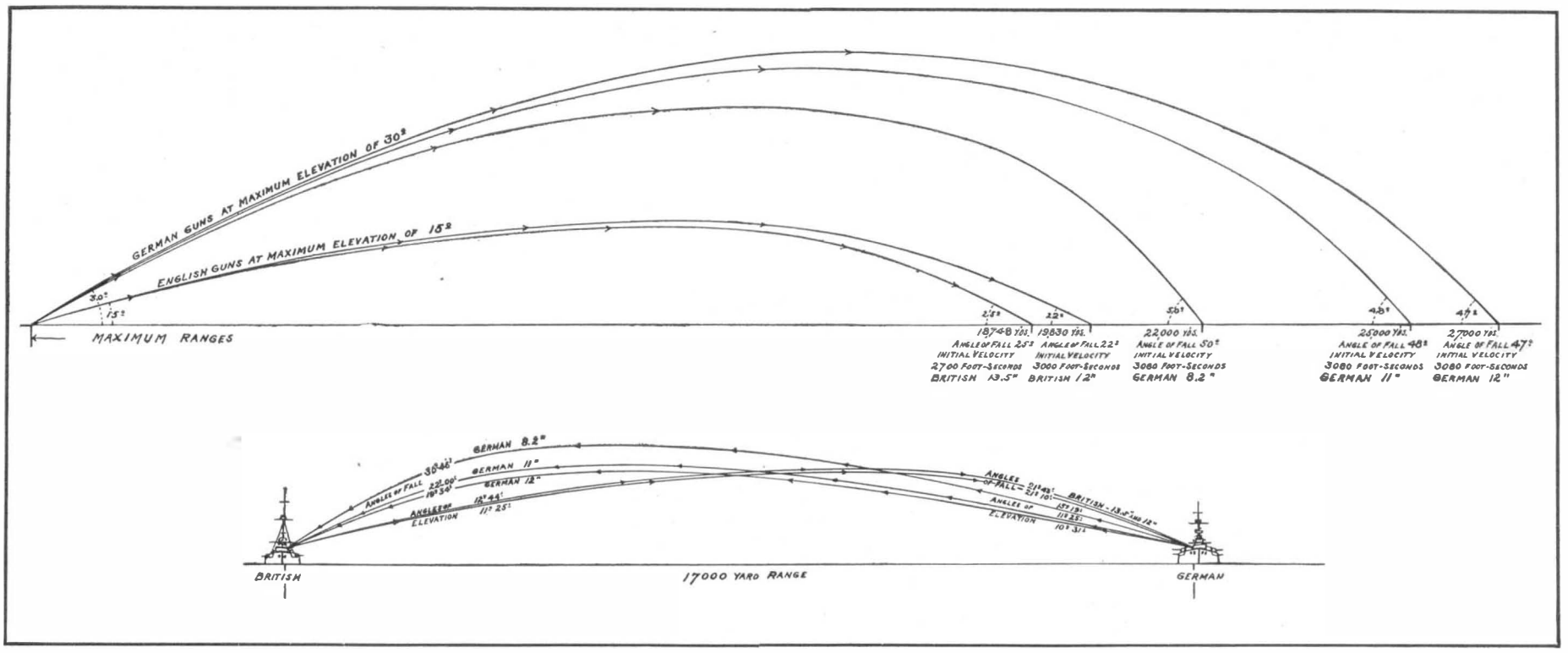
Hitting an Invisible Ship at a Ten-mile Range

How the Greater Elevation of the Lighter German Guns Enables Them to Outrange the Enemy



Data for maximum possible elevation, 30-degree German, 15-degree English.

BRITISH 13.5" GUN.
Fifteen Degrees.
Initial velocity, 2,700 f.s.
Weight of projectile, 1,250 lb.
Angle of elevation, 15°.
Range, 18,748 yds.
Angle of fall, 25°.

BRITISH 12" GUN.
Fifteen Degrees.
Initial velocity, 3,000 f.s.
Weight of projectile, 850 lb.
Angle of elevation, 15°.
Range, 19,830 yds.
Angle of fall, 22°.

GERMAN 12" GUN.
Thirty Degrees.
Initial velocity, 3,080 f.s.
Weight of projectile, 860 lb.
Angle of elevation, 30°.
Range, 27,500 yds.
Angle of fall, 47°.

