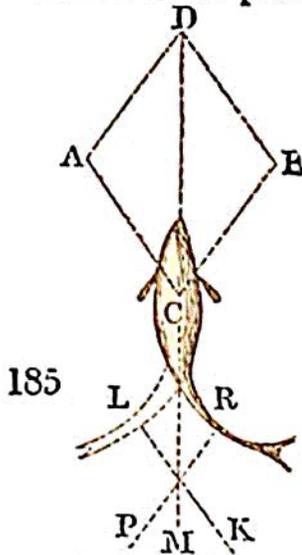


in paddling; for the action of the tail upon the water is lateral, like that of an oar, which it resembles in the vertical position of its plane; and the effect is transferred by the resist-



ance of the water to the body where the impulse originates. Let us suppose, for example, that the tail is slightly inclined to the right, as shown in Fig. 185. If, in this situation, the muscles on the left side, tending to bring the tail in a right line with the body, are suddenly thrown into action, the resistance of the water, by reacting against the broad surface of the tail in the direction PR , perpendicularly to that surface, will cause the muscular action to give the whole body an impulse in that direction; and the centre of gravity, c , will move onwards in the direction CB , parallel to PR . This impulse is not destroyed by the farther flexion of the tail towards the left side, because the principal force exerted by the muscles has already been expended in the motion from R to M , in bringing it to a straight line with the body; and the force which carries it on to L is much weaker, and, therefore, occasions a more feeble reaction. When the tail has arrived at the position L , indicated by the dotted outline, a similar action of the muscles on the right side will create a resistance and an impulse in the direction of KL , and a motion of the whole body in the same direction, CA . These impulses being repeated in quick succession, the fish moves forwards in the diagonal CD , intermediate between the directions of the two forces. By bending the whole body almost in a circle, and then suddenly straightening it, fishes are often able to leap to the top of a high cataract, in ascending against the stream of a river.

Such being the plan upon which progression is to be effected, we find that every part of the mechanism of the fish is calculated to promote its execution. The principal muscular strength is bestowed upon the movements of the tail; and the largest assemblage of muscles consists of those which give it the lateral flexions that have been just described.