

THE GOLF BALL'S FLIGHT.

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A SEEMING paradox is met with when a golf-player assures one that a properly "driven" golf-ball, after proceeding with an apparently equable motion over the first part of its flight, acquires at a later stage an additional impulse which enables it to describe the last part of its mid-air course with a velocity which is evidently greater than that which it has been just previously travelled under. Investigation for oneself, or enquiry from any intelligent golf-player, will convince one that the statement is borne out by the fact. Let us see what the theoretical reasons for this peculiarity are.

The ball is so placed on the ground with reference to the player that the blow is struck when the lowest part of the curve is being described by the golf-club in the hands of the player, in consequence of this the direction of the impelling force is horizontal; yet, a "well-driven" golf-ball starts in its flight at an angle of from 20° to 30° with the horizon; then it must be that this horizontally delivered blow is applied to the surface of the ball as much below the horizontal line, passing through its centre, as the line of flight is elevated above the horizon. It is evident, therefore, that the force not being applied at such a point that the prolongation of its direction would pass through its centre (assumed to be its centre of gravity as well), there will be evolved a motion of gyration about some point, generally near the upper surface of the ball, and never at its centre. Let us assume that the impelling force has been so applied that the gyrotory motion is about that point of the ball which is at the surface vertically over the point it is

resting on the ground; then the path traced out by this point in its flight will be the apparent path of the ball; and that gone over by the centre of gravity of the ball, its true path, an inverted curtate-cycloid.

It will be evident that the greater the number of gyrations in proportion to the velocity of the ball's flight, the greater the difference between the apparent and true path. If we assume that the ball gyrates once in going twice the length of its own diameter there will be two instants, separated by half of the total time we are considering, in which the ball will be in exactly the same place, excepting that the point of gyration will now be in advance of its previous position a distance equal to the ball's diameter. It is evident from this possible example that a large proportion of the impelling force of the blow is being absorbed in carrying the ball, or its centre of gravity, through this true path, and it will be equally evident that if by any means this gyrotory motion, which as pointed out is the cause of this difference between the apparent and true paths, could be arrested, there would be available just the amount of energy towards accelerating its-flight that is absorbed in gyration. Such a means is present in the resistance that the ball experiences from the atmosphere as it passes through it, but not *ipso facto*, because the resistance that the ball experiences in one part of its gyration, as a ball, is practically equal to the acceleration it is in receipt of in the correspondingly opposite portion, and in such a case this gyration would be maintained throughout its flight; but, if we consider our ball as an arm or