

crimson glow. These skies were often still more gorgeous in the morning, and on some occasions were so wonderful as to be styled *frightful* by some observers. I witnessed one of these sunrises from an altitude of 3000 feet in January, and it was almost an *awful* sight. The view to the east was over about thirty miles of plains to distant mountains; a low mist hung over the low ground, and the surface appeared slightly rolling as seen from above. The sky half an hour before sunrise was so intensely red, almost to the zenith, that it gave this mist the appearance of a sea of blood. Every object, tree-trunks, fern-trees, bushes, rocks, and the cottages about the hills, was of a similar lurid colour; still there was not yet sufficient light to read by comfortably. This display reminded me of the wonderfully red aurora witnessed in Australia on April 5, 1870, when the red light was so intense that ordinary newspaper type could be read by it at ten o'clock on a moonless night, the type appearing as if set in a blood-red sheet. This was the first time I recorded the *red spectrum line* of the aurora, and I think was one of the earliest observations of this fact.

Some of the recent sunsets have looked very much like an aurora in the west, and faint traces of stratification lent additional similarity; indeed on one night early in December, the *after-glow* merged into a beautiful aurora, and silver streamers were seen before all the red glow had disappeared.

From all over Australia reports of wonderful sunsets and sunrises have been sent to me. In one case the *red glow* was reported as margined by an immense *black bow* stretching across from north-west to south-west. On several occasions these glows prolonged the twilight considerably, and a correspondent at Urana, in New South Wales, described one occasion where approaching darkness after one of these sunsets at length compelled him to leave off watering his garden, but suddenly the light increased again sufficiently to induce him to resume his work; and he states that a similar accession of light—each time fainter—occurred on that same evening.

The season over the south of Australia especially, but all over the continent, has been remarkable, and, so far as this colony is concerned, unprecedented in my thirty-three years' knowledge of the climate. January, February, and March are usually our dry, hot months; this year they have been wet and cold ones. The average rainfall for January has been 1'60 inches; this year it was 4'75 inches. For February the average is 1'95 inches, and up to this date (the 27th) it has been also 1'95 inches. The mean temperature for January was 3°·5 below the average, and for February 2° below. Stormy, squally, wintry weather has predominated, with now and then a very hot or a tropical day for a change.

Even before the Krakatoa outburst the northern parts of Tasmania had become subject to prolonged *earth tremors*, with now and then a decided earthquake shock. These disturbances still continue, and appear to be extending northwards, for on the 15th of this month a shock was felt at Gabo Island, at the south-east extremity of Australia, and a very severe one again on the 17th, when a curious and sudden barometric disturbance, not unlike that at the time of the Java catastrophe, was shown on our barographs.

While on this subject it may be as well to state that Mr. Barrachi, one of my assistants, while at Port Darwin determining the difference of longitude between that place and Singapore in March 1883, saw sunsets, followed by after-glows, which prolonged the usual short twilights to a very considerable extent, and he states they were equally remarkable with those witnessed here. They only occurred either just before or just after very heavy rains.

Referring to the various hypotheses which have found their way into print explanatory of the unusual phenomena attending sunrise and sunset since August 1883, the belief that they have been in some way brought about by the Krakatoa eruption appears to be generally accepted, and while some doubt may be thrown on this assumption by records of equally remarkable chromatic effects at both sunrise and sunset and about the sun at other times of the day prior to the eruption, it must be admitted at present that the volcanic eruption has strong claims to credence.

There can be no doubt that, whatever the prime cause, the effects are due to the presence in the higher regions of our atmosphere of a *form of matter* not usually there, at least to such an extent. Now this matter, or *form of matter*, may, as far as we know, be due to Krakatoa, to the earth's orbit traversing streams or regions pervaded with extremely fine meteoric dust,

or to any other cause that might either introduce new or alter the form of existing matter.

It is well known in the laboratory that certain chemical combinations and mechanical mixtures will exist as such, but in a most unstable form,—a concussion or sharp sound, an electric spark, &c., either breaks them up or brings about a change of form so as to present altogether different physical properties. Now it is also well known that at the time of the Krakatoa eruption barometric pressure was spasmodically affected all over the world. Everywhere where barographs have been recorded this fact appears. This atmospheric shudder, undoubtedly originating at Krakatoa, was, I have reason to believe, conveyed rapidly from the centre through the higher and more tenuous regions of atmosphere, but affected the lower strata in its passage. This would perhaps account for the immense distance—thousands of miles—over which, it has been widely reported, explosions were heard about the time of the occurrence of the outburst.

Now if we assume that on the peripheral regions of our atmosphere *gases* and *forms of matter* exist in not very stable combinations or mixtures, it requires no great stretch of our imagination to picture the result of this great atmospheric shudder bringing about an alteration in the form or proportion of matter, and consequently such a change in its optical properties as to produce the unusual and remarkable effects which have been so universal.

ROBT. J. ELLERY

Melbourne Observatory, February 27

UNDER date of January 14 I named the bark *C. Southard Hurlburt* as having observed the glow on September 3. She was dismasted in a cyclone August 8, and came to Honolulu for repairs. On the former date she was in about lat. 17° N., long. 125° W. The captain's wife, Mrs. Davis, described the phenomena to me as extremely brilliant.

Only last week I learned from Hon. H. M. Whitney, Postmaster-General, that on September 5 Mrs. Whitney and himself distinctly observed the sun's disk before setting to be *green*. His residence was an exception to most of ours in Honolulu, from which trees cut off a view of the horizon. My wife spoke much that night of a strange green cumulus, seen by her ten minutes before calling me to observe the portentous masses of colour pouring out all over the sky.

I beg special attention to my former remark of the "earth-shadow sharply cutting off" the upper rim of the first glow. This was very manifest in the strong heavy glows of September, showing clearly that the first glow directly reflected the sun's rays, while in the after-glow which had no defined upper rim, but continued much longer, the haze reflects only the light of the first glow. This bears on estimates of the height of the haze.

Observers here are well agreed that during November there was a very great abatement of the glows, amounting almost to a cessation, although the whitish corona was always well developed through the day. Early in December the glows were renewed, and for six weeks continued quite as brilliant as during October. They are now somewhat abated, although quite uniform nightly. In September and October they were extremely unequal, as well as varying in position of greater colour, south or north of west.

As this revival of our glows closely followed their general diffusion over Europe and the United States, I suggest that this was the arrival in force by slow marches of the main body constituting the great *cone* of vapours, which, falling into the atmosphere in September, covered like a pall the Indian Ocean and Peninsula, down the extended western slope of which cone the light upper vapours were sent by the westward thrust of the earth's rotation, to find speed in their downward slide to carry them at once around the tropical belt as a light advance guard (as set forth in my letter of January 14). As the September haze became gradually dissipated, so the later December arrivals are wasting away.

S. E. BISHOP

Honolulu, January 30

AT Fanning's Island, long. 159° 22' W., lat. 3° 52' N., on September 4 last, the proprietor, Mr. Greig, states that the sun and sky had an extraordinary appearance; the sun "looked like a copper kettle." Lurid colours covered the sky. Great fears were felt for the safety of his schooner, the *Jennie Walker*, which sailed three days before.

From the master of the *Jennie Walker* I learn that on Sep-