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The British – Italian Performance in the Mediterranean From the Artillery Perspective

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Abstract. During the Second World War, the course of the naval conflict in the Mediterranean can be reduced to battles between the British and Italian fleets. Three years of operations against the Royal Navy only produced one more or less significant victory for the Italians, who enjoyed a considerable numerical superiority in this, their main theatre of operations, while the priority for Britain was minor or even third-hand! And most of the engagements, as a rule, ended with the Italian forces retiring as fast as possible.
Keywords: Mediterranean History; Naval History; Italia; Great Britain; Historical reconstruction.

Marc Antonio Bragadin's The Italian Navy in World War II is bewildering. Their 'greatest' victory was Pantellaria, in which a British destroyer and several transports were sunk. But given the correlation of the forces involved, the entire convoy should have been exterminated to the last vessel! And the 'super fast' Italian ships never could catch the much slower British vessels; *Bartilomeo Colleoni*, supposedly capable of 40 kts., was savaged by H.M.A.S. *Sydney*, which on her best day only made 32 kts.

How could it be that, having the larger fleet, magnificent artillery and well-trained crews, the Italian Fleet suffered one shattering defeat after another? Let us try to look at the problem through the prism of naval guns.

For the purposes of comparison, we shall select three artillery systems that were nearly analogous between the two navies: the 381-mm (15") main guns of the battleships, 203-mm (8") guns of the heavy cruisers, and the 152-mm (6") of the light cruisers. The performance of each is summarized below.

Caliber	Model	Shell's mass, kg	Muzzle velocity, m/s	Form factor to the low of 1943
152/50	Mk XXIII	50,8	841	1,08
203/50	Mk VIII	116,1	855	1,03
381/42	Mk I	871,0	752	1,27
152/53	Model 1926	47,5	1000	1,09
203/53	Model 1927	125,3	955	1,09
381/50	Model 1934	885,0	850	0,89

The technique and functions for ballistic calculations was presented in sufficient Detail in the pages of "Warship International" in an article by William Jurens. Many of the functions are of an empirical character, and so differ a little bit for each country. So in Russia the definitions of a standard atmosphere were set forth in the Russian State Standard 4401-78, which defined the character of temperature variations, density, viscosity, and air pressure at altitude functions. These are the functions used for this analysis. And for the laws of resistance the following were applied:

- Law resistance of Siacci (for shells of a form similar to the standard Type 1)
- The Law of 1930 (similar to a Type 8)
- The Law of 1943 (similar to a Type 7)

In this case for definition of the form factor of a shell, the Law of 1943 was selected. From the Table above, it is evident that the British and Italians have used shells with almost identical ballistic properties. However, here there is nothing exotic, as the British influence on Italian ordnance was very great. Up to the end of WW 1, the guns of the Italian fleet were made under license to designs from the firms of Armstrong [EOC] and Vickers. And as a matter of fact, subsequent gun development were modern versions of those designs. This connection, by the way, shows rather exponential comparison of the form factors for shells of the main guns of the leading maritime states. For example, for guns of about 127-mm (5") which were introduced into the inventories during the 1920 – 30s, as the main guns for destroyers, the values are as follows (using the Law of Siacci):

System	State	Muzzle velocity, m/s	Shell's mass, kg	Range for angle, m	Form factor to the Siacci's low
120/45 Mk I, Mk II	England	814	22,70	14450 (30)	0,82
130/40 Model 1924	France	725	34,85	18700 (35)	0,60
127/45 SK C/34	Germany	830	28,00	17400 (30)	0,66
120/50 Model 1926	Italy	950	23,15	22000 (45)	0,62
120/45 Type 3	Japan	825	20,41	16000 (33)	0,66
130/50 B 13	USSR	870	33,40	25730 (45)	0,52
127/38 Mk 12	USA	762	25,04	15300 (35)	0,73

From the above table, taken from Tony DiGiulan's contributions to the Warships1 website (www.warships1.com), the ballistics of guns of the main European states and Japan were at approximately the same level. It is interesting to note, however, that the Soviet shell had the best ballistic form. But this should not be surprising, as the attention given to ballistics in the USSR, which resulted in the M.1928 pattern projectiles, is well known now. Stalin even took a personal interest in the development program, which produced gun systems equal or superior to all foreign designs in all main parameters save one – barrel life. This unfortunately cancelled out all of their virtues, as the Effective Full Charge life of the gun was equal to the capacity of the magazine!

