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This article appeared in *the* July-August 1962 issue of *Ordnance, the journal of the Army Ordnance Association* under the heading: *"Rodman's Great Guns"*

The five years of the Civil War are quite rightly considered a period of ordnance and artillery experimentation, development, and transition. The work of one man led, in fact, to the casting of one of the biggest guns ever built, even to the present day - a monstrous 20-inch muzzle-loader that fired a 1,000-pound solid shot.

In 1844, Lieut. Thomas Jackson Rodman, a young Ordnance officer only three years out of the military academy, began a long series of experiments aimed at overcoming the principal difficulty in casting extremely large iron cannon, a difficulty that actually set a maximum size limit for iron artillery pieces. At that time cannon, cast around solid cores, could be cooled only from the outside. This practice caused the cooling metal to contract toward the outer surface of a cannon barrel and in large castings created internal strains and structural irregularities in the metal, as well as "pipes" or "blowholes" - actual cavities within the casting. In short, large guns all too often had a habit of cracking in cooling, breaking in transport, or finally bursting when fired.

Over a period of years, Rodman devised a theory to account for both internal strains and imperfections and for variations in the density, hardness, and tensile strength of the metal in cast-iron cannon. He outlined a plan to cast cannon around hollow cores, to be cooled from the inside, rather than externally, by a stream of running water.

This, Rodman felt, would cause the cooling metal to contract toward the bore and increase the density of the metal where it was most needed. The bore, of course, would later be reamed out and polished, eliminating any surface imperfections. The rate of cooling could be controlled by regulating the temperature and rate of flow of the water.

By following his procedures, Rodman claimed he could cast cannon of any practical size. Working at Knapp, Rudd & Company's Fort Pitt Cannon Foundry at Pittsburgh, casters of cannon for the government since 1803 and probably the largest foundry in the world, Rodman began a series of experiments and trials which lasted nearly ten years. Experimental cannon were carefully cast in pairs, one on the old solid core, the other around variations of Rodman's hollow core.

Of one pair, the gun cast by Rodman's principle was fired 1,500 times; its counterpart cast on a solid core and cooled externally, burst on the 299th shot. In another test of guns purposely made of poor material, Rodman's internally cooled gun fired 250 times and held together; the other piece burst on the 19th round.

Completely satisfied by Rodman's results, in 1860 the War Department authorized the casting of a 15-inch smoothbore Columbiad, even at that time a gun bigger than anything the world had ever seen. The first 15-inch gun, "The Lincoln Gun", made under Rodman's personal supervision at the Fort Pitt Foundry, was sent to Fortress Monroe, Va., where it was tested in March 1861 and became a model for the many Rodman guns which followed. The new gun proved a great success, although its huge size and weight, 49,000 pounds for the barrel alone, made it practical only for fixed positions in forts or permanent batteries.

Specifications were impressive. The 15-inch Rodman gun was 15 feet, 10 inches long, with a bore length of 13 feet, 9 inches, or 11 times caliber, a good deal shorter than the general rule. Most black-powder artillery, other than howitzers and mortars, had a bore length of fifteen to twenty times caliber. With an odd bottle-shaped appearance, and the absence of reinforcing rings, something new to artillery, the gun had a maximum outside diameter of four feet. Two types of ammunition were provided - a 450-pound solid shot, and a 330-pound explosive shell carrying a 17-pound bursting charge.

Perhaps even more important than his casting procedure was Rodman's development of progressive-burning powder. When any gun fires, of course, the volume of the bore behind the projectile increases as the projectile travels toward the muzzle. The normal black powder grain, however, irregular in shape, burns from the outside, so that its burning surface area continually decreases. Thus, in a normal black-powder piece, initial breech pressure is the highest obtained; the forward traveling projectile increases bore volume as the powder burns at a decreasing rate. Both occurrences reduce interior bore pressure.

Rodman proposed powder pressed into hexagonal grains perforated with several longitudinal holes so that as individual grains burned both inside and out, albeit almost instantaneously, the burning surface of each grain actually would increase. Rodman's powder didn't increase pressures - it simply maintained a higher bore pressure than normal powder could, as the projectile traveled forward. The result, logically, was an increased muzzle velocity of the projectile.

To be continued …