GERMAN 11" GUN.
Thirty Degrees.
Initial velocity, 3,080 f.s.
Weight of projectile, 660 lb.
Angle of elevation, 30°.
Range, 25,900 yds.
Angle of fall, 48°.

GERMAN 8.2" GUN.
Thirty Degrees.
Initial velocity, 3,080 f.s.
Weight of projectile, 275 lb.
Angle of elevation, 30°.
Range, 22,000 yds.
Angle of fall, 50°.

Data for 17,000-yard range.

BRITISH 13.5" GUN.
Initial velocity, 2,700 f.s.
Weight of projectile, 1,250 lb.
Range, 17,000 yds.
Angle of elevation, 12° 44′.
Angle of fall, 21° 43′.
Striking energy, 12,806 ft. tons.

BRITISH 12" GUN.
Initial velocity, 3,000 f.s.
Weight of projectile, 850 lb.
Range, 17,000 yds.
Angle of elevation, 11° 25′.
Angle of fall, 21° 10′.
Striking energy, 8,353 ft. tons.

GERMAN 12" GUN.
Initial velocity, 3,080 f.s.
Weight of projectile, 860 lb.
Range, 17,000 yds.
Angle of elevation, 10° 31′.
Angle of fall, 19° 34′.
Striking energy, 8,890 ft. tons.

GERMAN 11" GUN.
Initial velocity, 3,080 f.s.
Weight of projectile, 660 lb.
Range, 17,000 yds.
Angle of elevation, 11° 25′.
Angle of fall, 22°.
Striking energy, 6,196 ft. tons.

GERMAN 8.2" GUN.
Initial velocity, 3,080 f.s.
Weight of projectile, 275 lb.
Range, 17,000 yds.
Angle of elevation, 15° 19′.
Angle of fall, 30° 46′.
Striking energy, 2,115 ft. tons.

ONE of the surprises of the present naval war is the extraordinary ranges at which the engagements between ships carrying armor-piercing guns are being fought. In the action between Von Spee and Cradock off the coast of Chile, the first 8.2-inch salvos of the "Scharnhorst" and "Gneisenau" landed on the "Good Hope" with telling effect at 12,000 yards. In the engagement off the Falkland Islands, the earlier stages of the running fight were fought at 15,000 yards range. Later in the battle-cruiser engagement in the North Sea, Admiral Beatty in his official dispatch stated that he began to land on the enemy at 17,000 yards, or say ten miles; and later descriptions of the fight by those engaged stated that the range never fell below seven miles.

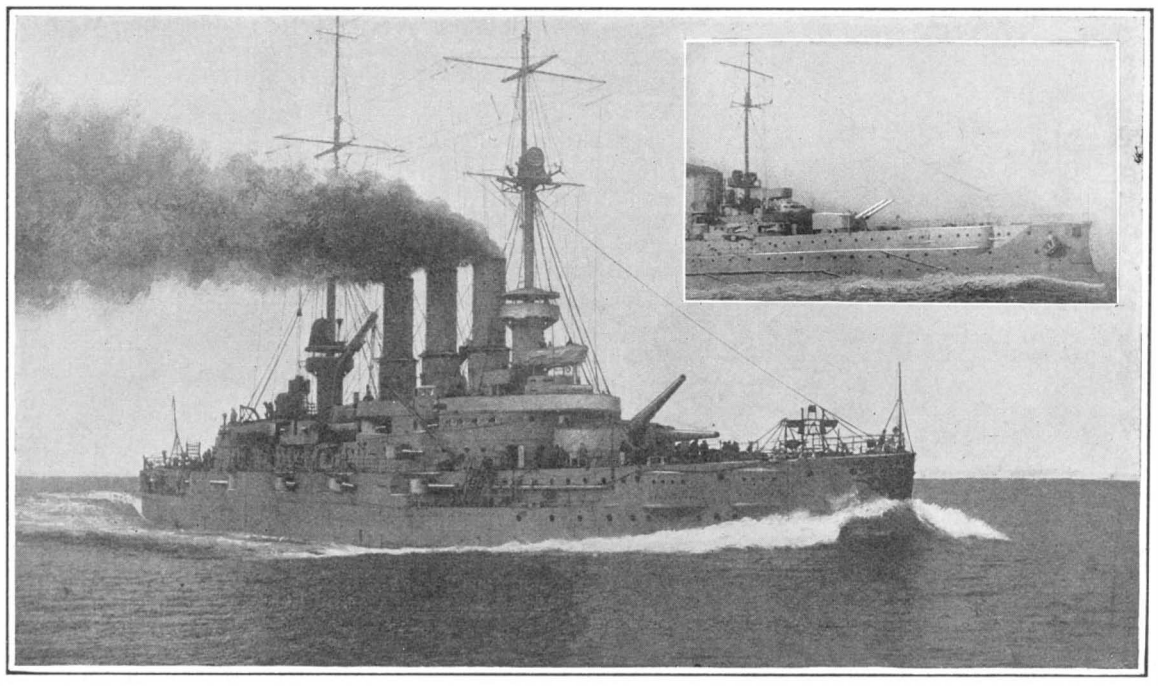
The question has been raised as to whether the lighter German guns were able to reach the British battle-cruisers during the earlier stages of the fight when the 13.5-inch shells were getting home. This is a decidedly interesting point, and with a view to presenting the actual conditions, we publish the accompanying photographs and diagrams, which show that not only the 12- and 11-inch, but also the 8.2-inch guns of the German battle-cruisers and armored cruiser were able not only to reach, but to outrange the British ships, and also that their penetrative power was theoretically sufficient for them to have done deadly execution.

