time, space and causality, or without being too precise as regards names, the exact sciences are arithmetic, geometry and logic. Schopenhauer's view is that each of these sciences is independent of the other, and he illustrates this by saying that mathematically it is just as self-evident that two parallel lines cannot meet as it is logically self-evident that an impossibility is not possible. He strongly objects to our aping the Greeks and basing mathematics on logic, and I feel sure that he would consider that mathematics were being degraded by the excuse so often given for teaching it at all, that "Euclid is an invaluable logical training." If I understand him correctly, Schopenhauer holds that any mathematical proposition is as self-evident as any correct logical sequence, and only requires illustrations or explanations (not proofs) to make this clear to our somewhat imperfect brain. This he might have illustrated by the Pythagorean proposition, which can be shown to be correct without the elaborate logical scaffolding used by Euclid, provided that one's mind can grasp the proportionality of similar triangles. Let  $a, b, c$  be the lengths of the sides of a right-angled triangle, draw a perpendicular from the apex intersecting the hypotenuse  $c$ , and divide it into two lengths  $d$  and  $e$ . We then have three similar right-angled triangles and the following two sets of proportions:—

$$\frac{c}{a} = \frac{a}{e} \text{ and } \frac{c}{b} = \frac{b}{d}$$

from which it follows that  $a^2 = c \cdot e$  and  $b^2 = c \cdot d$ , and as  $d + e = c$ , we have  $a^2 + b^2 = c^2$ .

Most other propositions, if not self-evident, might be dealt with in the same way; and if we were as gifted as Newton was, we would, as he did, wonder why anybody should trouble to demonstrate the, to him, quite self-evident truths in Euclid.

In our public schools we are taught classics, not because of the logic they contain, for it is often wrong, but because they exercise our memory (and, I fear, cripple our reasoning powers), and we teach mathematics, not to improve our knowledge of space, but to improve our logic and sometimes also to improve our memory. Naturally our views about space are often hazy, and our reasoning powers, which receive no direct training, are not infrequently stunted, or rather compelled to work in narrow grooves.

C. E. STROMEYER.

Lancefield, West Didsbury, May 12.

### Influence of Light upon Plant Assimilation.

I HAVE for some time been endeavouring to devise a simple and cheap apparatus for demonstrating the effect of red and blue light respectively upon the assimilatory power and nyctitropic movements of plants. The apparatus usually supplied by the dealers for this purpose consists of a double-walled bell-jar into which a solution of potassium bichromate or of ammoniacal copper sulphate may be poured. This is a rather expensive piece of apparatus for school use, especially if a large one is required. I have not been able to find a blue or red glass that absorbs blue or red light only. I have tried home-made glass cells about a foot square and a quarter of an inch internal diameter, but could not prevent leakage. Perhaps some reader of NATURE could help me. Is there a transparent coloured paper or some kind of coloured membrane that would serve the purpose?

E. E. HENNESSEY.

Bigods School, Dunmow, Essex, May 19.