or oxygen. The gases named have the same specific heat for equal volumes; but a hot object placed in hydrogen is really *touched* 3·8 times more frequently than it would be if placed in air, and 4 times more frequently than it would be if placed in an atmosphere of oxygen gas. Dalton had already ascribed this peculiarity of hydrogen to the high "mobility" of that gas. The same molecular property of hydrogen recommends the application of that gas in the air-engine, where the object is to alternately heat and cool a confined volume of gas with rapidity.

II. "Results of the Magnetic Observations at the Kew Observatory, from 1858 to 1862 inclusive."—No. I. By Major-General EDWARD SABINE, P.R.S. Received May 21, 1863.

(Abstract.)

The first three sections of this paper are occupied by a discussion of the Laws of the Disturbances of the Magnetic Declination at Kew, derived from the photographic records of the Kew Observatory between January 1, 1858, and December 31, 1862. In the first section a synoptical table is given, showing the direction and amount of the easterly and of the westerly deflections of the declination magnet at 24 equidistant epochs on each of 95 days of principal disturbance occurring in the years 1858 to 1862 inclusive. The deflections are measured from the normals of the same month and hour, computed from the undisturbed positions at the same epochs on the 1825 days comprised in the five years since the commencement of the photographic records. The phenomenal laws of the disturbances on the 95 days are then investigated, and are compared with the corresponding laws derived from a far larger number of observations in the same years, taken out by the well-known process employed by the author in the reduction of the observations of the colonial magnetic observatories. The result is shown to be that, so far as the laws of the disturbances are concerned, the two processes furnish mutual confirmation—the laws being approximately the same whether they are derived from the whole body of the hourly positions, or from that portion only which includes 95 days (or on an average 19 days in each year) which were specially affected by disturbance,—but that, for the purpose of eliminating the effects of the disturbances in the

subsequent investigation of the secular, periodical, and other minor magnetic variations, the process of elimination introduced by the author and employed by him for several years past in the reduction of the colonial observations has the advantage of separating from the whole body of the observations a far greater portion of the disturbing influence than would be gained by the simple omission of the observations on the 95 days. The laws of the *disturbance-diurnal* variation, thus found to be approximately the same whether obtained from the narrower or from the wider basis of investigation, are then stated, and are compared with the results of similar investigations recorded in the author's previous publications—the points of accordance or of difference being severally discussed in the third section.

The fourth section contains Tables of the "Diurnal Inequality," and of the "Solar-diurnal Variation" at Kew, showing the mean values at each hour and in each month. The "Diurnal Inequality" is explained as consisting of two principal constituents, viz. the "Disturbance-diurnal Variation," and the "Solar-diurnal Variation." It is obtained for each month by taking the differences between the mean positions of the magnet at each of the 24 hours, in the month, and the mean position in the month itself (viz. the mean of all the days and all the hours)—no omission whatsoever being made of disturbed observations.

The "Solar-diurnal Variation" is obtained by a similar process, after the separation and omission of all the observations which differed by a certain small and constant value from the normals of the same month and hour. By this process the effects of the "Casual and Transitory changes" are in a very great degree eliminated, and a very close approximation is obtained to the systematic diurnal action of the sun upon the direction of the horizontal magnet, apart from the effects of disturbances. The solar-diurnal variation thus obtained at Kew is compared with results similarly obtained at six other stations, viz. three stations in the interior of the two great northern continents, one equatorial station, and two stations in the middle latitudes of the southern hemisphere—thus generalizing upon a very extensive scale the action of the sun in producing the phenomena under notice.

The fifth section is occupied by a similar generalization of the facts which have placed in evidence the existence of a semiannual inequality

in the solar-diurnal variation, having its epochs coincident, or very nearly so, with the sun's passage of the equator, and dependent consequently on the earth's position in its orbit. The sun's action in producing this semiannual inequality is shown to be characteristically different from that which is manifested in the solar-diurnal variation itself, pointing apparently to a difference in the mode of the sun's action in the two cases.

The sixth section contains a tabular view of the "Lunar-diurnal Variation" at Kew, in each of the five years during which the photographic record has been maintained there; this is followed by a comparison with similar results at other stations on the globe, and a statement of the principal points of agreement or of difference which are shown thereby.

III. "Results of the Magnetic Observations at the Kew Observatory, from 1858 to 1862 inclusive."—No. II. By Major-General Edward Sabine, P.R.S. Received June 18, 1863.

(Abstract.)

This paper is a continuation of the preceding one. It consists of two sections, the seventh and eighth. In the seventh section the author discusses the secular change and annual variation of the declination; and in the eighth section, the annual variation or semiannual inequality of the inclination and of the horizontal and total magnetic force.

Seventh Section.—The positions of the horizontal magnet at 24 equidistant epochs in the day, tabulated from the photograms of the Kew declinometer, with the omission of the disturbed observations, as described in the former paper, are grouped in weekly means, forming 52 mean values, corresponding to the number of weeks in the year. A Table is given of these weekly values, comprehending, in five columns, the five years from January 1858 to December 1862 inclusive, and from these a sixth column is formed, representing the mean declination in each of the 52 weeks of a mean or typical year, corresponding in this instance to the year 1860. The mean declination obtained from all the weekly results in the five years, and corresponding to its middle epoch July 1, 1860, is $21° 39' 18''\cdot 1$; and from a comparison of the mean declinations corresponding to July 1 in the