It should be explained that the data regarding these guns, both British and German, are taken from the published commercial tables of Vickers-Maxim, Armstrong, and Krupp. With the exception of the British 13.5-inch guns, whose initial velocity is 2,700 feet per second, the velocities given are very high for guns of large caliber. They are perfectly possible; but because of the intense heat of combustion of the large powder charges necessary to secure these velocities, the erosion is presumably very high, and the accuracy-life of such guns is limited. The Krupp people claim to have mastered the problem of erosion; but whether by use of a special steel for the inner tube or by the quality of their powder, or both, they do not state. We do know that one of the leading naval powers not long ago made an offer to give the Krupp firm a contract to provide all of their heavy guns, provided a guarantee was given that, using these high velocities, the guns would have an accuracy-life of 250 rounds. The offer was refused. As regards the British guns of Vickers-Maxim and Armstrong, it is known that erosion is severe; but the British claim that they can reline their eroded guns so quickly, and at a cost so moderate, that they prefer to use high velocities, because of the great advantages of accuracy and hitting power at long ranges conferred thereby.

It will be noted from the diagrams that the British guns are credited with a maximum elevation of 15 degrees. That is the maximum for the main batteries in our own navy, and we believe the same practice is followed by the British. The motive for setting this limit is the fact that at 15 degrees elevation, when the ship is on an even keel, the shells will carry to a far greater distance than can be covered by the average sighting conditions on the high seas. The German Admiralty, however, with wise prevision, as it seems to us, have given to their heavy batteries a maximum elevation which is at least twice that of the British guns, namely, 30 degrees, or possibly more.

We present illustrations of two of their ships, the battleship "Schlesien," carrying 11-inch guns in its main battery, and the ill-fated "Bluecher," which mounted the 8.2-inch gun. In each photograph these pieces are shown swung up to full elevation, which apparently is slightly over 30 degrees. Now, referring to the diagram showing the trajectory of the shells at the 17,000 yards or ten-mile range at which the British first began to land on the Germans, we find that, if the velocities given are correct, the 8.2-inch guns of the "Bluecher," with an elevation of 15 degrees and 19 minutes, would have fallen on the British cruisers at an angle of 30 degrees and 46 minutes; that the 11-inch guns of the "Seydlitz" and "Moltke," firing at 11 degress 25 minutes elevation, landed their shells upon the British at an angle of 22 degrees, and that the 12-inch guns of the "Derfflinger," elevated to 10 degress and 31 minutes, would have hit the British ships at an angle of 19 degrees and 24 minutes. This last, it will be observed, is a flatter trajectory than that of the British 12-inch and 13.5-inch guns, the angle of fall of these being, respectively, 21 degrees 10 minutes and 21 degrees 43 minutes.