The American and British guns have the worst ballistics form, but this can not be the only criterion, since doctrine required the more universal application of both anti-surface and anti-air capabilities.

But to return to the Anglo-Italian conflict in the Mediterranean, it is well known that the hit probability is determined in large part by the angle in descent of a shell, known as the Danger Space. Steve McLaughlin defined this relationship as:

Danger space = Target width + Target height / Tangent of Angel of Descent

It follows, therefore, that the lower this angle of descent, the greater the hit probability, which is rationale behind the use of high velocity guns. Figure 1 reflects this parameter of the major British and Italian guns. Hereinafter the various graphs show 152mm guns as circles, 203mm guns as squares, and 381 mm guns as diamonds, with white designating the British and black the Italians.

As is depicted in Figure 1, at all battle ranges the angle of descent of the Italian shells is less than that of their British opposite number. Indeed, at ranges up to 16,000 meters, the angle of descent of the Italian 203mm shell is less than that of the British 381mm!

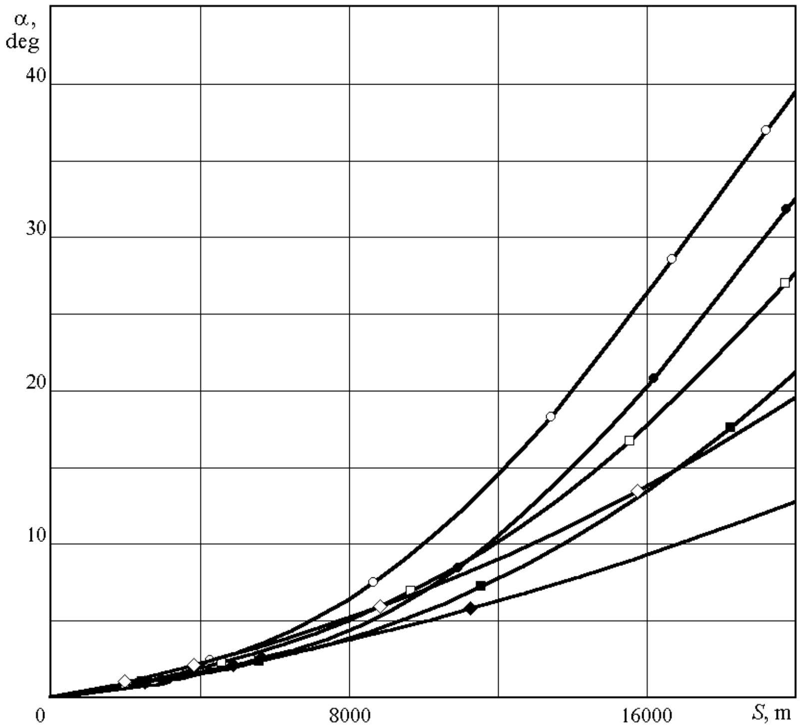

Fig. 1. Comparison of angle of incidences of shells

If comparison were only limited to the size of the danger space, than the Italians should have enjoyed a considerable advantage. This makes the results of the gun battles quite paradoxical. Therefore, as a second step we must try to estimate the values of the ballistic corrections. A technique for obtaining such values would be to determine the effect of corrections in an elevation angle: the variation of an elevation angle is applied, which affects the range. Thus, for each degree of deviation either way, the shell either falls short or flies over by a certain number of meters. Other corrections produce a similar result. The unique exception is a variation of the atmospheric density and pressure, the values of which are generally included in the Range Tables. The given technique was approved by the authors on the basis of Range Tables for the 122 mm Soviet howitzer, model 1938, and has given satisfactory convergence.

1) Correction of elevation angle – sensitivity of the gun the roll of the ship (see Figure 2). Though Fire Control Suites were common before the War, the very sensitive instruments that appeared only afterwards had effect as if the ship were on an even keel, the consequences of roll being eliminated insofar as the guns were concerned. But in the absence of such systems, the divergence between the British and Italian guns is most obvious in the performance of the 381mm guns. Dispersion of the Italian shells was almost 1.5 – 2 times greater! This means that in the presence of virtually any wave activity at sea (which is almost always), the British would have on average twice as many hits as would the Italians!

