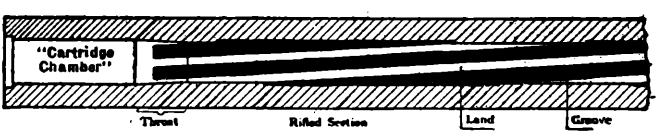
ELEMENTARY BALLISTICS

In order that the shooter may thoroughly comprehend, chose, and enjoy his hobby, it is necessary that he have at least an elementary knowledge of ballistics.

Ballistics is a term used to describe the movement and property of the bullet from the time it leaves the shell case until it reaches its destination. Ballistics are divided into two groups, internal and external. Internal ballistics have to do with the bullet while still in the barrel;

TRAJECTORY

external ballistics have to do with the bullet after leaving the muzzle of the gun. The blow of the firing pin upon the primer ignites the priming mixture much in the manner that an ordinary match ignites when the tip is struck or scratched. The flash of the primer in turn ignites the powder which is instantaneously converted into gas, causing very high pressure in all directions. The base of the bullet, being the only surface offering little resistance, gets the full benefit of the gas pressure and is forced out of the shell case into the bore of the gun and driven at high speed out of the muzzle. The more progressive or slow



CROSS SECTION VIEW OF RIFLE BARREL

burning the powder, the less jarringly the conversion from powder to gas takes place, and the more gradual and further from the chamber is the point of maximum pressure. The pressure exerted by the gas is expressed in atmospheres, or more commonly in pounds per square inch. Normal pressure in the 30/06 barrel is, for example, 30,000 pounds (10 tons) per square inch, and the Springfield Armory proof load for testing of the rifle is 45,000 pounds.

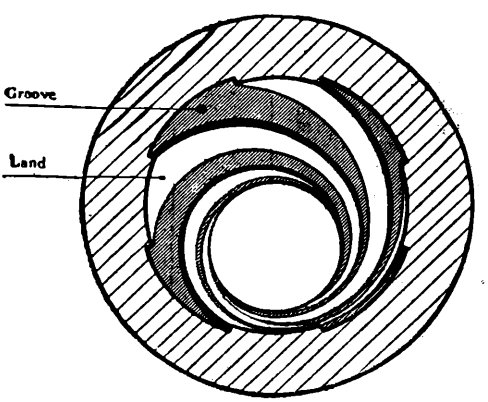
For different types of firearms different powders are necessary, for example, a powder suitable for a long barrel may be quite unsuited for use in a short barrel, as a portion of the powder would not be burned

until after the bullet had left the muzzle, thereby causing great loss in velocity and energy. Consequently the shorter the barrel, the greater the muzzle pressure, the louder the report, and usually the muzzle blast.

When the bullet enters the barrel, it engages the rifling and is forced into rotation. Without this rotation, any cylindrical bullet would tumble and have no accuracy upon leaving the muzzle.

The rate of twist is usually expressed in the number of inches required for any single land or groove to make a complete turn. The U. S. Springfield, for example, has a 10-inch twist. The depth of the grooves and the rate of twist varies with the type of bullet and the velocity. In general, barrels for lead or light copper jacketed bullets have deeper grooves than for those with hard cupro nickel jackets such as used in all high velocity cartridges. In general also the faster the twist the faster the cartridge.

A minimum barrel, extra wide grooves, improper shade of the conical shoulder greatly increase the pressure, concentrate it near the chamber and cause disturbances in the barrel affecting the accuracy of the shot. External



CROSS CUT VIEW OF BARREL

ballistics.

The muzzle velocity is given in foot seconds, representing the number of feet the projectile would travel in one second if it continued at the same rate as when leaving the muzzle. Since the bullet is subject to two forces, air resistance and gravity, the speed of flight begins to drop at once. The speed with which the bullet continues to travel is dependent upon the weight and form of the bullet, also upon the wind.