The diagram showing the curves of flight and the extreme ranges at the maximum possible elevation of the various guns, brings out the surprising fact that the 8.2-inch guns of the "Bluecher" were



German battleship "Schlesien" and armored cruiser "Bluecher," showing high elevation of guns.

capable of throwing their shells to an extreme range of 22,000 yards, or over 3,000 yards farther than the British 13.5-inch guns. The greatest range is that of the German 50-caliber 12-inch, which can throw its shell to a distance of 15½ miles; the German 11-inch can cover 14¾ miles; the German 8.2-inch, 12½ miles; the British 12-inch, 11½ miles; and the British 13.5-inch guns about 10 2/3 miles. It will be noted that the British 13.5-inch is outranged by the British 12-inch; which is to be accounted for by the fact that its initial velocity is 300 feet per second less.

The predisposing motive of the Germans in giving such high maximum elevation to their guns was to enable them to reach the enemy after their own ships, due to injury at the water line, had a heavy list toward the enemy. It is evident that the "Derfflinger," for instance, might be listed 15 degrees toward the enemy and still have 15 degrees of elevation available for long-range fighting. This wise provision has rendered it possible even for the lighter armor-piercing guns of the Germans to land upon the British at the great fighting ranges selected by the latter. It was the greater striking energy of the 13.5-inch gun and its much heavier bursting charge, coupled with better shooting and better engine-room equipment and operation, that enabled the British battle-cruisers to win the North Sea fight.

The striking energy of the projectiles at 10-mile range are: German 8-inch, 2,115-foot-tons; German 11-inch, 6,196 foot-tons; German 12-inch, 6,890 foot-tons, and British 12-inch, 8,353 foot-tons; British 13.5-inch, 12,806 foot-tons, or about 50 per cent more than that of the 12-inch gun.

When the British battle-cruisers began to land on the "Bluecher," her hull was invisible. Only by the fire control officers a hundred feet above the deck could her whole hull be seen. Similarly, when the 13.5-inch shells began to fall "out of the blue" upon the "Bluecher," the gunners in her turrets did not see the hull of the ship from which the projectiles came.

Among the many accounts given by participants in the North Sea fight, by far the most dramatic and instructive is that given by German survivors from the "Bluecher" and published in the *London Times* and *Sphere*, from which we take the following description:

"The British ships were away on the horizon, some 15 or 16 kilometers distant, when they started to fire. Shots came slowly at first. They fell ahead and over, raising vast columns of water; now they fell astern and short. The British guns were finding the range. Those deadly water spouts crept nearer and nearer. The men on deck watched them with a strange fascination. Soon one pitched close to the ship, and a vast watery pillar, a hundred meters high one of them affirmed, fell lashing on the deck. The range had been found. *Dann aber ging's los!* Now the shells came thick and fast with a horrible droning hum. At once they did terrible execution. The electric plant was soon destroyed, and the ship plunged in a darkness that could be felt. 'You could not see your hand before your nose,' said one. Down below decks there was horror and confusion, mingled with gasping shouts and moans as the shells plunged through the decks. It was only later, when the range shortened, that their trajectory flattened and they tore holes in the ship's sides and raked her decks. At first they came dropping from the sky." This observation is of particular interest; the diagram given on the adjoining page explains to what a great height the shells must have risen before they began falling toward the"Bluecher's" decks.

"The shells penetrated the decks," continues the *Times* narrator. "They bored their way even to the stokehold. The coal in the bunkers was set on fire. Since the bunkers were half empty the fire burned merrily. In the engine-room a shell licked up the oil and sprayed it around in flames of blue and green, scarring its victims and blazing where it fell. Men huddled together in dark compartments, but the shells sought them out and there Death had a rich harvest. The terrific air pressure resulting from explosion in a confined space left a deep impression on the minds of the men of the 'Bluecher.' The air, it would seem, roars through every opening and tears its way through every weak spot. All loose or insecure fittings are transformed into moving instruments of destruction. Open doors bang to—and jamb—and closed iron doors bend outward like tinplates, and through it all the bodies of men are whirled about like dead leaves in a winter blast, to be battered to death against the iron walls. In one of the engine-rooms—it was the room where the high-velocity engines for ventilation and forced draughts were at work—men were picked up by that terrible *Luftdruck* like the whirl-drift at a street corner and tossed to a horrible death amid the machinery. There were other horrors too fearful to recount.

