THE AMERICAN RIFLEMAN

OFFICIAL JOURNAL OF THE NATIONAL RIFLE ASSOCIATION OF AMERICA

SEPTEMBER 1968

This Issue—1,129,000 copies

84th Year of Publication

THE COVER

Rare indeed is the shooter, even among ardent muzzle-loader fans, who has ever fired a matchlock. The few such arms available are usually too valuable and too antique for firing. So when Thomas J. Ford, Jr., of Los Angeles, craved matchlock shooting, he built his own Japanese-style long gun. It can't be called a "shoulder arm" because this type of matchlock, with its short, down-curved butt, was fired from the cheek as shown. The shooter's right hand, wrapped around the butt, cushions the recoil. (The same hold was used with some German wheel locks of the 1600's.) For details of how Ford made his matchlock and how it performed, see Page 58.

Vol. 116, No. 9

THE AMERICAN RIFLEMAN is published monthly by The National Rifle Association of America, 1600 Rhode Island Ave., N.W., Washington, D. C. 20036, for the benefit of its members. Domestic rates (U. S. and possessions) $6 a year, $11 for 2 years, $16 for 3 years, $25 for 5 years; for foreign postage, add $1 a year. Second-class postage paid at Washington, D. C., and at additional mailing offices. To change your address, send both new address and old address from mailing label to the Membership Division. The editors welcome manuscripts and inquiries, but cannot be responsible for loss or damage to unsolicited material. Statements in bylined or initialed text are those of the individual, not the NRA. The advertisement or mention of a product or service does not imply that such product or service has been tested or approved by The National Rifle Association.

SPECIAL REPORT

MAJOR ARTICLES

BULLETS IN THE BRUSH— WHERE DO THEY GO?

By L. F. MOORE

Any bullet fired at game in the woods may possibly be deflected by a bush or twig. Also, brush deflection is not infrequently used as an alibi for a poor shot. While the subject is of considerable interest to the serious hunter, there has been little useful information available on it.

Because brush deflection of small arms bullets is complex, reliable observations cannot be made easily. Bullets fired in the woods may be subjected to an almost infinite number of combinations of hits with respect to number, size and density of bushes, and the angle at which the impacts occurred. It is improbable that the results of even a single shot fired under these conditions could be duplicated.

A technique was developed, however, which permitted brush deflection characteristics of small arms bullets to be observed. A single bullet was impacted on a single piece of simulated brush at a range of 25 yds., and the bullet's path and orientation were determined for the next 75 yds. by means of 32 lightweight paper screens.

Seasoned wood dowel pegs were used to simulate brush because of their uniform size and density. The pegs were supported by a collet in a steel frame, with the grain oriented at a right angle with the line of fire. One screen was set 3.5″ forward of the peg to permit an accurate measurement of the point of impact on the peg. Screens from number 2 to 22 were positioned 12″ apart and from 22 to 32 they were 20 ft. apart. Three photoelectric screens and 2 chronographs were used to measure the time of flight over 2 known distances. The bullet's velocity at impact with the peg could then be calculated.

Cal. .30 rifle used

A cal. .30 rifle was selected for this investigation because of the wide use of this caliber for military and sporting purposes, and because of the many types of bullets available. The barrel had a length of 24″ and right-twist rifling with one turn in 10″. The rifle, with a 20-power telescope sight attached, was mounted in a machine rest. The line of sight was adjusted parallel with the bore line in the vertical plane and on the bore line in the horizontal plane. An index point was then made on each target on a projection of the reticle.

An extensive firing program was conducted to observe the effect on deflection characteristics of the type, weight, and velocity of bullet; size and density of brush; and point of impact on the brush. Five shots were first fired without the peg in position and without moving the machine rest, to determine the normal path of the bullet. Ten hits were then made on the peg for each condition, attempting to obtain hits at various points on the peg diameter. Graphs were prepared to show the bullet's path as seen from the rifle's muzzle. A number of representative graphs have been selected to show various characteristics.

Fig. 1 shows the normal path of 5 ball M2 bullets as they traveled from 25 to 100 yds. The index point is given with reference to the bullet's path. This 5-shot group has an extreme spread of 1.7″. It can be observed that the bullet described a helix, which was right-hand as a consequence of the right-hand rifling. The gravitational force caused the bullet to drop as it traveled down range.

The path of a bullet after impact on a bush depends on its angular deflection,[a] yaw,[b] and velocity. Characteristics of the bush at the point of contact affect both the angular deflection and the yaw.

