

A Double Moon.

ON December 22, a well-defined double moon was seen 7m. before sunrise, which is here now at about 7. The fictitious moon was as a disk of white glass, through which the under-lapping part of the true moon could be seen. Atmospheric conditions being similar next morning, I watched for a repetition of the phenomenon, but after some abortive efforts, consisting of repeated, momentary, ill-defined projections of the moon's shape at a distance of three times the space occupied by her diameter, it was finally "given up." ROSE MARY CRAWSHAY.

Mentone, Hotel du Louvre, December 30, 1891.

ON THE RELATION OF NATURAL SCIENCE TO ART.¹

II.

THERE is yet another direction in which art owes instructive disclosures to the progress of photography. In the year 1836, the brothers William and Edward Weber represented, in their celebrated work on the "Mechanism of the Human Locomotive Apparatus," a person in the act of walking, in those attitudes which, according to theoretical calculation, must occur successively during one step. Thence a strange fact became apparent. At the beginning and end of each step, while the body rests for a short time on both feet, the pictures agree perfectly with the ordinary way in which painters have been accustomed to represent walking persons. But during the middle of the step, while one foot is swinging past the other, the effect is highly eccentric, not to say ludicrous; the individual appears to be stumbling over his own feet like a tipsy fiddler, and nobody had ever been seen walking in such a way. On the last page of their book, the brothers Weber propose to test the correctness of their diagrammatic figures by the aid of Stampfer and Plateau's stroboscopic disks, in the shape of Horner's *Dædaleum*,² which has, strange to say, returned to us from America as a new invention, under the name of "zoëtropé" or even "vivantoscope"; but whether the proposal was carried out or not, does not appear.

However, William Weber lived to see his assertions thoroughly justified almost half a century later by instantaneous photography. It was first put into practice in 1872 by Mr. Eadward Muybridge at the suggestion of Mr. Stanford, in order to fix the consecutive attitudes of horses in their different paces. The result was the same as in Weber's diagrammatic figures; pictures were obtained which nobody could believe to have seen in reality. On photographs of street life and processions the camera frequently surprised people in attitudes quite as odd as those attributed to them by the brothers Weber on theoretical grounds. The same is the case with the remarkable series of photographs of a flying bird during one beat of its wings, obtained by M. Marey with his photographic gun.

The explanation is known to be as follows: An object in motion, the speed of which varies periodically, leaves a deeper and more lasting impression on our mind in those positions which it occupies longest, while the impression is fainter and more fleeting in those through which it passes quickly. Apart from all knowledge of this law, a painter would never represent a Dutch clock in a cottage with the pendulum at the perpendicular, as every spectator would inquire why the clock had been

stopped. The pendulum, having swung in one direction, necessarily stops for a moment while preparing to return in the other, and consequently its diverging position is more vividly stamped on our minds than those during which it passes through its position of rest with a maximum of speed. Precisely the same thing occurs with the alternately swinging legs of a man during the act of walking; the body remains longest in the position in which both feet support it, and shortest in that during which one foot swings past the other. We therefore receive scarcely any impression from the latter series of attitudes. We imagine a walking person, and painters accordingly represent him, in the interval between two steps, with both feet touching the ground.

In the case of a running horse, however, particular circumstances intervene. However rapid the succession of instantaneous photographs, we never obtain the usual image of a racing horse such as it appears in large numbers in the print-shops at the racing season, and such as we suppose we actually see in reality. It is different in the case of man; there among pictures obtained methodically or by chance, which have, so to speak, never been perceived by the naked eye, some will always occur which agree with the usual aspect of a walking person. The difference consists in this, that in a racing horse the interval of time, during which the fore-legs remain in complete extension, does not coincide with that during which the hind-legs are fully extended. Both these positions prevailing in our memory, they are subsequently blended into the traditional picture of a racehorse, whereas instantaneous photography fixes them successively. Consequently the traditional picture is wrong, and exhibits the horse in a position through which it does not even transitorily pass.

In the year 1882, an illustrated American paper brought out a picture of a steeplechase, in which all the horses are copied from Muybridge's photographs, in attitudes only visible to a rapid plate. This ingenious sketch was communicated to us by Prof. Eder in Vienna, in a pamphlet on instantaneous photography, and a stranger spectacle cannot well be imagined. The correctness of these apparently wrong pictures can, however, be proved by realizing the idea originally suggested by the brothers Weber, and integrating into a general impression the periodical motion which has been resolved, as it were, into differential pictures. This is done by gazing in the *dædaleum* at a series of photographs taken at sufficiently brief intervals from an object in periodical motion, or illuminating or projecting it momentarily during its rapid flight past the eye. The latter method has been put into practice by Mr. Muybridge himself in his "zoopraxiscope," and with us in the electric stroboscope by Mr. Ottomar Anschütz, a most skilful handler of instantaneous photography. In both instruments we see men and horses reduced to their natural mode of walking, running, or jumping—with one exception. The speed with which the slits of the *dædaleum* pass before the eye, or the period during which each picture is illuminated, being exactly the same for the whole series, the general effect produced is somewhat different from what it would be in real life. On the whole, however, the position in which both feet are touching the ground, prevails, because the motion of the legs slackens when approaching this position, so that the pictures follow each other more closely and almost coincide.

The series of instantaneous photographs taken by Mr. Muybridge and Mr. Anschütz from an athlete, during the performance of a muscular effort, are an inexhaustible source of instruction to students of the nude. Mr. Anschütz's stroboscope exhibits a stone- and a spear-thrower in all the different stages of their violent action: their muscles are seen to swell and slacken, until finally the missile is represented after its discharge, as it cannot move any faster than the hand in the act of hurling it.

¹ An Address delivered by E. du Bois-Reymond, M.D., F.R.S., at the annual meeting of the Royal Academy of Sciences of Berlin in commemoration of Leibnitz, on July 3, 1890. Translated by his daughter. This Address was first printed in the weekly reports (*Sitzungsberichte*) of the Berlin Academy, then in Dr. Rodenberg's *Deutsche Rundschau*, and lastly it was published as a separate pamphlet by Veit and Co., at Leipzig, 1891. Continued from p. 204.

² *Philosophical Magazine*, January 1834, 3rd Series, vol. ii., p. 36.