"If it was appalling below deck it was more than appalling above. The 'Bluecher' was under the fire of so many ships. Even the little destroyers peppered her. 'It was one continuous explosion,' said a gunner. The ship heeled over as the broadsides struck her, then righted herself, rocking like a cradle. Gun crews were so destroyed that stokers had to be requisitioned to carry ammunition. Men lay flat for safety. The decks presented a tangled mass of scrap iron. In one casement, the only one, as they thought, undestroyed, two men continued to serve their gun. They fired it as the ship listed, adapting the elevation to the new situation. The 'Bluecher' had run her course. She was lagging lame, and with the steering gear gone was beginning slowly to circle. It was seen that she was doomed. The wounded 'Bluecher' finally settled down, turned wearily over, and disappeared in a swirl of water."

The Present Geographical Position of Serbia

By J. Cvijic

Serbia—the country which we of English speech so long miscalled "Servia," to the great annoyance of its inhabitants—has suddenly become an object of interest to the whole world, on account of the casus belli which it has furnished to the great Powers of Europe. Hence it seems timely to present the following abstract of a paper which appeared just before the outbreak of the present war in the recently founded Bulletin of the Serbian Geographical Society, as giving some idea of what the Serbs themselves think of the position of their country in contemporary geography.—EDITOR.

AFTER Montenegro, Serbia was the first Balkan state to emancipate itself from Turkish rule. In its original form, 1815-1833, it had an area of 7,790 square miles. Since that time it has spread mainly in a southerly direction. In 1833, enlarged by Prince Milosh, it attained an area of 14,570 square miles, and in 1878, after the Congress of Berlin, its surface amounted to 18,650 square miles. Since the treaty of Bucharest, 1913, the area is about 33,900 square miles. Along with these alterations in size, there has been a considerable modification of its original geographic position. It has gradually ceased to be a sort of outlying dependency of the great Pannonian basin and of the Austro-Hungarian monarchy, and has pushed its way south toward the center of the Balkan peninsula, along the axis indicated by the great valley of the Morava. At the same time, to a more and more marked extent, there have been added to the Dinaric Serbs, who constituted essentially the Serbia of Karageorge, the Serbs of the southern Morava and of the Vardar.

The territorial extension which followed the wars of 1876-78 definitely determined the development of Serbia toward the south. The country now not only included nearly the whole southern basin of the Morava and commanded the entrance to the Balkans, but also contained the focus of the two great highways intersecting the peninsula, viz., Nish, at the bifurcation of the road to Constantinople and that to Salonika. It had entered a new ethnic zone, in its spread toward Pirot and the southern Morava. This southerly movement had been forecast in the popular songs of the country, in which recurred the names of Kossovo, Prizren, Skoplie, Prilep, etc., and was stimulated by unhappy political and economic experiences in the north.

Serbia now occupies a truly central position in the Balkan peninsula, extending from the Danube to the vicinity of Salonika. To the Serbia of the Morava has been added the Serbia of the Vardar. The country possesses, through nearly its whole extent, the great central artery of the peninsula. Belgrade, Nish, Skoplie, and Salonika, which mark out this great natural route, are now about to assume the importance to which they are entitled. Moreover, Serbia now holds what may be termed the heart of the Balkans, viz., the region lying between Nish and Veles, and especially that including Skoplie and the Ovchepolye. In this region meet and intersect, or are destined to do so, all the great highways of the peninsula. Finally, the barrier between Serbia and Montenegro formerly presented by the sanjak of Novibazar has now disappeared; Bosnia is henceforth cut off from Salonika; while Serbia is now able to gain direct access to the sea by way of Montenegro.