The deflection when a bullet hits near the center of a bush may be too small to observe in field firing. Fig. 2 shows the path of a .30 ball M2 bullet which struck near the center of a ½″ diameter maple peg (density 42 lb./ft.^{3}). The graph shows the size and shape of the bullet hole in each target as well as its location with reference to the index lines. The impact caused only a small yaw and little, if any, angular deflection.

Fig. 3 shows the path of a ball M2 bullet which struck on the left edge of a ½″ birch peg. The yaw was small, but the deflection was great enough to cause a miss on a small target at 100 yds.

Fig. 4 shows the path of a ball M2 bullet which struck 0.12″ right of the center of a ½″ maple peg. The bullet was deflected to the right and a large yaw was induced, the bullet going through points of maximum and minimum yaw. The maximum yaw of 38° occurred about 4 ft. from the peg in the first period, and minimum yaw occurred at intervals of about 7 ft. The orientation precessed clockwise and advanced about 180° as it passed through the minimum yaw point. The bullet described a helix and accomplished several gyrations in traveling 75 yds., as it did in normal flight. Though deflected to the right, it traveled to the left as it went down range because of the aerodynamic effects of the induced yaw.

Fig. 5 shows the path of a ball M2 bullet after striking 0.10″ left of center on a ½″ maple peg. The bullet was deflected to the left by the impact, and a large yaw was induced which caused it to move to the right as it traveled down

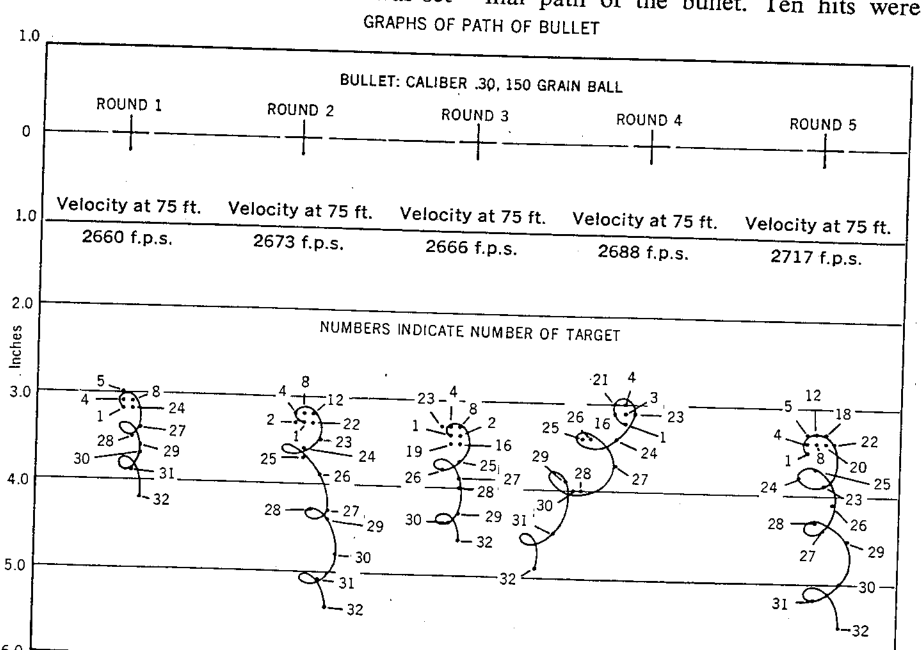

FIG. 1. Paths of 5 normal Ball M2 bullets from 25 to 100 yds., as seen from the rear. Determined in detail by firing through 32 paper screens.

[a] The angle between the velocity vector immediately before and that immediately after impact.
[b] The angle between the axis of the bullet and the velocity vector.

range. The maximum yaw of 46° occurred at 3 ft. and yaw period was 6 ft.

Thus when a ball M2 bullet impacted on a ½" diameter peg at 25 yds. it was deflected away from the center of the peg. If the point of the bullet hit the peg, the yaw induced was sufficient to cause it to move to the opposite side of the peg as it traveled down range. When the point of the bullet passed outside the peg, but its shoulder struck the peg, the yaw induced was insufficient to cause the bullet to move to the opposite side of the peg. The magnitude of yaw affected both the period of yaw and the magnitude of gyration, the larger yaw producing a shorter period and larger gyrations. Ball M2 bullets generally gave maximum yaw between 3 and 4 ft. beyond the peg and minimum yaw between 6 and 8 ft. The bullets described between 2 and 3 gyrations in traveling 75 yds. after impact with the peg.