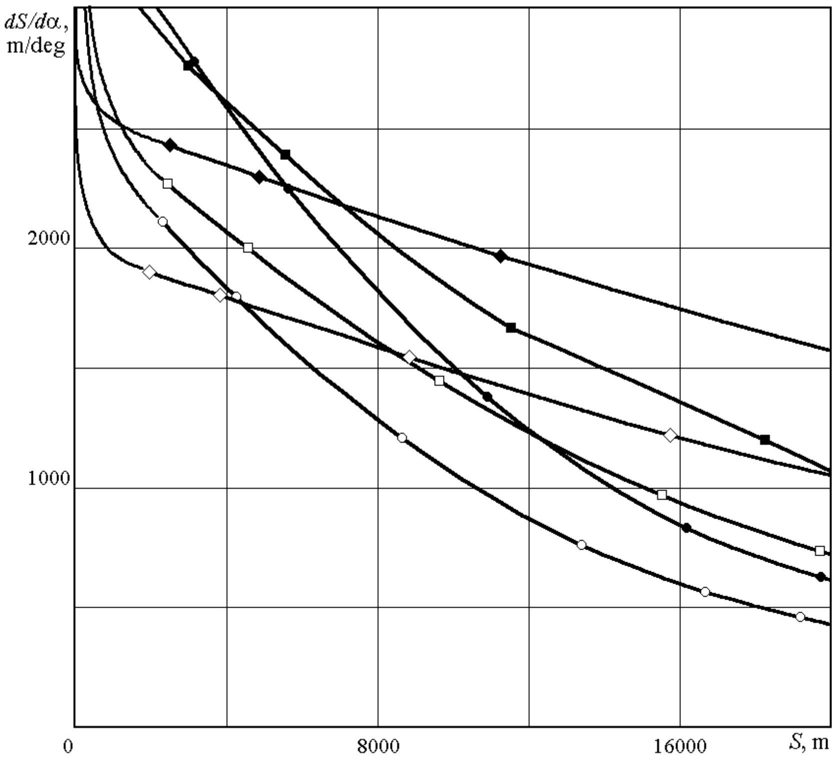

Fig. 2. The correction on an elevation angle

2) Correction for the mass of the shell – sensitivity of the gun to the 'know-how' of shells (see Figure 3). As is known, the more developed manufacturing processes warrant obtaining smaller tolerances. Thus, dispersion due to variation of the mass of the shell is lower, as the shells are more uniform. However, as Jack Greene and Alessandro Massignani have pointed out in their The Naval War in the Mediterranean 1940 – 1943, manufacturing tolerances in the production of the Italian shells were overly large on the one hand, as was the weight control of the propellant used in bagged charges.

The Table below shows the changes in range caused by a mere 1% variance in shell weight and propellant charge weight.

Condition	Shell Wt. (kg.)	M V (m/s)	Range @ 15-deg (meters)
Range Table	885	870	26,420
1% increase in charge	885	874.34	26,640
1% decrease in charge	885	865.64	26,201
1% increase in shell wt.	893.85	865.68	26,289
1% decrease in shell wt.	876.15	874.38	26,552
1% increase in both	893.85	870	26,507
1% decrease in both	876.15	870	26,332
1% increase in charge & 1% decrease in shell wt.	876.15	878.74	26,772
1% decrease in charge & 1% increase in shell wt.	893.85	861.34	26,070

So even though it may have been possible for the Italians to have adjusted for the variations in shell weight, which were often labeled on the projectile and allowed for in the Range Tables, the variation in the propellant charges could not. Thus the Italians were laboring under an additional burden with regard to dispersion.

3) Correction for atmospheric pressure (see Figure 4). In this area, the change in condition would affect both sides, with neither obtaining a material advantage. Thus, the value of this

correction is not so great, as atmospheric pressure varies rather slowly, which allows for its rather exact measure.