When we consider the progress of the civilizing influences at work in Serbia we find that the Serbs, and especially the Dinaric Serbs, readily respond to such influences, but at the same time have the faculty of adapting new ideas to suit the national character. Serbia, unlike the countries constituting the other two Mediterranean peninsulas, is united to Europe by a great plain. Moreover, the shortest route from Europe to the rest of the Balkan peninsula, the Aegean, and Asia Minor passes through her territory. Again, the spread of the Serbian race beyond the frontier toward the north, and west to the Adriatic, tends to attach Serbia more intimately to Europe than any other Balkan state. Nevertheless Serbia is by no means so strongly dominated by the influence of her northern neighbors as these facts might lead one to suppose. More and more, in her intercourse with the rest of Europe, she tends to pass right over the vast Pannonian basin, the immense Hungarian *puszta*, in which dwell people who have remained strangers to her in language, mentality and institutions. By a curious geographic anomaly, not only is this great fertile plain devoid of any marked influence upon the rugged country which borders it to the south, but it actually plays the role of isolating the latter more effectively than a chain of mountains might do. Only two routes, Belgrade-Budapest and Belgrade-Fiume, put Serbia in communication with the countries beyond.

During a recent period, lower Austria and Bohemia were the regions which gave most to Serbia, especially in supplying the material needs of existence. In recent years this intercourse has very sensibly diminished. Ideas, policies, and institutions have come under the influence of western Europe. With the exception of medical students, who are still educated mainly at the Austrian universities, nearly the whole youth of Serbia obtains its higher education in more distant countries—France, Germany, Switzerland and Belgium.

Since 1913, Serbia, previously subject almost exclusively to European influences, has pushed southward into the regions of old Balkan culture—i. e., Byzantine civilization as modified by Turkey—a type of culture from which, however, Moravan Serbia had not yet had time to become completely divested since its liberation from the Turkish yoke. This finds expression, for example, in markets of wooden booths, crooked and narrow streets, cross-legged merchants selling a little of everything; household furniture, cuisine and costumes very different from those of Europe; marked contrasts between the civilization of the towns and the patriarchal life of the country, etc. Moreover, in the south Serbia has entered a zone of climates and products which are new to her.

The old Balkan culture seems destined to disappear from the Serbia of the Vardar basin as it has disappeared from Moravan Serbia, since its existence appears to be dependent upon the rule of the Turk. It will, nevertheless, leave enduring traces.

Along an extensive frontier Serbia now finds herself in contact with modern Greece. In this contact the Greek temperament will probably exercise a greater influence than the Greek culture. This is characterized by alertness, a strong commercial spirit, and intense national pride. She will also feel the influence of Salonika and the distinct type of culture of which that place is the center. Lastly, she will come more fully than in the past under various Mediterranean and Levantine influences.

On the east her contact with Bulgaria will continue to play a neutral role, as to effects on her culture; while her new frontier with Albania will exercise a somewhat unfavorable influence in this respect.

Berlin Higher Schools and the War

THE higher educational institutions of Berlin have been greatly affected by the war, says the Berlin *Lokal Anzeiger*. Of the 7,059 men and 976 women who are enrolled as students in the university 4,269 men and 75 women are on leave of absence for army and hospital service, and it is probable that many others have gone to the front without notifying the university authorities. Among the 238 foreign students of the university are 22 Russians and 1 Englishman. In the Charlottenburg Technical School, which had 2,634 students last summer, only 684 were enrolled for the winter semester, and so many of these have since been called to the colors that the actual attendance is probably less than 200.

The Academy of Music, which had 331 students last summer, now has only 203, of whom 20 are foreigners. The Academy of Fine Arts, which usually has 300 students in winter, now has only 100.

The Veterinary College, which last summer was attended by 140 pupils of the Military Veterinary Academy and by 333 other students, now has a total attendance of 108 students, most of whom are too young for military service. The attendance at the Agriculture College has fallen from 897 to 169.

The Royal Academy of Mines still has the names of 180 students on its lists, but 140 of these are "on leave," i. e., in the field. Finally, the High School of Commerce, which had 562 students, even in the summer, now has only 372 enrolled, and only 167 in actual attendance.

Protection from Frost

IT is safe to say that much more attention has been paid to the problem of protecting plants and trees from frost in the United States than in all other countries combined. The problem is far from complete solution, however, and hence there was ample room for the collection of memoirs on the subject which constitute almost the entire contents of the *Monthly Weather Review* for October, 1914 (published in February, 1915, by the Weather Bureau at Washington). This symposium begins with a summary review of the subject, from a physical point of view, by Dr. W. J. Humphreys, which is followed by contributions from Weather Bureau officials and others, dealing with the question practically, historically, and controversially.