Because the ball M2 bullet has a high stability factor, the magnitude of yaw decreased with each following period and it would probably damp to a minimum in traveling 200 yds. When this bullet hits a peg of this size and density, the yaw induced has thus a greater in-

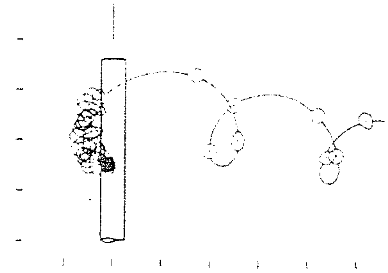

FIG. 6 (above): Cal. .30, 150-grain, ball bullet. Velocity at ½"-diameter pine peg is 2631 f.p.s.

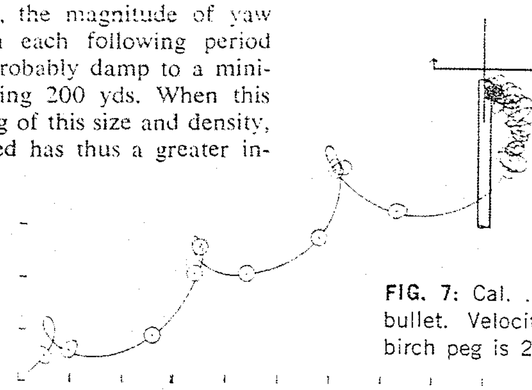

FIG. 7: Cal. .30, 150-grain, ball bullet. Velocity at ¼"-diameter birch peg is 2651 f.p.s.

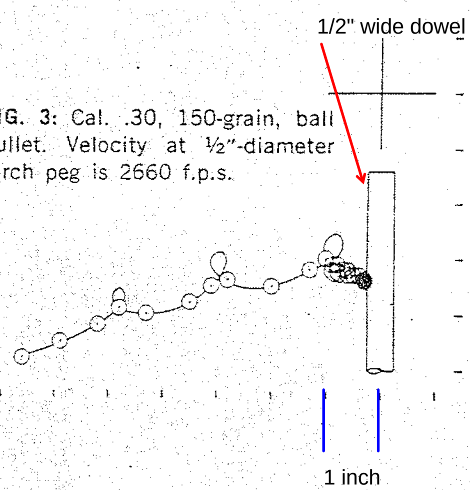

FIG. 3: Cal. .30, 150-grain, ball bullet. Velocity at ½"-diameter birch peg is 2660 f.p.s.

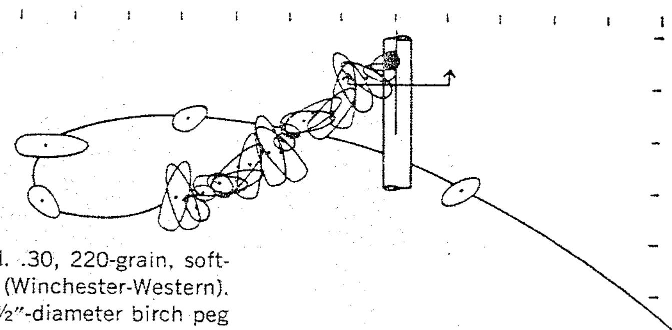

FIG. 11: Cal. .30, 220-grain, soft-point bullet (Winchester-Western). Velocity at ½"-diameter birch peg is 1101 f.p.s.

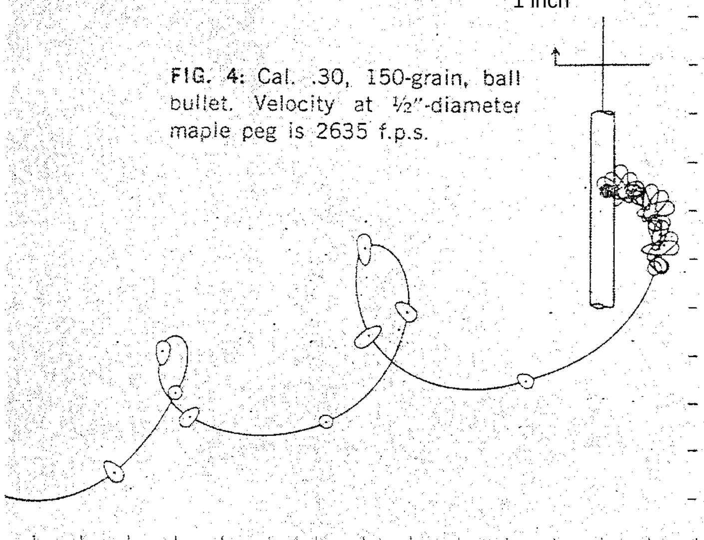

FIG. 4: Cal. .30, 150-grain, ball bullet. Velocity at ½"-diameter maple peg is 2635 f.p.s.

