and the conjoint Observatory, will be completely executed at the close of the year 1887. With its unparalleled instrumental equipment, and an unusual endowment for the prosecution of astronomical research; located where the sky is cloudless most of the year, and at such an elevation as to be above the clouds a great part of the remainder; and situate in a region, too, where the steadiness of the air permits astronomical measurement of the highest precision to proceed uninterruptedly throughout the entire night for months at a time,—the Lick Observatory is destined, under prudent management, to take its place at once in the foremost rank; and, although it is the first established mountain observatory, it may well expect to hold its own in the emulation of similar institutions which may subsequently be inaugurated at greater elevations.

TWILIGHT[1]

THIS essay, an extract from a more comprehensive work on the problem of twilight, which the author hopes to conclude in the course of this year, and embodying a lecture recently delivered by him both in Hamburg and Leipzig, describes the phenomena of twilight in general and of the remarkable sky-glows of the winter of 1883 in particular, with clearness, fullness, and exactness, and explains the physical causes of these phenomena from a special and mature study of that universally interesting field of observation, by numerous highly pertinent and illustrative experiments, and altogether in a manner which should bring home, even to the unscientific reader, a new sense and a new intelligence of the painting offered anew every morning and evening to the study and delight of man universally.

After relating and taking measure of the stupendous outburst of Krakatoa and the brilliant glows involving nearly the whole earth for a long period after that event, and comparing these two consecutive phenomena with the analogous phenomena of the outburst of "Graham Island" in 1831, followed by brilliant twilights and peculiar blue and violet sun colours, attracting the admiration, in particular, of Italy, France, and Germany, the book addresses itself to the task of investigating the physical laws concatening these two apparently heterogeneous phenomena, and why all volcanic outbursts are not attended by the same wonderful optic displays. While each particle of dust, smoke, or fog causes a bending or diffraction of the light, a collective effect, comprehending a brilliant development of colours, is produced only when all the particles of matter are of equal size and are distributed uniformly in space—a condition not even most remotely fulfilled in the case of ordinary smoke and fog. Diffraction includes the lateral dispersion of the light, which is all the more efficient the nearer the edges lie to each other, and therefore the smaller the particles are, and also the "interference" of like-coloured rays of light. When a red light falls, for example, on a fine glass thread or a diamond stroke scratched into glass, the shadow will consist not of one thin black line, but of a whole system of parallel stripes alternately dark and brilliant, *i.e.* black and red. When, again, a white light falls on the diamond stroke, the reflection shows a system of parallel stripes glowing in all the colours of the rainbow. In the case of a single line the development of colours is indeed so small as to be scarcely perceptible, but with many thousand lines of exactly the same breadth, and situated at exactly the same distance from one another, the reflex image is such that, taken up on a white screen, it is visible at great distances. Perfectly corresponding is the case with granules of dust. The shadow of a single granule of dust in red light consists of a system of concentric rings, alternately dark and redly luminous, which are all the broader the smaller is the granule. In white light, on the other hand, the shadow of the granule consists of alternately dark and bright rainbow coloured rings. If the dust granules are all of the same size, then will the like-coloured rings pretty nearly coincide, and, in the case of a sufficiently large number of granules, the reflex image will be composed of coloured rings of great luminousness. If, on the other hand, the dust-granules are of different size, then will all the different colours coincide, and, according to a well-known optic law, the image will be colourless. The image of a dust-cloud may, therefore, be rich in colours, poor in colours, or colourless, according as the particles of dust of which it is composed are of the same or of different size.

The experiments of Coulier and Mascart, extended by Aitkin, have demonstrated that in a perfectly moist air, no formation of fog is possible, however much the temperature is lowered, so long as the air is absolutely free of dust; and that the more air, sufficiently moist, is charged with such foreign particles, the more intense is the formation of fog under a sufficient lowering of the temperature or pressure of the air. Let filtered and completely moist air in a glass ball have its pressure diminished, then will only a few particles of fog reveal themselves to the most careful inspection, even under the powerful light of an electric lamp—particles of fog which, moreover, yield not the slightest coloured image. Admit now into this filtered air a few cubic millimetres of ordinary house air, then will a very fine, silvery, transparent fog at once form itself, of such slight density that even in the case of a considerable area of it the transparency of the atmosphere would be but very little affected. At the first moment of its formation let a reflected image of the sun, or the reflected light of an electric lamp, be viewed through it: the image will be seen surrounded by an intensely luminous blue or greenish light, with a broad, reddish ring, the colouring of which may range through all stages from brilliant purple red to the most delicate pale pink.

The phenomena of colour produced and explained by experiments of the above description are made to serve as the key to the more extensive but essentially identical phenomena composing the total process of twilight, which is distributed, like a spectacular play, into three acts with a prelude, and sometimes, though comparatively seldom, an afterlude—parts which, however, are not strictly distinguished in time, but occur to some extent simultaneously and overlap each other; as also to the comparatively unimportant deviations—apart from the intensity of colouring—from the normal course, which obtained in the remarkable sky-glows that arrested universal attention throughout the fall and winter of 1883.

[1] "Die Dämmerungserscheinungen im Jahre 1883 und ihre physikalische Erklärung." Von J. Kiessling, Professor am Johanneum zu Hamburg. (Hamburg und Leipzig. 1885.)

HENRY MILNE-EDWARDS

HENRY MILNE-EDWARDS was born at Bruges in October, 1800. Having completed his elementary studies in Belgium he attended medical lectures in Paris, where he took his diploma in medicine in 1823. While he retained an interest in medical and surgical pursuits until late in life, and was a member of the Academy of Medicine, Paris, of the Medical Societies of London, Edinburgh, &c., his earliest passion seems to have been for the study of natural history, and he soon abandoned the practice of his profession and devoted himself to scientific researches among the lower forms of animal life.

During the years 1826 and 1828, in company with his friend and fellow-labourer Audouin, the assistant to Lamarck and Latreille, he made a careful study of the various invertebrates to be met with on the coasts at Granville, around the Isles at Chansey, and as far as Cape Frehel. A member of the French Academy was,