familiar with the rhinoceros in the circus, did not identify it with his fierce *mono-ceros* or unicorn.

In connection with the use of rhinoceros hide as armour, it is recalled that it is only when the skin is dried and properly prepared that it becomes of iron-like hardness; for the skin of the living animal, notwithstanding popular hunters' tales to the contrary, is quite soft and can be readily penetrated in any place by a bullet or easily pierced by a hunting knife.

We have not space here to follow the author in his exhaustive account of the origin and development of defensive armour. He treats of this in long chapters devoted to "Defensive Armour of the Archaic Period" (B.C. 1122–255), characterised by hide cuirass and scale armour in which metal was absent; "Defensive Armour of the Han Period" (beginning in the third century B.C.), when metal (at first copper and latterly iron) scales were introduced, from Persia, Dr. Laufer believes, to form "plate" armour; "Chain and Ring Mail," also from Persia, though this was confined to the Arabs and Moghuls and Tibetans, and never adopted by the Chinese; "Plate" armour, which was much more ancient and at first formed of bone-plates; "Sheet" armour, as in the medieval West, first came into use in China in the Tang period (A.D. 618–906), and from India, the author seems to believe. A chapter is also devoted to "Horse-Armour," shedding much new light upon this interesting phase of protective armament.

A word of high praise must also be given to the illustrations, which are well chosen and significant; and the photographic plates, sixty-four in number, are beautifully reproduced.

L. A. WADDELL.

MODERN BULLETS IN WAR AND SPORT.

FOUR interesting articles appeared in the columns of *Engineering* in August of this year, contributed by Fleet-Surgeon C. Marsh Beadnell, and these have now been reprinted in the form of a thin pamphlet. The articles are full of information as to the weights and velocities of different bullets and as to the effects of bullets of different kinds when they strike various substances at different points in their trajectory. The great experience of the author as a big-game sportsman on the one hand and as having seen many cases in the South African and Philippine wars and the present war on the other give great value to his observations on the destructive or at times very slight effects produced by the modern bullet; his treatment of the dynamical and especially of the aerodynamical principles affecting the motion of projectiles is less satisfactory.

In dealing with the effects of bullets the author shows how the damage done depends on the energy lost by the bullet; how, for example, a bullet at a high velocity and striking properly end-on may drill a clean hole, doing the minimum of damage and losing but little of its velocity, while at a later stage of its flight when travelling more slowly, and especially if in any degree inclined to its trajectory, the destruction is incomparably greater, and the loss of energy as represented by v^2 equally so.

The following experiment will exemplify this fact:—Two skulls were filled with a substance of a consistency as near as possible to that of the brain. Against the one was fired a normal bullet at high velocity, against the other a similar bullet at low velocity, this being effected by using a quarter charge; the range in each case was 10 ft. The first skull was neatly perforated, and the bullet, unaltered in shape, was found embedded 26 in. in the wood backing; the second skull was partly disarticulated, and was fractured posteriorly, the bullet lying inside against its posterior wall. In the case of the first skull the bullet parted with but little of its energy, and that only at the actual points of entry and emergence. In the case of the second skull more of the bullet's energy, both absolutely and relatively, was expended on it and its contents.

In an experiment of this sort a good deal depends on the compressibility of the material filling the envelope. As illustrating this point it may be permitted to refer to an experiment made by the writer of this notice at the time that he was photographing bullets. In order to ascertain if it would be practicable to photograph a bullet glancing off still water, he constructed a long trough of thin wood open at the top, somewhere about 3 ft. long and 4 or 5 in. wide and deep, and on to the water in this he fired a 0·303 bullet at as near a grazing incidence as he could. The water was hit about two-thirds along the trough, and was driven out as by an explosion. The front and sides of the trough in advance of the point of striking were split into matchwood, and generally, apart from the photographic difficulties, it seemed desirable to experiment in other directions.

The author has experimented on the inclination at which the modern high-speed bullet will penetrate a skull, and found that at angles above 5° or 6° he obtained penetration, whereas Snider and Martini bullets would glance off at much greater angles. Space does not allow of reference to the numerous valuable observations of the author on the curious effects of bullets both in big game and in warfare. These will be read with the greatest interest. It is not possible, however, to follow the author in his excursions in the domain of pure dynamics, and his treatment of the action of the air on the projectile appears to the writer to be very largely imaginary and incorrect. So difficult a subject as the action of air upon a rotating projectile, whether spherical or elongated, and whether the axis of spin is in or across the trajectory, scarcely admits of any but the most rigid treatment, and in this the author might find Mr. Crabtree's admirable book illuminating. There is a statement which is new to the present writer, and it would have been well to have given the authority.

Thus, up to speeds of 790 ft. per second resistance varies as the square of the speed, between 790 and 990 ft. per second as the cube, between 990 and 1120 ft. per second as the sixth power, between 1120 and 1330 ft. per second again as the cube, and above 1330 ft. per second again as the square of the speed; above 1500 ft. per second the relationship is not known.

C. V. BOYS.