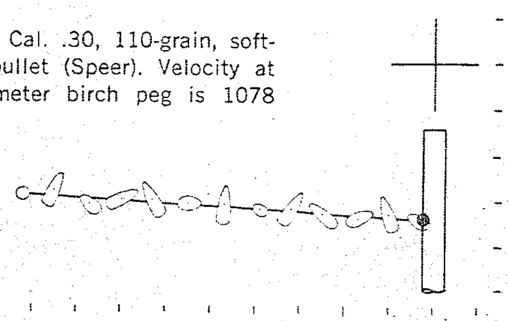

FIG. 9: Cal. .30, 110-grain, soft-point bullet (Speer). Velocity at ½"-diameter birch peg is 1078 f.p.s.

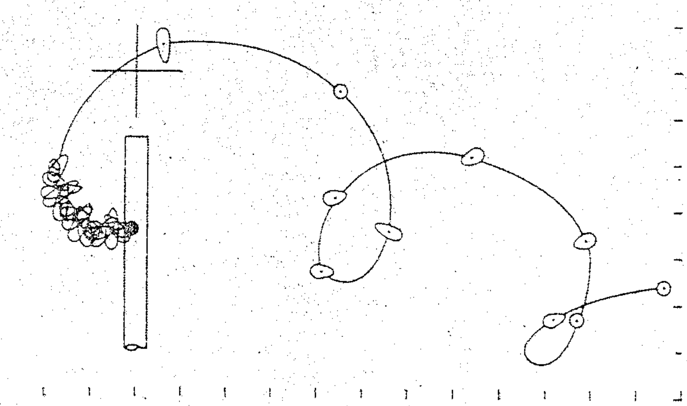

FIG. 5 (left): Cal. .30, 150-grain, ball bullet. Velocity at ½"-diameter maple peg is 2687 f.p.s.

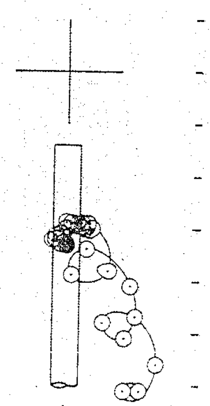

FIG. 2: Cal. .30, 150-grain, ball bullet. Velocity at ½"-diameter maple peg is 2665 f.p.s.

fluence on the bullet's path than the angular deflection.

Density of the bush affects the magnitude of deflection. Fig. 6 shows a ball M2 bullet which impacted 0.12" to left of center on a ½" diameter pine peg (density 31 lb./ft.^{3}). The maximum yaw of 24° occurred at between 3 and 4 ft. and the yaw period was 7 ft. The yaw for this bullet was less than that for a bullet which hit similarly on a maple peg of the same diameter.

Size of the bush affects both magnitude and characteristics of the deflection. Fig. 7 shows the path of a ball M2 bullet after impacting on a ¼" diameter birch peg, and Fig. 8 that of an M2 bullet after impacting on a 1" diameter birch peg. After impact on a 1" diameter peg this bullet did not demonstrate the characteristic of moving to the side of the peg opposite that on which the impact occurred, as it did after striking the smaller sizes of peg. The angular deflection caused by impact on the 1" peg had a greater effect than the yaw.

Bullet density has a major effect on deflection. Five additional bullet types were fired against ½" birch pegs. Tracer and armor-piercing bullets, which are the types of lowest density, suffered the greatest deflection.

The deflection also is affected greatly by the bullet's velocity. Figs. 9 and 10 show the paths of 110-gr. soft-point bullets and Figs. 11 and 12 those of 220-gr. soft-point, each type at a low and a high velocity. The 110-gr. bullet with the lower velocity was deflected so much that it hit the frame holding the 14th target, and the lower velocity 220-gr. bullet missed the last 3 targets. Higher velocity results in decreasing the deflection, for a particular set of conditions, so long as the bullet is not deformed enough to affect its flight appreciably.

Some 220-gr. bullets yawed even in normal flight, the rifling twist of one turn in 10" giving the 220-gr. bullet only marginal stability. The 110-gr. bullet has a high stability factor when fired in a barrel with this rate of twist. The rifling twist thus is expected to have a large effect on the magnitude of deflection.

The deflection of 125-, 150-, and 180-gr. soft-point bullets was comparable with that for the other 2 weights of soft-point bullet, when impacted under similar conditions at the same velocity level.