The flight of the bullet from muzzle to point of impact is in the form of a curve, with the highest point about 54 per cent of the way toward the target. The greater the distance of the target the more the muzzle must be elevated to provide against a drop short of the target. Point blank range is that range at which the bullet travels practically flat and before any perceptible drop due to air resistance or gravitation has taken place and coincides with the line from muzzle to target.

TEDDY
got
his Bird

QUIRINO
in
Action

These are in connection with Quirino's Articles on page 12

High velocity cartridges are those where the velocity is such that height of the trajectory over a line drawn from muzzle to target is very low. High velocity increases accuracy and makes the altering of the rear sight for small differences in range unnecessary. It follows that the higher the velocity, the greater the point blank range.

At the moment of leaving the muzzle, the base of the bullet is subjected to an uneven push from the gas escaping directly behind it, and because the bullet is no more guided by the barrel. This is detrimental to its balance and causes the base of the bullet to pendulate or "yaw." The degree of swing from the perpendicular is referred to as the "angle of yaw," and it is for this reason that a high velocity cartridge cutting a target at close range will keyhole, and its penetration be less than at a greater distance, because a well constructed bullet will rapidly lose its yaw ant settle to a regular flight. The amount of yaw is directly influenced by the length of the bearing surface of the bullet against the barrel. The shorter this surface, the greater the angle of yaw. For this reason a long round nose bullet has more penetration at short distances than a boat tail sharp pointed or Spitzer type. In general a full jacketed bullet has double the penetration of one of similar shape with soft nose.

The muzzle report is caused by escaping gas striking the air. The bullet report is caused by the piling up of air in front of the bullet. At a distance, only the bullet report is heard, behind the gun the sound heard is combination of both.

The muzzle flash is the dark reddish flash in front of the muzzle caused by powder not completely consumed in the barrel. A peculiar phenomenon familiar to all shooters, is the brilliant bluish ball of fire, usually known as the muzzle blast. When the highly heated gases strike the air they combine with it to create an explosive mixture which in turn explodes, intensifying the muzzle and bullet reports, all of which are heard as one by the shooter.

The amount of muzzle flash and blast varies according to bullet, powder, and barrel length.

DEVELOPMENT OF THE SPRINGFIELD SERVICE RIFLE

The Springfield Arsenal was opened shortly prior to 1799, when the first American army musket was built there. It was a copy of the French Charlesville rifle, caliber .69, shooting a one ounce ball with a muzzle

velocity of 900 foot seconds. With a few changes, all arms built at Springfield were .69 caliber, until 1842 when the first rifling was introduced and a spherical bullet used. The caliber was next reduced to .58, doubling the effective range from 250 to 500 yards.

In 1866, the first .50 caliber metal cartridge was employed, but lasted only until 1873 when it was reduced to .45 caliber. This rifle stayed until 1893, when the Krag was introduced in the successive models of 1892, 1894, and 1898. The Krag, in turn was discontinued in 1905, when the present day model of 1903, built on the pattern of the Mauser Model 1898, of which it is partly a copy and partly a modification, was adopted.

In 1905, attention was given the Mauser Spitzer bullet, which was adopted in 1906, and one thread was removed from the barrel, reducing the original length from 24 to 23.79 inches. The Spitzer type 1906 cartridge has double the accuracy and about 30 per cent greater velocity, energy, and range than the original 1903 cartridge.

Since 1906 the development has not been in the mechanical features of the rifle, but in the quality of materials used and the ammunition. For this reason the purchaser of a Springfield rifle should see to it that his rifle, if made at Springfield, has a serial number over 800,000, or if made at Rock Island, over 285,507.

We call attention to this because all actions under the respective numbers mentioned are destroyed and replaced when returned to Springfield. On the new actions nickel and chrome vanadium steels are used, together with new processes of heat treatment which assure the greatest degree of safety to the shooter.

The present trend in army rifles is the automatic type, and the time is undoubtedly close at hand when all armies will be so equipped.