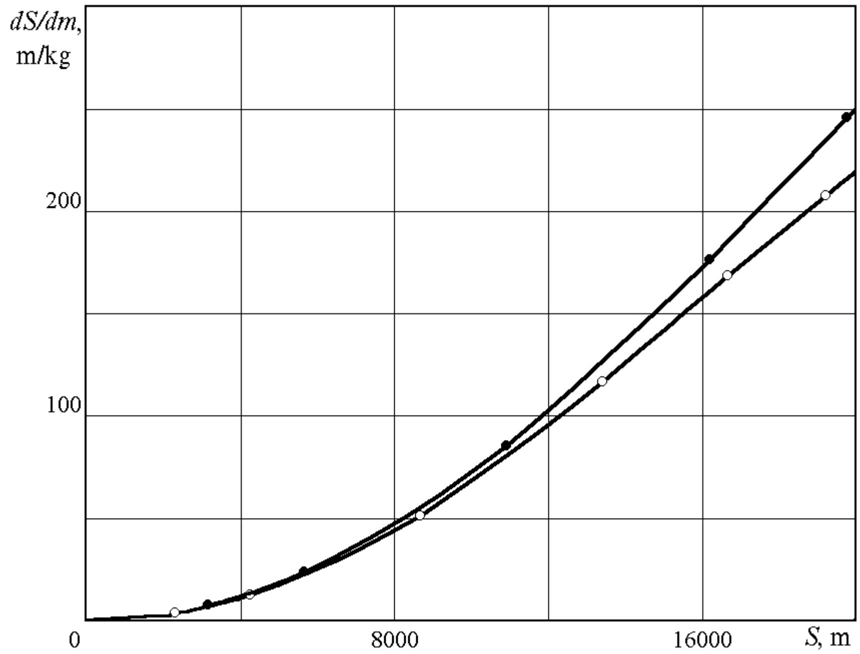

Fig. 3a. The correction on a mass for 152-mm shells

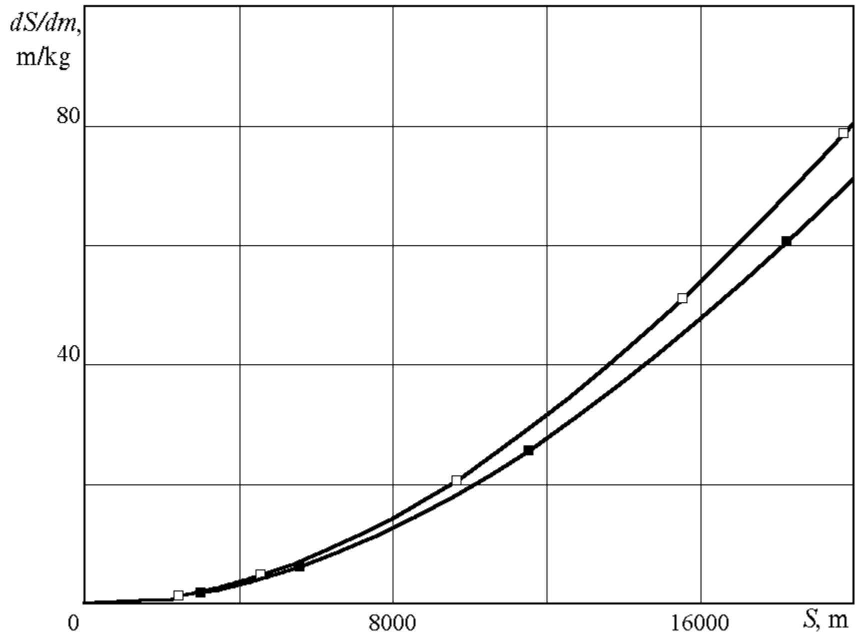

Fig. 3b. The correction on a mass for 203-mm shells

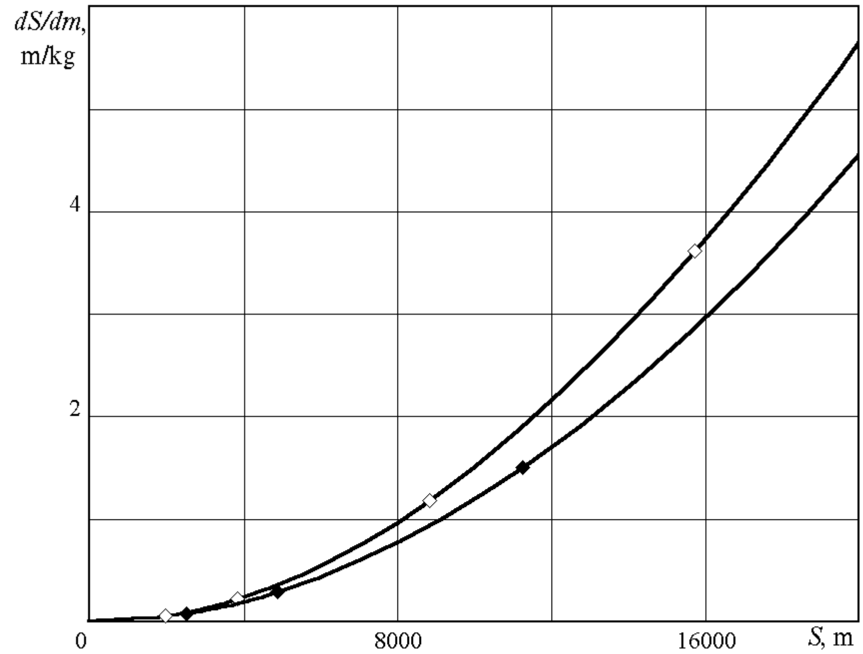

Fig. 3c. The correction on a mass for 381-mm shells

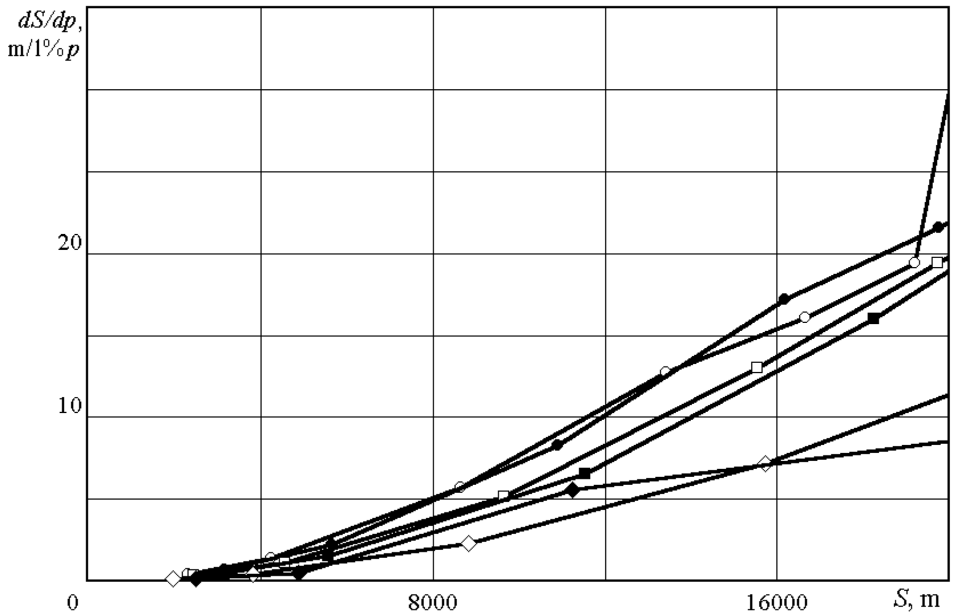

Fig. 4. The correction on atmospheric pressure

4) The correction for atmospheric density actually displays sensitivity of the gun to meteorological conditions, as the presence of rain or snow results in increased density of the air (see Figure 5). This correction, as opposed to atmospheric pressure, is rather difficult to take into account. Sudden rain or snow showers (the latter not common in the Mediterranean), or fog, would have a detrimental effect on ballistic performance. But in this regard, the opponents approximately correspond to each other, with neither obtaining an advantage.

5) Corrections in initial [muzzle] velocity caused by variations in the condition of the charges (see Figure 6). These include charge temperature. Within a range of tolerance, accounted for in the Range Tables, a higher temperature would result in a higher initial velocity, and a lower temperature a lower velocity. Other factors are not so predictable. The very conditions of storage can negatively effect the charges, and could result in a breakdown of the chemical components, while excess moisture would reduce burning efficiency. It is the opinion of the authors that the Italians had a slight advantage in this area.