Bullet velocity and density evidently are major factors in deflection. If relatively favorable brush deflection characteristics are desired, use a bullet at the maximum velocity consistent with safe chamber pressure and acceptable bullet deformation, and a rifling twist steep enough to give a high stability factor. ■

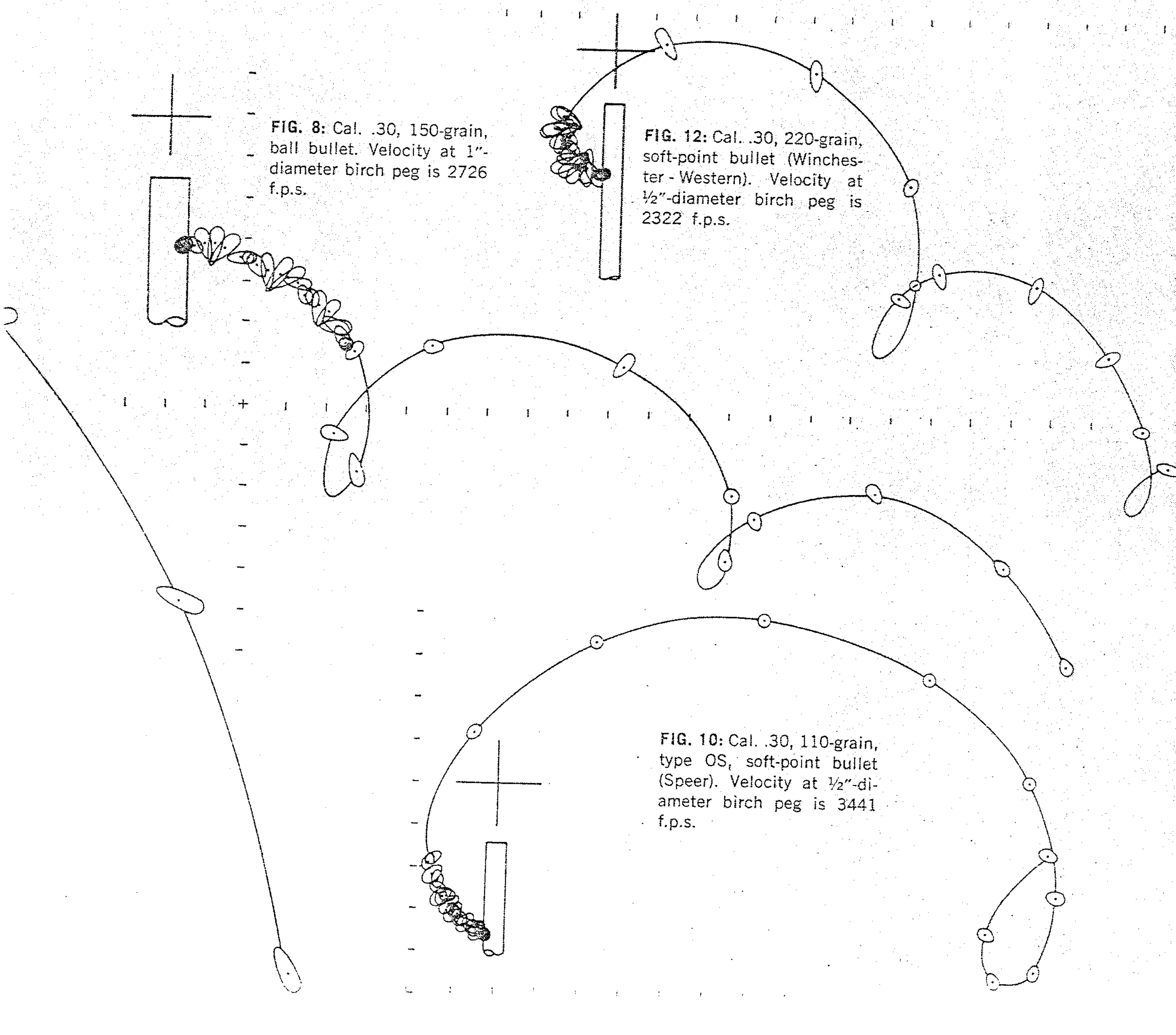

FIG. 8: Cal. .30, 150-grain, ball bullet. Velocity at 1"-diameter birch peg is 2726 f.p.s.

FIG. 12: Cal. .30, 220-grain, soft-point bullet (Winchester - Western). Velocity at ½"-diameter birch peg is 2322 f.p.s.

FIG. 10: Cal. .30, 110-grain, type OS, soft-point bullet (Speer). Velocity at ½"-diameter birch peg is 3441 f.p.s.