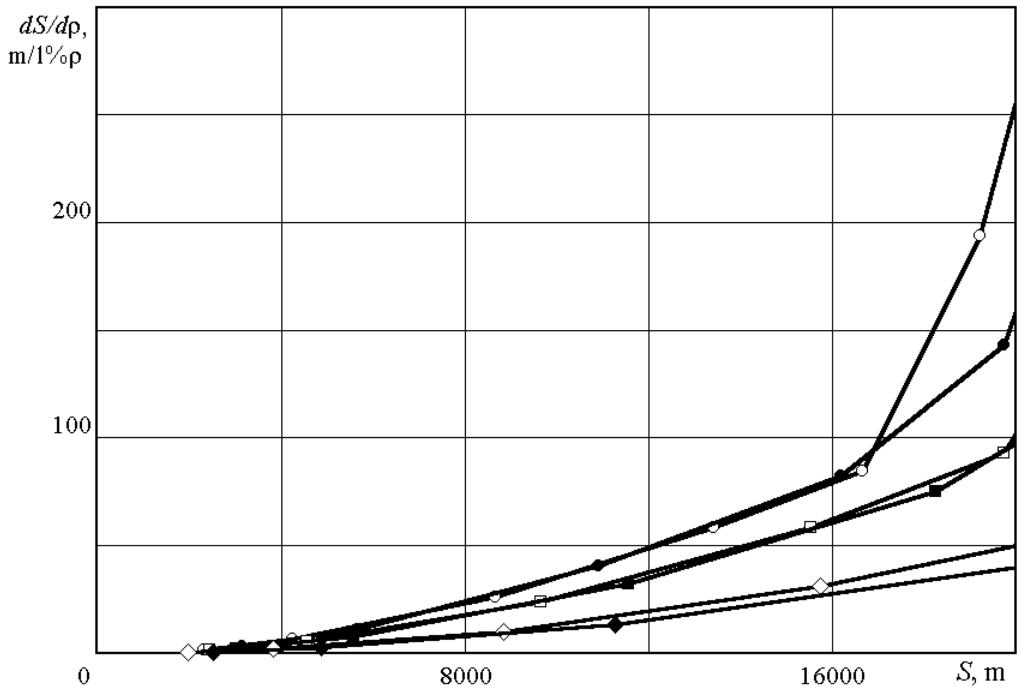

Fig. 5. A correction for air density

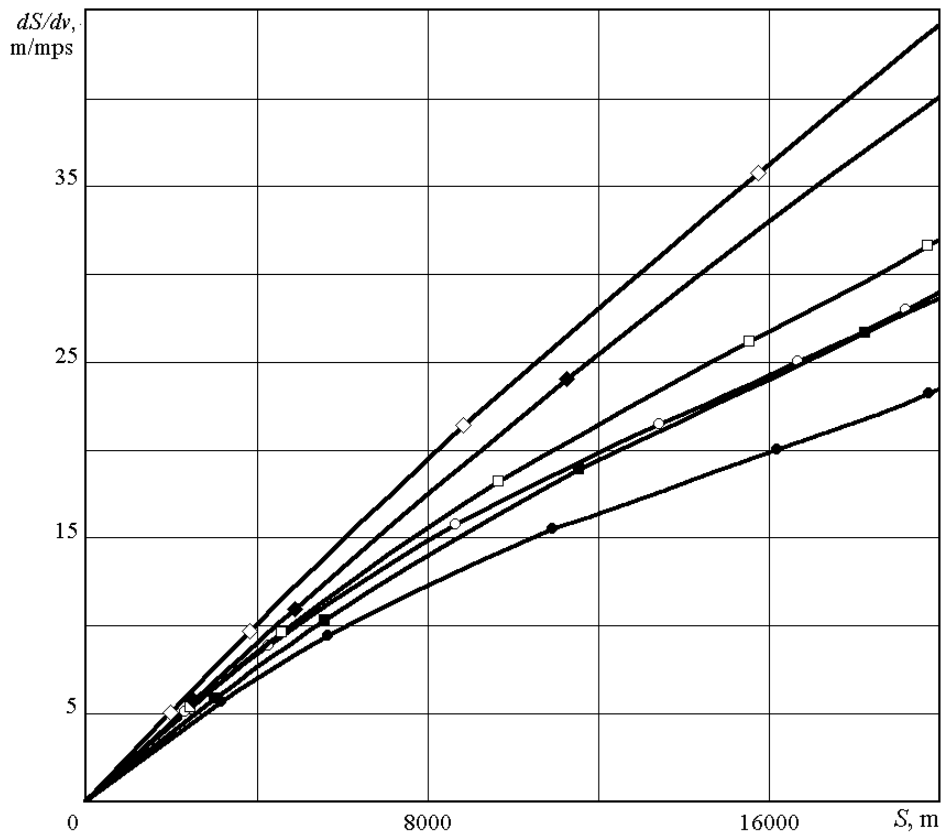

Fig. 6. The correction on initial velocity

On the face of it, the British Royal Navy have an advantage over the Italians in only one area of correction, but it is the most important and significant. What does this mean? In the theoretical sense, the smaller danger space of the lower velocity British guns would imply that only the most careful preparations and calculations would counter the Italian advantage in hit probability.

However, the ballistic effects of roll are less for the British than for the Italians, and therefore correspondingly easier to correct for. The worse the sea state, the greater the British advantage in this regard. It is interesting that, empirically, the Italian gunnery performance should have improved as a result of their reducing the muzzle velocity of their guns. The effect would have been to decrease the danger space on the one hand, but to enjoy a corresponding decrease in the dispersion caused by the roll of the ship on the other.

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